Data Summary Report for

Candidate Phase 1 Areas

Prepared for:

General Electric Company
Albany, NY

Prepared by:

Quantitative Environmental Analysis, LLC
Liverpool, NY

In conjunction with:

Environmental Standards, Inc.
Valley Forge, PA

September 30, 2004

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VIA FEDERAL EXPRESS

October 1, 2004

Team Leader, Hudson River Team
Emergency and Remedial Response Division
United States Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, New York 10007-1866
Attn: Douglas Garbarini, Hudson River PCBs Superfund Site (3 copies – 1 unbound)

Chief, New York/Caribbean Superfund Branch
Office of Regional Counsel
United States Environmental Protection Agency, Region 2
290 Broadway, 17th Floor
New York, New York 10007-1866
Attn: Hudson River PCBs Superfund Site Attorney (1 copy)

Director, Division of Environmental Remediation
New York State Department of Environmental Conservation
625 Broadway, 12th Floor
Albany, New York 12233-7011
Attn: Hudson River PCBs Superfund Site (3 copies – 1 unbound)

Director, Bureau of Environmental Exposure Investigation
New York State Department of Health
547 River Street
Troy, New York 12180
Attn: Hudson River PCBs Superfund Site (2 copies)

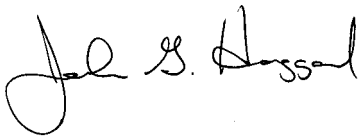
Re: Final Phase 1 Data Summary Report

Dear Sir or Madam:

Attached is the final Phase 1 Data Summary Report with redline changes accepted per your approval letter dated September 21, 2004.

If you have any comments concerning this submission, contact Bob Gibson at (518) 862-2736.

Sincerely,



John G. Haggard

JGH/bg
Enclosure

cc: Alison Hess, U.S. EPA
Dean Maraldo, U.S. EPA
Robert Gibson, GE
Margaret Murphy, QEA
David Blye, ESI

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Job Number:

GENrem:211

September 30, 2004

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SECTION 1
INTRODUCTION

General Electric Company (GE) and the United States Environmental Protection Agency (USEPA) entered into an Administrative Order on Consent (Sampling AOC; Index No. CERCLA-02-2002-2023) for the Hudson River PCBs Superfund Site ("Site"), effective on July 26, 2002, "to provide for the performance of sampling, analysis and geophysical investigations of the sediments of the Hudson River…to provide useful information for the design and implementation of the remedial action selected in USEPA's February 2002 Record of Decision for the site." (Sampling AOC Paragraph 6). These investigations have been termed the Sediment Sampling and Analysis Program (SSAP).

This Data Summary Report (DSR) presents the results of the activities performed during 2002 and 2003 as part of the SSAP in areas designated as candidates for Phase 1 dredging (i.e., the Candidate Phase 1 Areas). This report supercedes the Year 1 DSR submitted to USEPA on May 9, 2003 which presented the results of a subset of the activities covered by this report. A DSR for the Phase 2 Areas will be submitted at a later date and will include all data collected as part of the SSAP regardless of year in the Phase 2 Areas. These Candidate Phase 1 Areas, in upstream to downstream order, are the Northern Thompson Island Pool [TIP; north of River Mile (RM) 192.1], the Griffin Island area (RM 190.5 to 189.4), and the Northumberland Dam area (RM 185.2 to 183.3) and are described further at the beginning of Section 2 of this report.

The Field Sampling Plan (FSP; QEA 2002) for the SSAP was approved by USEPA on July 26, 2002. The Quality Assurance Project Plan (QAPP; ESI and QEA 2002) for the SSAP was approved by USEPA on October 1, 2002. The Supplemental Field Sampling Plan (SFSP; QEA 2003a) was submitted to USEPA on May 7, 2003 and the revised SFSP was submitted to USEPA on June 27, 2003. USEPA has not approved the SFSP; however, the Agency has supported its implementation.

Sampling in the Candidate Phase 1 Areas was performed on a priority basis in an effort to provide data for these areas as early in the program as possible. SSAP field operations were

initiated on October 2, 2002. Sediment sampling for PCB analysis continued until October 31, 2002 in anticipation of the seasonal closure of the Champlain Canal by the New York State Canal Corporation and deteriorating weather conditions. Geophysical survey operations continued until November 25, 2002 in areas of the river that could be reached without relying on passage through the canal locks. Field operations resumed on May 19, 2003. Sample collection in the Candidate Phase 1 Areas was completed on September 18, 2003. Sediment sampling in other areas continued until October 22, 2003. Work associated with geophysical surveys (sub-bottom profiling testing) and probing to fill side scan sonar data gaps continued until November 7, 2003.

1.1 BACKGROUND

In the Record of Decision (ROD; USEPA 2002), USEPA divided the Upper Hudson into three river sections (Figure 1-1):

- River Section 1 – former location of Fort Edward Dam to Thompson Island Dam (approximately 6.3 miles);
- River Section 2 – Thompson Island Dam to Northumberland Dam (approximately 5.1 miles); and
- River Section 3 – Northumberland Dam to the Federal Dam in Troy (approximately 29.5 miles).

The selected remedy (REM 3/10/Select) includes the following components (ROD at page 94):

- removal of sediments based primarily on a mass per unit area (MPA) of PCBs with three or more chlorine atoms (Tri+ PCBs) of 3 g/m^2 or greater (approximately 1.56 million cubic yards of sediments) from River Section 1;

- removal of sediments based primarily on an MPA of 10 g/m^2 Tri+ PCBs or greater (approximately 0.58 million cubic yards of sediments) from River Section 2;

- removal of selected sediments with high concentrations of PCBs and high erosional potential; New York State Department of Environmental Conservation (NYSDEC) Hot Spots 36, 37, and the southern portion of Hot Spot 39; approximately 0.51 million cubic yards) from River Section 3;

- dredging of the navigation channel, as necessary, to implement the remedy and to avoid hindering canal traffic during implementation. Approximately 341,000 cubic yards of sediments will be removed from the navigation channel (included in volume estimates in the first three components, above); and

- removal of all PCB-contaminated sediments within areas targeted for remediation, with an anticipated residual of approximately 1 mg/kg Tri+ PCBs (prior to backfilling).

The conceptual sediment sampling program described in the Feasibility Study (FS; USEPA 2000) was used as a starting point for the FSP and SFSP. USEPA guidance (USEPA 2001) also was considered during the development of these plans.

1.2 PROJECT OBJECTIVES

The objective of the SSAP is to provide sediment data for the design of the remedy set forth in the ROD. These data will be used in delineating the locations (areal extent and depth) of sediment to be removed and will provide measurements of certain chemical and physical properties of the sediment to be removed that are important for the design of dredging, treatment, and disposal. As part of the SSAP, the sediment sampling results and related geophysical survey data are being reviewed to elicit information useful for determining the possible presence of cultural resources.

1.3 REPORT OBJECTIVES

The objective of this DSR is to present results from the SSAP Candidate Phase 1 Areas. Data from this report will be used to develop the Phase 1 Dredge Area Delineation Report. Data interpretation efforts presented in this DSR are limited to assessing data quality and usability.

1.4 REPORT ORGANIZATION

This report is divided into ten sections that summarize the field activities conducted for the SSAP in Candidate Phase 1 Areas. Section 1 includes the introduction and report and project objectives. Section 2 provides a description of the Candidate Phase 1 Areas, and a summary of the work activities performed in these areas. In Section 3, the methods for the SSAP are summarized. Field observations made during the sediment characterization program are presented in Section 4. Section 5 presents the results of the analyses of the sediment core samples. Sections 6 presents the results of the side scan sonar surveys performed in the Candidate Phase 1 Areas. Sections 7 and 8 present data quality and the data usability assessment, respectively. Section 9 gives an overall summary of the field activities, and Section 10 contains the references. Eight appendices also are included that provide documentation for the various field activities.

SECTION 2
CANDIDATE PHASE 1 AREAS

The ROD specifies that Phase 1 dredging should target a sediment volume between 150,000 and 300,000 cubic yards (cy) (USEPA 2002), but it does not specify the area of the site within which the dredging should occur. The Remedial Design Administrative Order on Consent (RDAOC; Index No. CERCLA-02-2003-2027) entered into by the USEPA and GE specifies an expectation that "…Phase 1 target areas will be areas that are unlikely to require re-dredging during Phase 2". The RDAOC further specifies that the target areas for Phase 1 satisfy the following requirements:

- acreage and volume of sediments that can be actively remediated (i.e., through dredging and appropriate backfilling) in a single field season;
- a range of river conditions (e.g., rocky areas, varying water depths, the navigational channel, varying thicknesses of sediment to be removed) that are representative of the river conditions that are anticipated to be encountered during Phase 2 of the remedial action; and
- to the extent practicable, a suitable test for the potential range of dredging, handling, and transport equipment and procedures that are expected for Phase 2 of the remedial action.

The USEPA and GE have agreed to evaluate the three areas of the river shown in Figure 2-1 as candidates for the Phase 1 dredging. These Candidate Phase 1 Areas, in upstream to downstream order, are referred to as: TIP; Griffin Island area; and Northumberland Dam area, and encompass the following areas:

- Northern TIP: The northern portion of TIP from north of Rogers Island to the mouth of the Snook Kill (the area of the river between the northing parallel at 1,605,034 and the northing parallel at 1,617,246; NYS Plane East, NAD 83);

- Griffin Island: The area of the river in the vicinity of Griffin Island located between the northing parallel at 1,592,438 and the northing parallel at 1,598,220; and

- Northumberland Dam: The area of the river upstream of Northumberland Dam between the northing parallel at 1,573,050 and the northing parallel at 1,563,900.

2.1 ACTIVITIES IN CANDIDATE PHASE 1 AREAS

2.1.1 Sediment Characterization

The SSAP is focused on sediments having some likelihood of qualifying for removal based on the criteria set out in the ROD. These sediments have been divided into two categories:

- Target Areas: areas most likely requiring sediment removal based on existing data in accordance with the ROD; and

- Areas-to-be-Screened: areas having a reasonable probability of containing PCBs at or near the criteria set forth in the ROD, but additional data are required in order to determine whether or not sediment removal is required.

For the Northern TIP and Griffin Island areas, both of which are in River Section 1, the Target Areas and Areas-to-be-Screened were those identified in the FS based on historical data. For the Northumberland Dam area, which is located in River Section 2, Target Areas associated with Hot Spots 33, 34, and 35 were sampled. Within the three Candidate Phase 1 Areas, sediment cores were collected at predetermined locations along a grid system. Sediment cores were cut into segments and analyzed for PCBs and other parameters according to the methods approved by USEPA under the Sampling AOC and summarized below (additional detail is provided in the FSP). Following a preliminary evaluation of the PCB data, additional sediment cores were collected to fill data gaps.

2.1.2 Geophysical Surveys

GE contracted with Ocean Surveys, Inc. (OSI) to perform all of the geophysical investigations required by the SSAP: side scan sonar, bathymetry, and sub-bottom profiling tests.

2.1.2.1 Side Scan Sonar

The primary objective of the side scan sonar investigations, with regard to the SSAP, was to develop maps of surficial sediment types that may be correlated with PCB concentrations and inventory in River Sections 1, 2, and 3. This information was used to identify additional Areas to be Screened - specifically, fine-grained sediment deposits in River Sections 2 and 3 having an area of 50,000 ft^2 or more that were not previously designated as Target Areas for SSAP sediment coring. Ancillary side scan sonar objectives included the creation of survey deliverables (images, maps, and geo-referenced data sets) that facilitate the comparison of current river conditions to those observed during the 1991 and 1992 surveys, and to identify where obstructions to dredging (e.g., boulders and debris) or hard surfaces (rock outcrops) are present in, or adjacent to, areas of sediments targeted for removal. The survey was designed to provide bank-to-bank sonar coverage wherever navigation and imaging were possible.

OSI completed side scan sonar surveys in River Sections 1 and 3 between October 31 and November 22, 2002. Survey methods and preliminary results were reported to USEPA in the Draft Year 1 DSR submitted on March 7, 2003[1]. Complete survey documentation (OSI 2003a)

[1] On August 18, 2003, USEPA provided GE with comments on the Year 1 DSR, including several comments on the side scan sonar processing techniques and data interpretation. Since that time, GE, USEPA, and their respective contractors have been involved in a series of meetings and interactions in order to resolve differences related to the delineation of fine-grained sediments in River Section 3. Through this process, consensus was reached on the interpretation of groundtruth results (i.e., what constitutes fine sediments) and numerous areas in River Section 3 were reviewed, reinterpreted as necessary, and additional sediment cores or groundtruth samples were acquired. In areas of River Sections 2 and 3 lacking side scan coverage, sediment probing and visual characterization were performed where navigation was deemed safe and the deposition of fine-grained sediments was considered possible. Additional cores in fine-grained sediments within these areas will be acquired in 2004. The complete results of these supplemental investigations are detailed in a separate report (QEA 2003c). No comments have been received from USEPA regarding the interpretation of sediment types in River Section 2 and considerable agreement had been reached between USEPA and GE prior to the submittal of River Section 2 deliverables; it is unlikely that supplemental investigations will be required in River Section 2.

and electronic deliverables (i.e., georeferenced maps) were included as appendices to the Supplemental FSP and the revised Year 1 DSR submitted to USEPA on May 7 and 9, 2003, respectively. The side scan sonar survey in River Section 2 and the adjacent Land Cut could not be performed in 2002 due to seasonal closure the New York State Champlain Canal. This survey was completed between May 28 and June 1, 2003; survey documentation and results for River Section 2 were submitted to USEPA on October 1, 2003 in a report from OSI (OSI 2003b). Survey methods and results for Candidate Phase 1 Areas are summarized in Sections 3.4.1 and Section 6 respectively.

SECTION 3
METHODS

3.1 SEDIMENT CHARACTERIZATION

3.1.1 Sediment Coring

The FSP (QEA 2002) defined the sediment core sample locations for River Section 1 and portions of River Section 2, which were located using an 80-ft. triangular grid within Target Areas. In Areas-to-be-Screened and in Target Areas of the navigational channel (including areas designated for navigational dredging), a coarser 160-ft. triangular grid (i.e., every other node of the 80-ft. triangular grid) was used to select the initial sample core locations. In some areas, the geographic shape of the Target Areas or Areas-to-be-Screened (e.g., long, thin areas adjacent to the shoreline) precluded the use of a uniform grid system. In these instances, core locations were assigned manually at a frequency that corresponded to eight cores per acre in Target Areas, and four cores per acre in Areas-to-be-Screened. The limited field season in 2002 prevented the collection of sediment samples at a portion of the Candidate Phase 1 Area sampling locations identified in the FSP; these locations were completed in 2003. Additional sample locations were proposed for the Candidate Phase 1 Areas in the SFSP (QEA 2003a) to fill data gaps identified as a result of preliminary data analysis. Evaluation of the side scan sonar survey conducted in the River Section 2 Candidate Phase 1 Area during 2003 indicated that there were no areas of fine-grained sediment in this area that had not been identified during previous surveys. Therefore, locating core samples to characterize additional fine-grained areas was not required for the Candidate Phase 1 Areas. Sampling in Candidate Phase 1 Areas was completed on September 18, 2003. Sediment cores were collected from 1656 of 1897 occupied locations. Grab samples were collected at 50 locations and 191 locations were abandoned. A total of 9620 samples were generated from the cores and grabs and processed for measurement of various analytes.

3.2 2002 FIELD OPERATIONS IN CANDIDATE PHASE 1 AREAS

3.2.1 Sediment Core Collection

The 2002 sampling program was performed using five specially equipped sampling vessels. Three of these vessels were operated by Atlantic Testing Laboratories, Ltd. (ATL), one by Blasland, Bouck & Lee, Inc. (BBL), and one by QEA. QEA also provided overall coordination and management of the field program. The sampling activities were coordinated from a staging area, located at the former West River Road Marina site, in the Town of Moreau. The West River Road staging area was equipped with docking facilities, two office trailers, and equipment storage facilities. Sampling vessels were also moored occasionally at the lower end of Champlain Canal Lock 6.

Each sampling vessel was provided coordinates for a block of target locations (typically approximately 100 locations). As each vessel completed the block of locations, QEA provided an additional contiguous block of sample locations. Each vessel received the coordinates for the sampling locations in electronic format, and these were downloaded into each vessel's on-board global positioning system (GPS). The vessels then navigated to these coordinates, anchored into position using spuds, and collected core samples using vibracoring techniques (or grabs where less than 6 in. of sediment present) in accordance with the sediment coring standard operating procedures (SOP) presented in the FSP, as modified by corrective action memoranda (Corrective Action Memoranda: QEA002, QEA003; see Appendix 1).

In 2002, sediment coring took place between October 2, 2002 and October 31, 2002. A total of 1046 locations in the three Candidate Phase 1 Areas were occupied, resulting in the collection of 854 core samples and 32 grab samples. A total of 160 locations were abandoned where it was not possible to collect a sample. After processing, the core and grab samples generated a total of 4396 analytical samples. Additionally, side scan sonar surveys were conducted in River Sections 1 and 3 to develop a map of the surface sediment types. The maps were used to assist in delineating the boundaries of areas targeted for dredging and to identify fine-grained sediment deposits in River Section 3 for sediment coring in 2003.

3.2.2 Sediment Core Processing

The core processing facility was located in Building 40 at GE's Fort Edward Plant. Sediment cores were delivered to the laboratory at the end of every day and stored on ice overnight for processing the following day. Cores that were collected on Friday were stored on ice over the weekend and processed the following Monday. The core processing facility was equipped to process approximately 60 sediment cores per day. This was accomplished using three "assembly lines", each consisting of an area for supporting and cutting the core tubes, homogenizing (i.e., mixing) the sediment and placing it into sample containers, and a system for producing labels for the sample containers and maintaining records, including chain of custody forms. Additional facilities included decontamination stations with laboratory hoods for ventilation, new and spent solvent storage areas, and solid PCB waste storage areas. Spent solvent and PCB solid waste were disposed of appropriately through GE's Fort Edward Plant waste management system.

The procedures for processing the sediment cores followed the SOP presented in the approved QAPP (ESI and QEA 2002) and modified by corrective action memoranda (Corrective Action Memoranda: ESI003, ESI004, QEA001; see Appendix 2). A brief summary of the SOP is presented below:

- All equipment that was reused was decontaminated.
- Cores were electronically assigned to each sample custodian for processing.
- The overlying water was drained from the cores and the cores were weighed.
- Cores were fastened to a clamping system and sectioned based on the total length of the recovered core with pipe cutters (aluminum tubing) or vibratory saw (Lexan® tubing). The bottom 2 in. of the core was disposed.
- Except for the top 2 in., each core segment was weighed (top 2 in. segment bulk density determined in the analytical laboratory). This weight was recorded in the database.

- A visual description of each core segment (i.e., grain type, color, odor) was entered into the database. Potential cultural resources were removed from the sample and placed in a resealable plastic bag.

- The sample was thoroughly homogenized and placed into glass containers for shipment to the analytical laboratory.

- Samples were packed on ice and shipped to the appropriate laboratory.

3.3 2003 FIELD OPERATIONS IN CANDIDATE PHASE 1 AREAS

Sampling and analysis activities specified in the SSAP FSP that were not completed in 2002 were completed in 2003 (large portion of River Section 1 and River Section 2 in the vicinity of the Candidate Phase 1 Areas). Side scan sonar mapping in River Section 2 was completed in 2003; however, evaluation of these data indicated that there were no areas of fine-grained sediment in this area that had not been identified during previous surveys. Therefore, locating core samples to characterize additional fine-grained areas was not required for the Candidate Phase 1 Areas.

The majority of the 2003 sampling program was performed by the same five specially equipped sampling vessels that were utilized in 2002. Field operations continued to be based out of the staging area located at the former West River Road Marina in Moreau. As the sampling progressed downstream, sampling vessels utilized mooring facilities at private marinas in River Section 3 (Alcove Marine in Schuylerville, Admirals Marina in Stillwater, and Lock 1 Marina in Waterford). In addition, the New York State Canal Corporation allowed sampling vessels to dock at several of the Champlain Canal Locks. Following a break in sampling from August 22, 2003 to September 8, 2003, sampling resumed with four vessels (one QEA boat, one BBL boat, two ATL barges) and completed in that manner until the 2003 program was completed on October 18, 2003.

In Candidate Phase 1 Areas, sediment coring took place between May 19, 2003, and September 18, 2003. During this period, a total of 851 additional locations in the three Candidate Phase 1 Areas were occupied, resulting in the collection of 802 core samples and 18 grab samples. A total of 31 locations were abandoned where it was not possible to collect a sample. After processing, the core and grab samples generated a total of 5224 samples (including 1191 archive only samples that were not submitted for analysis).

3.3.1 Sediment Core Collection

Sediment coring techniques were generally consistent with those utilized during the 2002 program; however, the SOP for coring was modified based on recommendations developed after evaluation of the 2002 data and input from USEPA oversight personnel (QEA 2003a). The purpose of these changes was to improve the likelihood for consistently recovering high quality cores that were representative of the sediment in the areas sampled. The SOP modifications were phased in over a period of several weeks at the beginning of the 2003 field season and were approved by USEPA in July 2003 (see Appendix 1). Significant changes to the 2002 SOP that were incorporated into the 2003 SOP included:

- standardization of the vibracoring units used by all coring crews;
- using more accurate measuring tools in the field to determine core recovery;
- discarding cores in the processing laboratory and recollection by field crews if the difference between field and lab recovery was greater than 6 in;
- discontinuing the use of Lexan® tubing, with exclusive use of aluminum tubing; and
- limitation of core tube length to 8 ft., thereby limiting penetration depth to approximately 7.5 ft.

3.3.1.1 Data Gap Core Collection

Sampling in Target Areas at Griffin Island and Northumberland Dam in 2002 was conducted on the coarser 160-ft. grid to obtain as much coverage of the proposed Candidate Phase 1 Areas as possible prior to the end of the field season. In 2003, the grid was completed on the finer 80-ft. grid as required in the FSP. In addition, data obtained from the samples located on the 160-ft. grid in Areas-to-be-Screened were analyzed on a preliminary basis to identify potential data gaps, and to determine whether additional sediment cores should be collected from any of the remaining sampling nodes to fill in the 80-ft. grid. These additional sampling locations were presented in the SFSP (QEA 2003a) and in a letter to USEPA (GE 2003).

3.3.2 Sediment Core Processing

Sediment core processing techniques were generally consistent with those utilized during the 2002 program; however, the SOP for core processing was modified based on recommendations developed after evaluation of the 2002 data and input from USEPA oversight personnel (QEA 2003a). The purpose of these changes was to improve the likelihood for consistently recovering high quality samples that were representative of the sediment in the areas sampled. The SOP modifications were phased in over a period of several weeks at the beginning of the 2003 field season and were approved by USEPA in July 2003 (see Appendix 2). Significant changes to the 2002 SOP that were incorporated into the 2003 SOP included:

- archiving the bottom 2-in. segment of the core;
- discarding cores that exhibited differences between field and laboratory recovery greater than 6 in.;
- for cores greater than 36 in., archiving the intervals below 36 in.; and
- development of procedures for dealing with voids observed in the cores.

3.4 SAMPLE ANALYSIS

A homogenized sediment sample from each core segment was prepared and either immediately submitted for analysis (core segments above 36 in. in depth – all segments in 2002) or frozen and archived (core segments below 36 in. in depth – 2003 only) for potential future analysis. In addition, the bottom 2-in. segment in each core was frozen and archived (2003 only). After the initial data (i.e., top 36 in.) were received, archived samples from cores greater than 36 in. in Candidate Phase 1 Areas were submitted for analysis if the cores contained Total PCBs at concentrations greater than 1 mg/kg in the 30 – 36-in. segment. Similarly, for incomplete cores less than 36 in., the archived bottom 2-in. segment was submitted for analysis if the section immediately above it contained Total PCBs at concentrations greater than 1 mg/kg.

Samples were analyzed for Total PCBs using the project-specific PCB Aroclor Method (GEHR8082) specified in the QAPP (ESI and QEA 2002). When reference is made to Total PCBs, GEHR8082 is implied. Additional analyses, including moisture content and bulk density in each core segment, were performed in accordance with the methods identified in the QAPP. Bulk density was analyzed according to a modified ASTM D4531-86 procedure for each of the top two-in. core segment samples (ESI and QEA 2002). Bulk density was calculated for the remaining core segments using field measurements obtained during sample processing. The top two-in. segment also was analyzed for Cesium-137 by gamma ray spectroscopy and total organic carbon (TOC) by the Lloyd Kahn Method (ESI and QEA 2002). Approximately five percent of the samples were analyzed for additional geotechnical parameters, including: grain size distribution by ASTM D422, Atterberg Limits by ASTM D4318-93, TOC by the Lloyd Kahn Method, specific gravity by ASTM D854-001, and USCS classification by ASTM D2487 (ESI and QEA 2002). The selection of the samples for additional geotechnical testing was based on visual characterization using the grain size during sample processing. This resulted in an evaluation of the range of sediment properties, including fine/coarse particle content, solids concentration, organic content, and specific gravity.

A total of 1,421 GEHR8082 Aroclor PCB extracts obtained from sediment and field duplicate samples during the SSAP in 2002 and 2003 were analyzed for PCB homologs using the

project-specific Method GEHR680 (ESI and QEA 2002). Of those 1,421 samples, 517 (ENV and DUP) are within the Candidate Phase 1 Areas. The samples for PCB homolog analysis were selected from the Aroclor PCB extracts from each laboratory approximately in accordance with its rate of Aroclor PCB analyses (Table 3-1). The subset of sample extracts being analyzed for PCB homologs spanned a similar range of PCB concentration as the subset being analyzed for Aroclors (Table 3-2). The GEHR8082 sample extracts selected for PCB homolog analysis (GEHR680) prior to the 2003 field season were from sample delivery groups (SDGs) that satisfied the performance evaluation (PE) criteria for Aroclors (ESI and QEA 2002). As a result of changes to the PE program for 2003, GEHR8082 sample extracts selected during the 2003 field season for PCB homolog analysis (GEHR680) were from the population of samples that were bracketed by weekly PE results that were within ± 3 standard deviations (s) of the mean PE acceptance criteria.

Additionally, 113 samples selected from core segments immediately below the deepest segment in which Total PCBs were measured at greater than 1 mg/kg were analyzed for Resource Conservation and Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium) by SW-846 Method 6010B/7471A and high resolution dioxins/furans by USEPA Method 1613B (ESI and QEA 2002). This represented approximately 2% of the total number of cores collected during the SSAP. The 1 mg/kg criterion was selected to provide an indication of sediments that may be present at the bed surface after dredging; however, the PCB concentration used to define dredging cut lines will be established during remedial design. During the 2002 field season, the samples were selected randomly from the population meeting the above criteria, in accordance with the QAPP (ESI and QEA 2002). However, GE and USEPA agreed that during 2003 the sediment samples were to be collected from areas likely to be dredged. Of the 113 samples analyzed for RCRA metals and high resolution dioxins/furans, 24 environmental samples and one duplicate sample originate from the Candidate Phase 1 Areas.

3.4.1 Sample Analyses and Laboratories Used

As described in the Year 1 DSR (QEA et al. 2003), six analytical laboratories were initially used to perform PCB analyses (GEHR8082). Due to quality assurance/quality control (QA/QC) issues experienced in 2002, many of the samples with positive PCB results and 40 samples reported non-detected for PCBs analyzed by one laboratory (Lab 4) were reanalyzed by another laboratory (Lab 15), with the reanalysis results replacing the Lab 4 results in the database. The remaining Lab 4 samples that were reported as non-detected for PCBs are used and summarized in this report. The Lab 4 analysis QA/QC issues were not resolved prior to the 2003 field season. Therefore, samples were not submitted to Lab 4 for analysis during 2003. Lab 1, Lab 6, Lab 14, and Lab 15 were used for PCB analysis during 2003. Lab 16 was not used for PCB analysis during 2003 but was available as a backup laboratory in the event the sample load required additional analytical capacity. The number of samples sent to each laboratory was dependent on each laboratory's capacity and ability to analyze samples within the holding time specified in the analytical method. The number of samples analyzed for Total PCBs (GEHR8082) by each laboratory for samples originating from the Candidate Phase 1 Areas (including field blanks, field duplicates, and PE samples), is listed below:

- Lab 1 – 1308 samples;
- Lab 4 – 276 samples; (includes only samples with non-detected PCB results and associated QC samples from 2002);
- Lab 6 – 2327 samples;
- Lab 14 – 2287 samples;
- Lab 15 – 2699 samples (includes 199 environmental samples originally analyzed by Lab 4 in 2002); and
- Lab 16 – 262 samples.

In addition, one laboratory (Lab 17) received 445 geotechnical samples (including field duplicates) from the Candidate Phase 1 Areas. Samples for geotechnical analysis were collected at a rate of approximately 5% of the total number of SSAP samples processed for PCB analyses, excluding field blanks, field duplicates, and PE samples. Another laboratory (Lab 19) analyzed the top 2-in. core sample sections for Cesium-137; 1748 such samples from Candidate Phase 1 Areas were processed and analyzed. Laboratory 15 performed the TOC analysis on all geotechnical samples and the top 2-in. samples (including grabs); 2249 such environmental and duplicate samples from Candidate Phase 1 Areas were processed and analyzed. Laboratory 15 also performed the PCB homolog analysis on 587 samples (including field blanks, field duplicates, and PE samples) from the Candidate Phase 1 Areas. In addition, moisture content was analyzed on all sediment samples (8434 environmental and duplicate samples for Candidate Phase 1 Areas) by each of the PCB laboratories listed above to facilitate the reporting of PCB concentrations on a sediment dry weight basis. Laboratory 6 performed the RCRA metals analysis on 25 environmental and duplicate samples for Candidate Phase 1 Areas, and Lab 18 performed the high resolution dioxin/furan analysis on 25 samples for Candidate Phase 1 Areas. Appendix 3 provides copies of the analytical data packages, excluding those previously submitted in the Year 1 DSR (QEA et al. 2003), in an electronic format (Acrobat® or zip files), as well as a listing of the data package file names for each laboratory SDG.

3.5 GEOPHYSICAL SURVEYS

3.5.1 Side Scan Sonar

Side scan sonar imaging was conducted by OSI in River Sections 1 and 3 during fall 2002 and in River Section 2 during spring 2003 using the procedures and specifications presented in the SOP (ESI and QEA 2002). Procedures for each survey were completed and documented in respective data interpretation reports (OSI 2003a, 2003b). The surveys were conducted from a shallow draft boat using a Klein 595 side-scan sonar system with a high resolution, dual frequency (100 and 500 kilohertz [kHz]) sonar tow fish. The sonar fish had a vertical beam width of 50.0°, a horizontal beam width of 1.0°, and the depression angle set at

20°. The sonar range was set to 37.5 m throughout the survey - the same range scale that was used during the 1991 and 1992 survey. A Triton Elics International (TEI) ISIS data acquisition platform was used to acquire digital side scan sonar, position, heading, and motion information. A digital depth sounder[2] was used to collect water depth information along each survey line. Track line spacing was adjusted, as necessary, to achieve bank-to-bank sonar coverage throughout River Sections 1 and 3, except in areas where the depth of water was too shallow or submerged obstructions precluded navigation. National Oceanic and Atmospheric Administration (NOAA) guidelines for side scan sonar data acquisition, which define the effective scanning range as equal to 12.5 times the height of the tow fish off the river bottom, were considered during the layout of survey track lines.

GPS base stations were established at known control monument locations in each river section to facilitate RTK on-the-fly (OTF) navigation. Navigational checkpoints were established at each dock based on the differential correctors transmitted from the control monument to the survey vessel's Trimble 7400 Msi GPS receivers. These checkpoints were used to verify the accuracy of the positioning system at the beginning and end of each day of field operations. GPS accuracy was monitored by navigational software to verify adequate satellite coverage for RTK control throughout the survey. Bar checks were also performed at the beginning and end of each day to verify the accuracy of the vertical beam echo sounder in determining water depth. Side scan confidence checks were performed daily to verify proper operation and tuning of the system.

Sonar images were processed using Universal Systems CARIS SIPS software. Base maps depicting the survey track lines, bottom sediment-type definitions, and sonar targets (probes, obstructions, etc.) were generated using AutoCAD. The results from the 2002 and 2003 surveys, including surficial sediment delineations, sonar images, and sonar targets (e.g., debris and obstructions) have been incorporated into the Hudson River GIS database. A summary of the major findings for the side scan sonar surveys of each Candidate Phase 1 Area is presented in Section 6.

[2] During 2002, an Innerspace 448 single frequency (200 kHz) depth sounder was used; during 2003, an Odom Echotrac DF3200 MKII dual frequency (24 and 200 kHz) was used.

3.5.1.1 Groundtruth Data

OSI collected ancillary sediment texture information during the sonar survey by probing the river bottom as specified in the SOP. To groundtruth the sonar imagery data, push probing was conducted at more than 2300 locations during the 2002 and 2003 investigations. Push probing was performed by the geologist onboard while the survey vessel was surveying on-line and consisted of pushing (by hand) a ½-in. diameter pipe into the bottom and interpreting the "feel" of the sediments through the probe. The relatively simple task of push probing into the bottom while surveying provided immediate information to the geologist about the bottom sediments, and later added to the final interpretation and mapping of sediment distribution. The probing results and coordinates were logged as target files using the TEI ISIS sonar acquisition software. In total, OSI conducted 467 bottom probes during the 2003 survey of River Section 2. Probing results and sonar images were evaluated during the course of the survey to determine locations for confirmatory grain size sampling in each river section.

The confirmatory sediment sampling was conducted in accordance with the approved FSP and QAPP. Samples were obtained from 146 locations in River Section 1, 133 locations in River Section 2 and 150 locations in River Section 3. OSI selected sample locations, which were provided to QEA sampling personnel. QEA's sampling vessel was positioned at each location using RTK GPS. Cores were collected in 3 in. outside diameter Lexan® tubing using push coring techniques. The sediment cores were extruded on the sampling vessel and the top one inch was collected for grain size measurement. On average, four cores were collected at each location to assure proper sample volume. In areas where sediment cores could not be collected, Ponar grab samples were collected. The samples then underwent laboratory grain size analysis. The Data Interpretation Report for River Sections 1 and 3 (OSI 2003a), which includes tabulated results of the confirmatory core grain-size analyses, was presented as an appendix to the SFSP (QEA 2003a). Tabulated grain size results for confirmatory cores collected in River Section 2 were included in the Side Scan Sonar Data Interpretation Report for 2003 (OSI Report No. 02ES072 - DIR-S2003) submitted to USEPA in October 2003; this report will be included as an appendix to the Phase 2 DSR.

3.5.2 Bathymetry

OSI conducted a bathymetric survey of River Section 1, including the Candidate Phase 1 Areas in Northern TIP and at Griffin Island, in October 2001. Survey transects during the 2001 survey were nominally spaced at 125 ft.; transect data from this survey was reprocessed in spring 2003 and contoured at 1-ft. intervals to support the remedial design. The reprocessed data from the 2001 survey has since been included in the Hudson River GIS database.

OSI completed the bathymetric survey in the Candidate Phase 1 Area north of Northumberland Dam during June 2003. The survey was conducted using a shallow draft boat with a dual frequency depth sounder following the procedures outlined in Appendix 2 of the QAPP (ESI and QEA 2002). Nominal line spacing for bathymetry transects in this Candidate Phase 1 Area was 100 ft. Elevation data for these transects have been included in the Hudson River GIS database; additional processing and contouring of this data set will be completed at a future date, if deemed necessary for the final design.

Results from bathymetry surveys conducted during 2003 in the remainder of River Sections 2 and 3 have been incorporated into the Hudson River GIS database. A discussion of these surveys will be presented in the Phase 2 DSR.

3.5.3 Sub-Bottom Tests

OSI conducted sub-bottom tests in October 2003 in sub-areas of each Candidate Phase 1 Area. These tests included the evaluation of low-frequency acoustic (i.e., chirp) and high-frequency electromagnetic (i.e., ground-penetrating radar; GPR) remote sensing instrumentation to assess their utility in the remedial design. The tests were conducted in accordance with the Sub-Bottom Test Work Plan (QEA 2003b) and Appendix 3 of the QAPP (ESI and QEA 2002). Results from these tests are still pending and will be presented in the Phase 2 DSR.

3.6 QUALITY ASSURANCE/QUALITY CONTROL

3.6.1 PE Sample Program

During the 2002 field season, one PE sample for GEHR8082 analysis was analyzed per lab, per day (QEA 2003b). The lab running the PCB homolog analysis (GEHR680) analyzed the extracts of 12 PE samples in the first two weeks (i.e., three at each of the four PCB concentration levels); thereafter, it analyzed one per every two SDGs or one PE per day, whichever was more frequent, for each lab satisfactorily performing the GEHR8082 analysis. The primary objective of the 2002 PE program was to provide a basis for choosing PCB results for manual validation.

As agreed upon with USEPA prior to commencement of sampling in 2003, the PE sample program was revised to decouple it from data validation (discussed in Section 3.5.2.4) and to use it as an independent QA monitor of laboratory accuracy and precision. To conserve the limited supply of PE material, PE samples were submitted on a tiered structure as follows:

- Tier I: for laboratories within control limits, submit one PE sample per week.
- Tier II: if a laboratory is outside of control limits, perform corrective actions. Monitor the effectiveness of the corrective action by measuring one PE sample every two days until the lab is once more within control limits, and then resume the Tier I frequency.

Four Hudson River PE samples (PE1, PE2, PE3, and PE4) and a synthetic Aroclor PE prepared by Wibby Environmental (PE5) were used in the program. A description of the PE material is provided in the Year 1 DSR (QEA et al. 2003). PE1, the low concentration Hudson River PE, and PE5, the synthetic Aroclor PE, were submitted more frequently during 2003 to optimize use of the remaining Hudson River PE sample inventory and to ensure that sufficient PE material was available for any necessary corrective action (Table 3-3). The analysis of GEHR8082 extracts for homolog PCBs by GEHR680 was conducted several weeks after the GEHR8082 analysis so that the Aroclor analysis results could be used as a basis for selection of

the extracts for analysis. Therefore, the GEHR680 PE submission frequency is listed by extract selection week (Table 3-3).

The PE control limits used in 2002 are discussed in the Year 1 DSR (QEA 2003b). The limits were revised for 2003 to better reflect the purposes of the PE program. The 2003 PE control limits used the mean value for each PE established from the Inter-laboratory Comparison Study results and the variance from the 2002 SSAP PE results. The Inter-laboratory Comparison Study provided the best estimate of the true PCB concentration of each PE sample and the variability experienced in the 2002 SSAP program provided the best estimate of the precision that could be obtained under SSAP conditions. The control limits were set at three sigma (i.e., the mean plus three standard deviations and the mean minus three standard deviations).

3.6.2 Field QA/QC

QEA personnel and USEPA representatives provided oversight for the sampling activities to maximize consistency between the various sampling crews and ensure adherence to the core sampling SOP presented in the QAPP. The field database maintained by each sampling crew was reviewed for accuracy at the end of each day. Daily checks of the RTK GPS on each vessel were performed by occupying checkpoints to confirm that the GPS was operating within the criteria defined in the QAPP (+/- 1 ft.).

QA/QC samples were prepared to allow evaluation of data quality. Field QA/QC samples included field blanks, field duplicate samples, matrix spike samples, and matrix spike duplicate samples. The types and frequency of QA/QC samples to be collected for each parameter were specified in Section B5.1 of the QAPP and are summarized below.

3.6.2.1 Field Blanks

Field blanks for solid samples for PCBs and TOC were prepared by processing a sample of clean and pre-tested sand in the same manner as environmental samples, including placement

in new core sample tubing, removal, mixing, and placing in containers. One field blank core sample was prepared by each sampling vessel crew each day. Field blanks were collected at the rate of 5% of the total number of environmental samples. Field blanks were not collected for TCLP metals, total RCRA metals, or Cesium-137 (ESI and QEA 2002).

3.6.2.2 Field Duplicates

Field duplicates were prepared in the processing laboratory at the rate of 5% of the total number of environmental samples and consisted of two aliquots from the same segment of a sediment core (after homogenization).

3.6.2.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) (or, alternatively, laboratory duplicate; LD) samples were not required for every analysis under the SSAP. Specifically:

- MS and MSDs were not required for Aroclors and Total PCBs by GEHR8082, PCB Homologs by GEHR680, Dioxins/Dibenzofurans, and Cesium-137.
- MS was required for TCLP Analyses, but MSD/LD were not required. MS was required for TOC and RCRA metals.
- LDs were required for TOC, RCRA metals, ignitability, bulk density, and moisture content.
- MSs/MSDs/LDs were analyzed at the rate of one pair per sample batch (up to 20 samples) for the required analyses.

3.6.2.4 Data Verification/Validation

Electronic data verification and data validation (where necessary) were conducted after samples were collected and analyzed in order to assess the quality of the data. The usability of the analytical data was assessed using a tiered approach. Data initially underwent electronic data *verification*, which evaluated batch quality control results presented in the laboratory electronic data deliverables (EDDs). The term "verification" is used to designate the criteria-based checking of the laboratory-reported QC results against the limits defined in the QAPP. This comparison was used to qualify data. Full data *validation* (i.e., manual qualitative and quantitative checking) during 2002 was performed on the PCB analytical results that were subject to question based on the PE sample results and on a subset of the other analytical results as discussed in the Year 1 DSR (QEA et al. 2003). USEPA approved decoupling manual validation of PCB data from the PE results for the 2003 SSAP. During the 2003 SSAP, 6% of the environmental samples for PCBs were manually validated. The samples were selected on an SDG basis spread out evenly among the labs and throughout the sampling program (Table 3-4). Validation of other analytical results was as described in the QAPP (ESI and QEA 2002).

The automated electronic data verification was performed on 100% of the Total PCB, Aroclor, homolog PCB, total RCRA metals, TOC, and dioxin/furan data using the batch quality control results provided by the laboratories in the EDDs. The specific measures evaluated during verification and the associated criteria are discussed in QAPP Section D.2.2 and include:

- holding times;
- accuracy [by evaluating laboratory control sample (LCS) recovery, and MS/MSD recoveries (except for PCBs)];
- precision (by evaluating laboratory duplicate results);
- field duplicate sample precision;
- blank contamination (laboratory method blanks and field generated blanks);

- surrogate compound recoveries; and
- percent solids for solid matrices.

The electronic verification process provided an understanding of the data quality based on those QC indicators that have the most influence on qualification of data. The electronic verification process was automated so that the quality of the data could be determined soon after the laboratory reported it. In contrast, manual validation findings were not available for several weeks after the data packages were submitted because of the length of time professional validation takes.

Full validation included an evaluation of documented QA/QC measures through a review of tabulated QC summary forms and raw instrument data (ESI and QEA 2002). The validation results were also compared to the results of the electronic verification for the same set of data, which provided an indication of the accuracy of the electronic verification process. Verification and validation findings are discussed in Section 7.

3.6.3 USEPA Split Samples

The USACE representatives or USEPA contractors collected 171 split samples in 2002 and 2003 with 22 split samples from the Candidate Phase 1 Areas. GE analyzed its portion of the split samples for Total PCBs as Aroclors by SOP GEHR8082 and homologs by SOP GEHR680 (Table 3-5; ESI and QEA 2002). GE analyzed each split sample as indicated by USEPA contractors. USEPA analyzed the split samples for PCB homologs (with the exception of those discarded due to temperature exceedances) by USEPA Method 680. The FSP and QAPP specify that USEPA is to analyze its portion of split samples that GE analyzed using GEHR680 with a similar method (QEA 2002, ESI and QEA 2002). An analysis of the split sample results is presented in Section 7.5 of this report.

SECTION 4
FIELD OBSERVATIONS

4.1 SEDIMENT CORING

This section presents an overall description of field data collected during the sampling program, a discussion of the classification of cores as complete or incomplete, and an assessment of abandoned locations. This information is then evaluated for each of the Candidate Phase 1 Areas (Northern TIP, Griffin Island, Northumberland Dam).

4.1.1 Field Data (Probing, Penetration, and Recovery)

Field data including probing depth, penetration depth, and recovery were evaluated to assess whether each core sample provided an accurate representation of the sediment from which it was collected. These parameters were recorded at each sampling location and were compared against the criteria defined in the core collection SOP (Section 3.1).

Sediment probing was conducted using a ½-in. diameter steel rod marked in 1 ft. increments to characterize the depth and type of sediment in the vicinity of each coring location to assist the field crew in choosing the type and length of core tubing. As described in Section 3.1, the core collection SOP was modified early in the 2003 field season, and included changes in the procedures for the selection of core tubing length and material type (see Appendix A). In 2003, the use of Lexan® tubing was discontinued, and the maximum length of core tubing used was limited to 8 ft. At locations where the probing depth was less than 6 ft., a core tube approximately 2 ft. longer than the probing depth was used. At the beginning of the program, Lexan® tubing was typically selected for sites with finer sediments and aluminum tubing was selected for coarser sediment sites.

The penetration depth reflects the depth that a core tube was advanced into the sediment using the vibracoring equipment. In the 2003 SSAP, penetration depth was limited to 8 ft. in order to avoid logistical problems associated with transportation of the longer cores to the laboratory for processing, and to reduce the number of samples containing less than 1 mg/kg Total PCBs that were typically generated by such long cores.

Recovery reflects the length of the recovered sediment core. It was measured twice, once on the sampling vessel directly after core retrieval (field recovery), and a second time in the laboratory prior to processing (lab recovery). The field recovery was used in conjunction with the penetration depth to determine whether a core met the criteria specified in the core collection SOP (Section 3.1), and, therefore would be retained for processing and analysis. In accordance with the core collection SOP, cores with a penetration/recovery ratio less than 60% were not retained for processing and analysis unless a core with better recovery could not be obtained at a given sampling location after three attempts (Appendix 1). The lab recovery was used to determine whether the core would be kept for further processing and to determine its segmentation scheme. Significant differences between field and lab recovery occurred less frequently in 2003 compared to 2002; and was typically insignificant in all sediment types, with the exception of gravel. Two changes to core collection and processing SOPs implemented in 2003 were likely responsible for this improvement: 1) if lab recovery differed from field recovery by more than 2 in. in the first 2 ft. and 1 in. every 1 ft. thereafter cores were discarded in the laboratory and targeted for re-sampling; and 2) more accurate methods were used in the field to measure recovery (Appendices 1 and 2).

4.1.2 Identification of Complete/Incomplete Cores

Incomplete cores complicate the use of SSAP data for dredge area delineation by introducing uncertainty into the extent of PCB contamination in targeted areas. As documented in the Year 1 DSR (QEA et al. 2003), incomplete cores were defined as cores with a Total PCB concentration greater than 1 mg/kg in their bottom core segment, while complete cores were defined as containing $\leq$ 1 mg/kg in the bottom core segment(s). The characteristics of complete

cores often included a high ratio between penetration depth and recovery, and yielded classic PCB concentration profiles, including ≤1 mg/kg Total PCBs in the bottom segment(s). When less than six inches of sediment were present based on probing, a surface grab was collected with a Ponar dredge. When the sampling conditions were such that no sample could be retrieved by either coring or with a Ponar dredge (i.e., little or no sediment), the location was abandoned.

Incomplete cores were most often collected from either coarser-grained sediments or soft sediments with high organic matter content. Cores collected in coarse-grained sediment tend to have a higher incidence of being incomplete compared to other sediment types due to the difficulty associated with penetrating these materials with the coring equipment, and/or the presence of a hard substrate immediately below the sediment layer. If the sediment above this substrate contains PCBs, it is not possible to obtain clean material in the bottom of the core. Incomplete core sample locations tended to be clustered in rocky or coarse-grained areas, where core collection was more difficult or impossible. Abandoned locations were typically adjacent to incomplete locations, further confirming the difficulty of collecting cores from these areas. Sediment containing a high proportion of organic materials may have had a higher occurrence of incomplete cores due to the susceptibility of these materials to disturbance and mixing during the vibracoring process.

The existence of incomplete cores also was found to be related to other factors, including composition of the sediment in the bottom core segment which determines the quality of the "plug" in the core tube (QEA et al. 2003). Cores that had clay present in the bottom of the core had a very high probability of being complete. Additionally, the segmentation procedure in 2002 included discarding the bottom two inches of each core. In 2003, the bottom two inches of each core were archived and subsequently analyzed when cores were determined to be incomplete. This procedure resulted in an increase in the number of complete cores collected in 2003.

4.1.3 Abandoned Locations

An information gap may result when a location is abandoned, thereby reducing the certainty of the estimate of PCB contamination in targeted areas. In general, sample locations were abandoned when little or no sediment could be collected from the targeted core location using the methods specified in the core collection SOP (Appendix 1). Probing data and field notes for stations that were abandoned in 2002 were used to divide these locations into three groups according to the likelihood of collecting a sample using an alternative coring technique (QEA et al. 2003). This process was repeated for the data collected in 2003, with the abandoned locations classified into one of the following groups:

1. Abandoned locations with no likelihood of being successfully sampled in the future. The abandoned locations that are not likely to be successfully sampled were typically located in hard bottom areas, with the bottom being bedrock or a combination of bedrock overlain with cobbles, gravel, shale fragments, and/or debris such as logs or submerged man-made structures (timber classification cribs, old bridge abutments, etc.). The probing depth in these locations was less than 6 in.
2. Abandoned locations with some likelihood of recovery upon future re-sampling. These locations had a probing depth greater than 6 in; however, the bottom materials were predominantly coarse-grained media including gravel, cobbles, and coarse sand. These materials could be probed with a small diameter rod, but it was difficult or impossible to penetrate them with the 3 in. diameter core tube, and difficult to retain any materials that were penetrated. In accordance with the core collection SOP, grab sampling was not attempted at these locations because the probing depth exceeded 6 in.
3. Abandoned locations with high likelihood of recovery upon future re-sampling. Abandoned locations that are likely to be successfully re-sampled were in areas with probing depth greater than 6 in. where sediment was either fine-grained, or primarily fine-grained with a top layer of coarse sand or gravel, or high organic content sediments. To the extent that the sediments were very fine-grained with high water content, it is possible that the vibration of the core tube disrupted the cohesive forces holding the sediment together and the sediment drained out of the tube as it was raised.

4.1.4 Improvements in 2003

The number of incomplete cores and abandoned locations declined in 2003 compared to 2002 for the three Candidate Phase 1 Areas, likely as a result of changes that were implemented in the sampling program (Figure 4-1). A summary of the field data for cores collected during the 2002 and 2003 sediment sampling seasons in the Candidate Phase 1 Areas is presented in Tables 4-1, 4-2 [Northern TIP (Table 4-1a, Table 4-2a), Griffin Island (Table 4-1b, Table 4-2b) and Northumberland Dam area (Table 4-1c, Table 4-2c)]. A comparison of the 2002 and 2003 data (Table 4-1) suggests that changes made in sediment coring and core processing in 2003 (Sections 3.3.1. and 3.3.2) improved the program, as follows:

- increased penetration depth, recovered core length, and recovery ratios in difficult coring areas (Northern TIP and Northumberland Dam);
- minimized the difference between field and lab recovery depths;
- reduced the percentage of recovered cores with incomplete PCB profiles; and
- reduced the number of abandoned locations.

The relationship between sediment type at the bottom of the core layer and field characteristics of recovered and incomplete cores in the 2002 and 2003 SSAP field seasons indicates slight differences between years (Table 4-2). Coring was not attempted during 2003 in areas that were designated as gravelly or rocky by the side scan sonar survey. This also likely reduced the number of abandoned locations and incomplete cores in 2003.

4.1.5 Field Observations for Sediment Cores in Candidate Phase 1 Areas

An overview of the sediment types in Candidate Phase 1 Areas and the number of cores, grabs, and abandoned locations collected in the 2002 and 2003 sediment sampling seasons is provided in Figure 4-2 [Northern TIP (Figure 4-2a, 4-2b), Griffin Island (Figure 4-2c) and

Northumberland Dam area (Figure 4-2d, 4-2e)]. There are differences in sediment characteristics among each of the Candidate Phase 1 Areas (Figure 4-2). The riverbed in the Northern TIP area is covered primarily by a mixture of sediment types, with two larger coarse-grained sediment areas near RM 194 and a large rock outcrop area between RM 193 and 192. The Griffin Island area is covered by large fine-grained and sandy areas with two rocky areas located upstream and downstream of the island (Figure 4-1). The Northumberland Dam area is primarily composed of fine-grained sediment along the shoreline and sandy areas within the main channel, with areas of coarse-grained sediment and rock near RM 185 and 184. Additionally, there is an area of submerged timber classification cribs (remnants from the logging industry) on the east side of the channel near RM 184.

4.1.5.1 Northern TIP

A total of 1003 sampling locations were occupied in the Northern TIP area; a core or a grab sample was obtained from approximately 87% of these locations (84% 2002, 97% 2003). Core samples were collected at 848 locations (85%) and grab samples were collected at an additional 26 locations (3%). The remaining 129 locations (13%) were abandoned (16% 2002, ~3% 2003). The mean probing and penetration depths in the Northern TIP area were 46 in. and 49 in., respectively. The mean recovered core length was 37 in., with the highest mean recovery in sediments underlain by clay (51 in.), and the lowest recovery in areas underlain by coarse grain sand and gravel (28 to 29 in.). The field and lab recovery ratios in 2002 had mean values of 72% and 68%, respectively. In 2003, the equivalent mean values were 76% and 75%, respectively.

Of the 848 cores collected in the Northern TIP, 289 cores were incomplete (38% in 2002, 25% in 2003). The mean Total PCB concentration in the bottom core segment of the incomplete cores was 127 mg/kg and the median value was 34 mg/ kg (Table 4-1a). In areas with sediments underlain by gravel, coarse sand, silt, or organic matter, more than 49% of the recovered cores were incomplete, while 8% of the cores from sediments underlain by clay were incomplete. The mean and median Total PCB concentrations from the grab samples were 33 mg/kg and 26 mg/kg, respectively.

Sampling was re-attempted in 2003 at 19 locations that were abandoned in 2002. These locations were designated as having either high or some likelihood of recovery in the evaluation of the potential for successful re-sampling (See Section 4.1.3) and the absence of data at these locations appeared to constitute a significant data gap. The 19 locations were re-sampled successfully. None of the nine locations abandoned in 2003 were in the likely to be recovered during re-sampling category; four were designated as having some likelihood of recovery, and five were designated with no likelihood for recovery. Incomplete cores, abandoned locations, and grabs were frequently clustered together, and were often located near rocky or coarse-grained areas (e.g., between RM 193 and 192; Figure 4-1b). Additional sediment sampling in abandoned locations will occur in 2004 consistent with the SFSP for Year 3.

4.1.5.2 Griffin Island

A total of 499 sampling locations was occupied in the Griffin Island area and a core or a grab sample was obtained from approximately 96% of these locations (91% in 2002, 98% in 2003). Core samples were collected at 470 locations (94%), and grab samples were collected at eight locations (2%). The remaining 21 locations (4%) were abandoned. The mean probing and penetration depths in the Griffin Island area were 55 in. and 62 in., respectively. The mean core recovery was 46 in., with the highest recovery observed in sediments underlain by clay (51 in.; Table 4-2b). The rest of the Griffin Island sediments yielded quite consistent recoveries, ranging from 39 to 47 in. The mean field and lab recovery ratios were 74% and 72%, respectively.

Of the 470 cores collected in the Griffin Island area, 35 cores (7%) were incomplete. The mean Total PCB concentration in the bottom segment of incomplete cores was 50 mg/kg, while the median value was 4 mg/ kg (Table 4-1b). Obtaining complete cores was most difficult in sediments underlain by gravel and silt; approximately 30% of the locations having these conditions yielded incomplete cores (Table 4-2b). Coring in the other sediment types yielded a very low percentage of incomplete cores (2-12%; Table 4-2b). The mean Total PCB concentration of the grab samples was 16 mg/kg and the median value was 15 mg/kg.

No re-sampling of locations abandoned in 2002 was attempted in 2003 in this area. Based on a review of the field notes for the eight abandoned locations reported in 2003, one had some likelihood of recovery and seven were designated to have no likelihood of recovery. The majority of the incomplete cores, abandoned locations, and grabs in the Griffin Island area were concentrated either upstream of the island near coarse-grained sediments (Figure 4-1c), or downstream near the rocky area (Figure 4-1d). Additional sediment sampling in abandoned locations will occur in 2004 consistent with the SFSP for Year 3.

4.1.5.3 Northumberland Dam

A total of 395 sampling locations was occupied upstream of Northumberland Dam; a core or a grab sample was obtained form approximately 90% of these locations (85% in 2002, 94% in 2003). Core samples were collected at 338 locations (86%) and grab samples were collected in an additional 16 locations (4%). The remaining 41 locations (10%) were abandoned. The mean probing and penetration depths were 61 in. and 54 in., respectively, which are significantly higher than the mean values from the other Candidate Phase 1 Areas. The mean core recovery was 39 in., with the highest recovery in sediments underlain by clay (60 in.). In other sediment types, consistent recoveries were observed, ranging from 32 to 47 in., regardless of the bottom segment sediment composition. The average field and lab recovery ratios were 70% and 69%, respectively.

Of the 338 cores collected in the Northumberland Dam area, 102 cores (30%) were incomplete. The mean Total PCB concentration in the bottom segment of incomplete cores was 110 mg/kg, while the median value was 16 mg/ kg (Table 4-1c). There was one incomplete core in sediments underlain by clay. For the remaining sediment types (based on that of the bottom core segment), the percentage of incomplete cores ranged from 27% to 50% (Table 4-2c). The mean Total PCB concentration of the grab samples was 20 mg/kg, with a median of 12 mg/kg.

In 2003, sampling was successfully re-attempted at one location that was abandoned in 2002, which was classified as having some likelihood of being re-sampled. No other locations were resampled because the absence of data at these locations did not appear to constitute

significant data gaps. The incomplete cores, abandoned locations, and grabs in this area appear to be localized either within, or adjacent to, the navigational channel which is often gravelly or rocky (Figure 4-1d and 4-1e). Additional sediment sampling in abandoned locations will occur in 2004 consistent with the Supplemental Field Sampling Plan for Year 3.

SECTION 5
RESULTS OF MEASUREMENTS ON SEDIMENT CORE SAMPLES

5.1 DATA REPORTING

Data generated for the SSAP were submitted electronically to Environmental Standards, Inc. (ESI) for data quality reviews (Section 7) and assembly of the data into a project-specific database. The data are presented in two forms in this report: the analytical results are included in the GE Hudson River database, attached to this report on CD-ROM (Appendix 4); and the electronic data packages submitted by the analytical laboratories (Appendix 3).

5.2 NORTHERN TIP

5.2.1 PCB Results

The 848 cores and 26 grab samples collected during 2002 and 2003 in the Northern TIP area produced 4,166 sediment samples that were submitted for PCB analysis (3,965 environmental samples plus 201 blind duplicates). PCBs were detected using Method GEHR 8082 in 3,115 of these samples at concentrations that ranged from 0.009 to 13,820 mg/kg (Figure 5-1; Appendix 4).

5.2.2 Bulk Density

Bulk density is the weight of the solid material in the sediment per unit of sediment volume, including pore space. Two methods were used to determine bulk density. For grab samples and the top 2-in. sections of sediment cores, bulk density was measured in an analytical laboratory using a modification of ASTM Method D4531-86. For subsurface core sections, bulk density was calculated from section weights measured in the field processing laboratory and

sample moisture content measured in an analytical laboratory. In the Northern TIP, bulk density was measured on 874 sediment samples and on an additional 46 laboratory duplicates (Appendix 4) and was calculated for 3,091 samples (87 of which were judged to be outliers; see Section 8.2) and 155 laboratory duplicates (no outliers). Outliers were removed from the data set and replaced with average bulk density values by primary and secondary sediment type. Calculated and measured bulk density values are presented in Appendix 4. A detailed discussion of the bulk density data is presented in a memorandum to USEPA submitted on October 21, 2003 (see Appendix 5).

5.2.3 TOC in Top 2-Inch Segment

Grab samples and the top 2-in. segment of each core were analyzed for TOC. A total of 920 samples from the Northern TIP were analyzed for TOC, including 874 environmental samples and 46 duplicates (Appendix 4).

5.2.4 Cesium-137

Cesium-137 concentration was measured in the top 2-in. segment of each sediment core. From the Northern TIP, 847 top 2-in. segment samples were analyzed with an additional 45 measurements completed on laboratory duplicates (Appendix 4).

5.2.5 Dioxins/Furans

Eleven samples were analyzed for high-resolution dioxins/furans by USEPA Method 1613 in the Northern TIP. These samples were from core segments immediately below the deepest segment in which the Total PCB concentration was greater than 1 mg/kg. They were selected from cores located in potential dredge areas and provide an estimate of residual levels. Detectable levels of dioxins were reported in three samples; furans were detected in five samples (Tables 5-1, 5-2).

5.2.6 RCRA Metals

The eleven samples analyzed for dioxins/furans were also analyzed for RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium) by USEPA Method 6010B and 7471A as an estimate of residual levels. Arsenic, barium, chromium, cadmium, and lead were detected in all samples, and mercury was detected in seven samples (Table 5-3). Selenium and silver were not detected.

5.2.7 Geotechnical Parameters

5.2.7.1 Atterberg Limits

The liquid and plastic limits of the sediment were determined for use in remedial design. The liquid limit is the moisture content at which the sediment begins to act as a liquid material. The plastic limit is the moisture content at which the sediment begins to act as a plastic material (i.e., it can be molded into a shape and retain that shape). The moisture content range between these limits, referred to as the plasticity index, defines the range between behavior as a solid and behavior as a liquid.

A total of 201 environmental samples and 20 duplicate samples from the Northern TIP underwent Atterberg Limit analysis. Atterberg Limits were reported only for 35 of the samples (28 environmental; 7 duplicate), as only samples with a significant amount of silt and clay could be tested (Table 5-4).

5.2.7.2 Grain Size Distribution

The quantitative sediment grain size distribution was determined for 221 samples from the Northern TIP (201 environmental samples and 20 field duplicate samples - Appendix 5). These data are presented in Figure 5-2 in the form of cumulative bar plots showing the quantitative grain size distribution for each sample on a percent by weight basis; each plot presents a subset of samples grouped according to their primary sediment type, as determined by

visual classification in the processing laboratory. The number of samples in each group is indicated at the top of the bar chart (i.e., there are 19 samples that were visually described as having clay as the primary component) and each sample is represented by a separate bar on the chart. Note that the analytical laboratory does not have a classification for sediments composed predominantly of organics. The five samples with organics as the primary constituent were classified by the analytical laboratory as fine sand. The total number of samples with organics as the primary constituent accounted for only 3% of the samples in Northern TIP.

Figure 5-2 shows a general correspondence between the primary visual classification and the quantitative grain size data. The visually identified primary grain size component from a sample should generally constitute at least 35% (by weight) of the entire sample (Burmister 1958). For the samples visually classified as clay, silt, fine sand, and gravel, greater than 30% of the sample dry weight was, on average, in the size range of the primary visual classification. The grain size analyses for samples from Northern TIP do show that the samples visually described as silt contain, on average, a higher percentage of fine sand (i.e., 68% of samples visually classified as silt have more fine sand than silt on a weight percent basis). The opposite, however, does not hold true – only 3% of samples classified as fine sand had a higher fraction of silt. Samples visually characterized as coarse sand tended to contain significant amounts of medium sand and, to a lesser extent, fine sand. Classification bias may be related to a fundamental difference between visual and quantitative characterization; the former is based on a volume distribution whereas the latter is based on a weight distribution.

USEPA has suggested, for the purposes of grain size reporting for this Phase 1 DSR, that the classification scheme be revised to group the samples based on subsets of the primary visual classification as follows: 1) clay; 2) silt and fine sand; and 3) medium sand, coarse sand, and gravel. While this classification scheme is acceptable for the purposes of grouping sample textures into finer, fine, and coarse fractions, respectively, GE maintains that the visual classification scheme applied in the processing laboratory provides valuable information. For example, when comparing samples with a visual primary classification of silt to those visually classified as fine sand, a student t-test indicates that there is a statistically significant difference in the average weight percent of silt in these samples (i.e., samples classified as silt have, on

average, a higher percentage of silt in them than samples that are classified as fine sand).[3] Thus, the visual classification is still important to the design of the remedy for the purposes of discriminating sediments with a higher silt fraction from those without.

5.2.7.3 Moisture Content

Each sample analyzed for PCBs also was analyzed for moisture content. A total of 4,192 samples from the Northern TIP were analyzed for moisture content, including 3,985 environmental samples and 207 duplicates (Appendix 4). There are 26 samples within this count that were reported twice: once by the PCB analytical laboratory and once by the laboratory analyzing TOC for geotechnical samples (these were reported inadvertently and were not a requested analysis from that laboratory). The relative percent difference in moisture content in the individual samples ranged from 0 to 28% (mean 11.9%; median 9.1%) with the mean and median by lab listed below:

- Lab 1 – 5 samples, mean RPD 9.3%, median 6.2%.
- Lab 14 – 8 samples, mean RPD 9.9%, median 9.0%.
- Lab 15 – 3 samples, mean RPD 11.4%, median 12.9%.
- Lab 16 – 5 samples, mean RPD 17.0%, median 17.5%.
- Lab 6 – 5 samples, mean RPD 13.1%, 6.1%.

[3] Results of two-sample t-test with unequal variance on Northern TIP grains size analyses: mean weight percent silt in samples classified as silt = 30.1% (n = 37); mean weight percent silt in samples classified as fine sand = 12.6% (n = 57). Critical t value = 6.4; P-value = 1.5E-08. The results reject the null hypothesis that the mean weight percent of silt in samples visually classified as fine sand is the same as in those visually classified as silt; the results favor the alternative hypothesis that the mean weight percent of silt in samples visually classified as fine sand is less than the mean weight percent of silt in samples visually classified as silt.

5.2.7.4 Specific Gravity

The specific gravity is the density of a substance divided by the density of water. A total of 221 samples from the Northern TIP were analyzed for specific gravity of the granular sample material, including 201 environmental samples and 20 duplicates (Table 5-5; Appendix 4).

5.2.7.5 Unified Soil Classification Scheme

Grain size analysis is conducted to identify the range of sediment types and classify the soil types. Grain size analyses (Section 5.2.7.2) were used to determine the USCS classification for 201 environmental samples and 20 duplicates from the Northern TIP area (Appendix 4).

5.3 GRIFFIN ISLAND

5.3.1 PCB Results

The 470 cores and 8 grab samples collected during 2002 and 2003 in the Griffin Island area produced 2,476 sediment samples that were submitted for PCB analysis (2,348 environmental samples plus 128 blind duplicates). PCBs were detected using Method GEHR 8082 in 1,531 of these samples at concentrations ranging from 0.008 to 1,620 mg/kg (Figure 5-3; Appendix 4).

5.3.2 Bulk Density

In the Griffin Island area, 478 bulk density measurements were performed on grab samples and the top 2-in. samples from sediment cores with an additional 31 measurements performed on laboratory duplicates (Appendix 4). Bulk density was calculated for 1,870 subsurface core section samples (51 of these were judged to be statistical outliers) and 97 laboratory duplicates (one outlier; see Section 8.2 for discussion on outliers). Outliers were removed from the data set and replaced with average bulk densities values by primary and

secondary sediment type. Calculated and measured bulk density values are presented in Appendix 4. A detailed discussion of the bulk density data is presented in a memorandum to USEPA submitted on October 21, 2003 (Appendix 5).

5.3.3 TOC in the Top 2-Inch Segment

A total of 509 samples from Griffin Island were analyzed for TOC, including 478 environmental samples and 31 duplicates (Appendix 4).

5.3.4 Cesium-137

A total of 470 top 2-in. segments of cores collected from the Griffin Island area were analyzed; and an additional 31 measurements were completed on laboratory duplicates (Appendix 4).

5.3.5 Dioxins/Furans

Ten samples (nine environmental plus one blind duplicate) from the Griffin Island area were analyzed for high-resolution dioxins/furans by USEPA Method 1613. These samples were from core segments immediately below the deepest segment in which Total PCBs were greater than 1 mg/kg. They were selected from cores located in potential dredge areas. Dioxins were detected in four samples; furans were detected in six samples (Tables 5-1, 5-2).

5.3.6 RCRA Metals

The ten samples analyzed for dioxins/furans also were analyzed for RCRA metals by USEPA Method 6010B and 7471A. Arsenic, barium, chromium, and lead were detected in all

the samples, cadmium and mercury were detected in seven samples, and silver was detected in one sample (Table 5-3). Selenium was not detected.

5.3.7 Geotechnical Parameters

5.3.7.1 Atterberg Limits

A total of 127 environmental samples and 9 duplicate samples from the Griffin Island area were submitted for Atterberg Limit testing. Atterberg Limits were reported for 48 of the samples (44 environmental, 4 duplicates), as only samples with a significant amount of silt and clay could be tested (Table 5-5).

5.3.7.2 Grain Size Distribution

The quantitative sediment grain size distribution was determined for 136 samples from the Griffin Island area (127 environmental samples and 9 field duplicate samples - Appendix 5). These data are presented in Figure 5-4 in the form of cumulative bar plots showing the quantitative grain size distribution for each sample on a percent by weight basis; each plot presents a subset of samples grouped according to their primary sediment type, as determined by visual classification in the processing laboratory. Three samples visually classified as primarily organics for which there is no quantitative grain size equivalent, were primarily quantified as fine sand on a weight percent basis. The total number of samples with organics as the primary constituent accounted for less than 5% of the samples in the Griffin Island area.

Figure 5-4 shows a general correspondence between the primary visual classification and the quantitative grain size data. In all cases, except coarse sand, 35% or more of the sample dry weight was, on average, in the size range of the primary visual classification. As noted in Section 5.2.7.2, samples with the visual primary classification of silt tended to have a high fraction of fine sand on a weight percent basis (52% of samples visually classified as silt had a higher weight percent of fine sand than silt), while the opposite was not true (12% of fine sand samples had more silt than fine sand). Statistically, however, the visual classification of silt is

indicative of finer sediments with a higher fraction of silt than would be found in those visually classified as fine sand.[4] Samples visually characterized as coarse sand contained significant amounts of fine and medium sand and gravel. As suggested by USEPA, sample textures are described as finer (clay), fine (silt and fine sand), or coarse (medium sand, coarse sand, and gravel). However, the primary visual classification maintains value for the design of the remedy because it allows for discriminating between fine samples with higher silt contents (i.e., silt versus fine sand).

5.3.7.3 Moisture Content

A total of 2,476 samples from the Griffin Island area were analyzed for moisture content, including 2,348 environmental samples and 128 duplicates (Appendix 4).

5.3.7.4 Specific Gravity

A total of 136 samples from the Griffin Island area were analyzed for specific gravity of the granular sample material, including 127 environmental samples and nine duplicates (Table 5-5; Appendix 4).

5.3.7.5 Unified Soil Classification Scheme

Grain size analyses (Section 5.3.7.2) were used to determine the USCS classification for 127 environmental samples and 9 duplicates from the Griffin Island area (Appendix 4).

[4] Results of two-sample t-test with unequal variance on Griffin Island grain size analyses: mean weight percent silt in samples classified as silt = 37.2% (n = 56); mean weight percent silt in samples classified as fine sand = 17.2% (n = 41). Critical t value = 6.4; P-value = 4.6E-09. The results reject the null hypothesis that the mean weight percent of silt in samples visually classified as fine sand is the same as in those visually classified as silt; the results favor the alternative hypothesis that the mean weight percent of silt in samples visually classified as fine sand is less than the mean weight percent of silt in samples visually classified as silt.

5.4 NORTHUMBERLAND DAM

5.4.1 PCB Results

The 338 cores and 16 grab samples collected during 2002 and 2003 in the Northumberland Dam area produced 1,766 sediment samples that were analyzed for PCBs (1675 environmental samples plus 91 blind duplicates). PCBs were detected in 1370 of these samples at concentrations ranging from 0.02 to 3,900 mg/kg (Figure 5-5).

5.4.2 Bulk Density

In the Northumberland Dam area, 354 bulk density measurements were performed on grab samples and the top 2-in. samples from sediment cores with an additional 21 measurements performed on laboratory duplicates (Appendix 4). For subsurface core sections, bulk density was calculated for 1,321 samples (29 outliers) and 70 laboratory duplicates (no outliers; Section 8.2). Outliers were removed from the data set and replaced with average bulk densities values by primary and secondary sediment type. Calculated and measured bulk density values are presented in Appendix 4. A detailed discussion of the bulk density data is presented in a memorandum to USEPA submitted on October 21, 2003 (Appendix 5).

5.4.3 TOC in the Top 2-Inch Segment

The top 2-in. segment of each core was analyzed for TOC. A total of 375 samples from the Northumberland Dam area were analyzed for TOC, including 354 environmental samples and 21 duplicates (Appendix 4).

5.4.4 Cesium-137

Cesium-137 concentration was measured in the top 2-in. segment of each sediment core. A total of 334 top 2-in. segments from the Northumberland Dam area were analyzed; an additional 21 measurements were completed on laboratory duplicates (Appendix 4).

5.4.5 Dioxins/Furans

Four core segments from the Northumberland Dam area were analyzed for high-resolution dioxins/furans by USEPA Method 1613. These samples were from core segments immediately below the deepest segment in which Total PCBs were greater than 1 mg/kg. They were selected from cores located in potential dredge areas. Dioxins were detected in the four samples, furans were detected in three samples (Tables 5-1, 5-2).

5.4.6 RCRA Metals

The four samples analyzed for dioxins/furans were also analyzed for RCRA metals by USEPA Method 6010B and 7471A. Arsenic, barium, chromium, cadmium, and lead were detected in all the samples, mercury were detected in two samples, and silver was detected in one sample (Table 5-3). Selenium was not detected.

5.4.7 Geotechnical Parameters

5.4.7.1 Atterberg Limits

A total of 83 environmental samples and 5 duplicate samples from the Northumberland Dam area underwent Atterberg Limit testing. Atterberg Limits were reported for 30 of the samples (29 environmental; 1 duplicate), as only samples with a significant amount of silt and clay could be tested (Table 5-6).

5.4.7.2 Grain Size Distribution

The quantitative sediment grain size distribution was determined for 88 samples from the Northumberland Dam area (83 environmental samples and 5 field duplicate samples - Appendix 5). These data are presented in Figure 5-6 in the form of cumulative bar plots showing the quantitative grain size distribution for each sample on a percent by weight basis; each plot presents a subset of samples grouped according to their primary sediment type, as determined by visual classification in the processing laboratory. There were no samples with the primary visual classification of clay or gravel from the Northumberland Dam area. Three samples visually classified primarily as organics, for which there is no quantitative grain size equivalent, were primarily quantified as fine sand on a weight percent basis. The total number of samples with organics as the primary constituent accounted for only 9% of the samples in the Northumberland Dam.

Figure 5-6 shows a general correspondence between the primary visual classification and the quantitative grain size data. In all cases except coarse sand, greater than 35% of the sample dry weight was, on average, in the size range of the primary visual classification. The four samples visually characterized as coarse sand contained significant amounts of fine and medium sand and gravel. As noted in Section 5.2.7.2, samples with the visual primary classification of silt tended to have a high fraction of fine sand on a weight percent basis (43% of silt samples had a higher weight percent of fine sand than silt), while the opposite was not true (none of the fine sand samples had more silt than fine sand). Statistically, however, the visual classification of silt is indicative of finer sediments with a higher fraction of silt than would be found in those classified as fine sand.[5] Samples visually characterized as coarse sand contained significant amounts of fine and medium sand and gravel. As suggested by USEPA, sample textures are described as finer (clay), fine (silt and fine sand), or coarse (medium sand, coarse sand, and gravel). However, the primary visual classification maintains value for the design of the remedy

[5] Results of two-sample t-test with unequal variance on Northumberland Dam grains size analyses: mean weight percent silt in samples classified as silt = 39.4% (n = 40); mean weight percent silt in samples classified as fine sand = 13.0% (n = 24). Critical t value = 7.8; P-value = 9.0E-11. The results reject the null hypothesis that the mean weight percent of silt in samples visually classified as fine sand is the same as in those visually classified as silt; the results favor the alternative hypothesis that the mean weight percent of silt in samples visually classified as fine sand is less than the mean weight percent of silt in samples visually classified as silt.

because it allows for discriminating between fine samples with higher silt contents (i.e., silt versus fine sand).

5.4.7.3 Moisture Content

A total of 1,766 samples were analyzed for moisture content from the Northumberland Dam area, including 1,675 environmental samples and 91 duplicates (Appendix 4).

5.4.7.4 Specific Gravity

A total of 88 samples from the Northumberland Dam area were analyzed for specific gravity of the granular sample material, including 83 environmental samples and 5 duplicates (Table 5-6; Appendix 4).

5.4.7.5 Unified Soil Classification Scheme

Grain size analyses (Section 5.4.7.2) were used to determine the USCS classification for 83 environmental samples and 5 duplicates from the Northumberland Dam area (Appendix 4).

SECTION 6
RESULTS OF SIDE SCAN SONAR

6.1 NORTHERN TIP

Side scan sonar imaging was conducted in the Northern TIP Candidate Phase 1 Area in November 2002 (see Figure 4-1 and Appendix 6). In much of the Northern TIP, OSI noted a complex assemblage of sediments that, accordingly, were mapped as variable/transitional (Type IV) sediments. In the vicinity of Rogers Island, the Type IV areas tended to be dominated by coarser sediments with large areas of sands (Type II) and gravels (Type III) also encountered. South of Rogers Island, silty (Type I) sediments were encountered in shallow near-shore areas, and coarse Type IV sediments were predominant in the center of river until the bend near RM 191.5. Below RM 191.5, distinct areas of sands (Type II), gravels (Type III), and a large rocky area (Type V) were found in the center of the river, with Type I and IV areas found closer to shore. OSI identified numerous sonar targets in this area - predominantly rocks and fallen trees. Two NOAA-charted shipwrecks were mapped in this area near the southern tip of Rogers Island.

6.2 GRIFFIN ISLAND

Side scan sonar imaging was conducted in the Griffin Island Candidate Phase 1 Area in November 2002 (See Figure 4-1 and Appendix 6). On the east side of the island, sands, gravels, and rocky areas were predominant, with the exception of a large silty (Type I) area and a finer Type IV area near RM 190 (NYSDEC Hot Spot 14). In the backwater area on the west side of the island, highly aqueous sediments and prominent submerged aquatic vegetation (SAV) were present. Several distinct sonar targets (primarily rocks) were mapped in this area and two large regions of downed trees were mapped along the eastern shore of the island.

6.3 NORTHUMBERLAND DAM

Side scan sonar imaging was conducted in the Northumberland Dam Candidate Phase 1 Area in June 2003 (see Figure 4-1 and Appendix 6). Above the dam, rocky (Type V) and gravel (Type III) areas were mapped in the center of the river flanked by prominent fine (Type I) sediment areas along shore (NYSDEC Hot Spots 35 to the east and 34 to the west); dense SAV was encountered in the eastern Type I region, particularly in the backwater area just below the Route 4 Bridge. Above the small island to the north of the bridge, another large Type I sediment area (NYSDEC Hot Spot 33) was encountered extending from the channel to the eastern shore. A narrow region of coarser sands, gravels, and mixed sediments was found in the navigation channel; finer Type I sediments were mapped in the shallow areas along the western shore. OSI mapped numerous sonar targets in this region; of particular interest were the numerous navigation hazards posed by submerged relic cribs, many of which were previously charted by NOAA.

SECTION 7
DATA QUALITY

7.1 PE PROGRAM

The PE program is described in Section 3.5.1. The results of this program for the 2002 field season have previously been described (QEA 2003b). PE results from the beginning of the 2003 SSAP field season until September 18, 2003, which covers the date range of sampling for the Candidate Phase 1 Areas, are discussed here.

The PE results were monitored using control charts. These charts examine the PE results after they have been transformed to " Z-scores", as shown below:

$$Zi = \left(Xi - \overline{X}\right) / s \qquad (7\text{-}1)$$

where:

Zi is the Z-score (relative change in the standard deviation) for point i;

Xi is the PE concentration value of point i; and

$\overline{X}$ is the mean and s is the standard deviation of the PE control limit.

The mean (X) and standard deviation(s) in the above equation refer to the mean and standard deviation of the 2003 PE control limits, respectively. As indicated in Section 3.5.1, the 2003 PE control limits used the mean value for each PE established from the Inter-laboratory Comparison Study data set results and the variance from the 2002 SSAP PE data set results. The 2003 PE control limits remained static for the duration of the 2003 SSAP. The Western Electric rules (Minitab R12.2) were used in the control charting to identify an "out-of-control" condition. These rules were established as a process control check and they identify conditions that only have about 3 chances in 1000 of occurring if the laboratory result is from the population defined

by the pre-established mean and variance. Following these rules, an "out-of-control" condition is declared if any of the following occurs:

- any point outside of ± 3 standard deviations;
- 2 of last 3 points outside of ± 2 standard deviations, on the same side of the mean;
- 4 of last 5 points outside of ± 1 standard deviations, on the same side of the mean;
- 9 consecutive points with the same sign (on the same side of the mean);
- 6 points in a row all increasing or decreasing; and
- 14 points in a row alternating sign.

The control charts for the GEHR8082 Total PCB PE results indicate that all laboratories remained in control during the Candidate Phase 1 Areas sample collection dates (Figures 7-1 to 7-4). The results for the GEHR8082 PEs were generally within ± 2 standard deviations of the mean, demonstrating that the results are accurate and comparable. The GEHR680 homolog analysis Total PCB PE results showed good performance with the exception of PE1 (the low concentration Hudson River PE matrix), which was more than 3 standard deviations below the mean for 6 of 9 analyses during the Candidate Phase 1 Areas sample collection dates (Figure 7-5). An "out-of-control" condition was declared after the June 12, 2003 PE1 results were received and the GEHR680 analysis PE frequency was increased to Tier II requiring submission of 2 PEs a week if greater than 20 sample extracts were selected for analysis (Table 3-3).

Investigation into the cause of the low PE1 homolog results did not reveal any analytical errors. Rather, the investigation indicated that the PE sample was not stable and its PCB concentration declined over time. This conclusion is based on a statistical analysis conducted to determine whether the PE1 PCB concentration data exhibit a significant time trend. The analysis consisted of tests comparing the 2002 and 2003 results; specifically the Kolmogorov-Smirnov, Wilcoxon, and student's t-tests were used to test the significance of the difference between

means. The p-values determined from the three statistical tests are shown in Table 7-1. Significant differences (i.e., p-value <0.05) occurred for Aroclor 1221 (GEHR8082 analysis) and for dichlorobiphenyls (GEHR680 analysis). Since the 2003 GEHR680 extracts for PE1 originate from each of the four laboratories performing the GEHR8082 Aroclor extraction and analysis, it is unlikely that all four laboratories experienced analytical errors that caused the lower 2003 PE1 results. Thus, the GEHR680 2003 PE1 control limits determined from the 2002 PE results are not valid to monitor the analysis. GEHR680 homolog PCB results for samples associated with the "out-of-control" conditions were not qualified because of the apparent lability of the PE1 sample.

Subsequent to issuing the draft of this report, further evaluation of the GEHR680 LCS results has been conducted to understand if the low results for the GEHR680 PE1 samples may be related to the analytical procedure. The PCB homolog method included analysis of LCSs as a measure of accuracy. The LCS extracts originated from the Aroclor (GEHR8082) analysis laboratories in the same manner as the sample extracts. The LCS consisted of Aroclor 1242 at a concentration of 1.25 mg/Kg, a very similar concentration to that of PE1 (2003 GEHR8082 control limit mean concentration of 1.43 mg/Kg Total PCBs as Aroclors). A total of 83 LCS analyses were performed for PCB homologs by GEHR680 with 88% of the LCSs meeting acceptance criteria (60 – 140% recovery). The GEHR680 LCS recoveries in the second half of 2003 are lower than existed earlier in the SSAP. This finding suggests that the decline in GEHR680 PE1 results may be partially due to a decay of laboratory accuracy at low PCB concentrations, although the GEHR8082 data independently show a degradation of PE1 concentration as discussed above.

The statistical analysis also indicated a statistically significant decline in Aroclor 1221 (GEHR8082 analysis) for PE3. This is consistent with the finding that the first set of GEHR8082 Total PCB results for PE3 (June 18, 2003) reported by each laboratory were only slightly above the Total PCB lower control limit. Therefore, PE3 extracts were not used for the GEHR680 homolog PCB analysis. For the same reason, the use of PE3 for the GEHR8082 Aroclor PCB analysis was terminated after the August 20, 2003 collection date, even though the results were within control limits.

7.2 VALIDATION/VERIFICATION

Electronic data verification and data validation were conducted as described in Section 3.5.2.4 after samples were collected and analyzed to provide an understanding of the analytical data quality. During the 2002 SSAP, analytical database queries were used to associate the samples that required validation for PCB analysis by GEHR8082 and GEHR680 based on the results of PE sample analysis as defined in the QAPP. As previously indicated, USEPA approved decoupling manual validation of PCB data from the PE results for the 2003 SSAP. During the 2003 SSAP, 6% of the environmental samples for PCBs were manually validated. The samples were selected on an SDG basis spread out evenly among the labs and throughout the sampling program duration. Validation of other analytical results was as described in the QAPP. The number of Candidate Phase 1 Area samples validated for each method is presented in Section 3.5.2.4. Additionally, Appendix 7 provides a listing of each Candidate Phase 1 Area sample that was validated for each method and laboratory. Appendix 8 provides copies of the 29 data validation reports prepared for each group of 2003 sample data that was validated that contain Candidate Phase 1 Area samples. The 45 data validation reports for samples collected during the 2002 SSAP have been previously submitted with the Year 1 DSR (QEA et al. 2003). These reports provide the specific details of the data qualification resulting from the validation process.

Validation qualifier codes were placed next to the results in the GE analytical database so that data users can quickly assess the qualitative and/or quantitative reliability of any result. The analytical database was then used to generate tabulated reports (data tables) of the validation results and qualifier codes. The final validated results for each data set are presented as data tables in each data validation report included in Appendix 8.

The same qualifier codes were used for both the data verification and validation processes. The qualifier codes and definitions used for the data were as follows:

- "Null" - No qualifier code. The compound was detected and should be considered quantitatively and qualitatively valid based on the QC reviewed.

- U - The compound/analyte was analyzed for, but was not detected above the reported sample quantitation/detection limit.

- U* - This compound/analyte should be considered "not detected" since it was detected in a blank at a similar level.

- J - Quantitation is approximate (estimated) due to limitations identified during the quality assurance review (data validation or verification).

- J3 – Quantitation is approximate (estimated) due to the value falling between the MDL and the RL.

- N - The analysis indicates that there is presumptive evidence to make a "tentative identification" of this compound/analyte.

- JN - Quantitation is approximate (estimated) due to limitations identified during the quality assurance review (data validation or verification) and the analysis indicates that there is presumptive evidence to make a "tentative identification" of this compound/analyte.

- R - Unusable (rejected) result – compound/analyte may or may not be present in this sample.

- UR - Unusable "not-detected" result; compound may or may not be present in this sample.

- UJ - This compound/analyte was not detected, but the quantitation/detection limit is probably higher than reported due to a low bias identified during the quality assurance review.

- EMPC - Estimated Maximum Possible Concentration (dioxin/dibenzofurans only); chromatographic peaks are present in the expected retention time window, but the peaks

do not meet all of the conditions required for a positive identification. The reported result represents the estimated maximum possible concentration if the dioxin or dibenzofuran was present.

- RSA - Original bulk density result an outlier or missing and has been replaced with the statistical average for the sediment texture type (QEA 2003c). This qualifier is only used for bulk density.

The validation qualifier code field of the GE analytical database was queried to provide a tabulation of the number of results for each analysis fraction that was valid as reported [(unqualified results and non-detected results, U and estimated maximum possible concentrations, EMPCs, for dioxins/furans only)] and that was qualified with each qualifier code identified above. The percent usable and unusable data and the percent completeness was calculated for each analysis fraction according to the following equations:

% Usable Data	=	Unqualified Positive Results + #U + #U* + #J +#JN + #UJ [+ #EMPC for Dioxins/Dibenzofurans]/Total Number of Results
% Unusable Data	=	#R + #UR/Total Number of Results
% Completeness	=	Valid Data as Reported [Unqualified Positive Results + #U + #EMPC for Dioxins/Dibenzofurans]/Total Number of Results

The percent completeness calculation does not include results qualified as estimated values ("J") due to being below the sample specific reporting limit but above the MDL. These results are not included in the completeness calculation because they are estimated values due to a standard USEPA analytical data reporting convention.

A summary of the data quality for the individual analytical fractions is presented in the following sections. The data quality has been described based on the percent completeness and percent usable results as follows:

Qualitative Data Quality (QDQ)	% Completeness	% Usable
Excellent	≥95%	100%
Very good	≥85%	≥95%
Good	≥75%	≥90%
Above average	≥65%	≥85%
Average	≥45%	≥80%
Poor	<45%	<80%

The percent completeness goal stated in the QAPP is 95%. The above Qualitative Data Quality (QDQ) index was based on professional judgment and experience. It was developed to provide a qualitative framework to discuss the data quality. Although the description of data quality has been based on criteria for both the percent completeness and percent usable data calculations, the percent usable data calculation is a more critical reflection of the data quality than the percent completeness calculation. Percent completeness reflects the percentage of the data that satisfied all of the data quality objectives (DQOs) (i.e., the percentage of unqualified data), whereas percent usability reflects the percentage of the data that has some qualitative and/or quantitative use, which is inclusive of the data which satisfied all of the DQOs. The results of the percent completeness calculation do not indicate the nature of the qualification of the "incomplete" data. The data which are usable but qualitatively or quantitatively qualified (i.e., the difference between the percent usable data and the percent completeness) may have no impact on the end use of the data, depending on what decisions need to be made based on that data. In other words, data that have low percent completeness may still be "100% complete" for decision-making purposes.

The following example calculations are provided by referring to the % completeness, % unusable, and % usable data presented on Table 7-2 for PCBs as Aroclors (GEHR8082) and following the explanations in Notes 5, 6, and 7:

1. % Completeness is the sum of results that were valid as reported [Unqualified Positive Results + U + EMPC for Dioxins/Dibenzofurans]/[Total Number of Results - J3]. Ex. 76.2% = ((10,939 + 36,280)/(63,904 - 1,934))* 100.
2. % Unusable Data is the sum of the results qualified R + UR/Total Number of Results. Ex. 0.03% = ((0 + 170)/63,904)*100.

3. % Usable Data is the sum of the Unqualified Positive Results + U + U* + J + J3 + JN + UJ [+ EMPC for Dioxins/Dibenzofurans]/Total Number of Results. Ex. 99.7% = ((10,939 + 36,280 + 457 + 6,560 + 1,934 + 1 + 9,497)/63,904)*100.

Instances where sample delivery problems occurred or samples arrived broken at the laboratory were identified to the sample processing personnel. Samples that were broken upon receipt at the laboratory were resubmitted from the archive storage freezer for analysis. Sample RS1-9089-WT0202-002024 that is within the Candidate Phase 1 Areas could not be analyzed for Atterberg Limits, as the sample was not amendable to this analysis. This is the only sample analysis that has been identified as not being performed.

The overall data quality for the sediment sample data is above average, and the vast majority of the results are usable (Table 7-2). The percent usable data, percent unusable data and percent completeness for the entire sediment data set are 99.7%, 0.34% and 74.2%, respectively.

7.2.1 Data Verification and Validation Results for PCBs as Aroclor by GEHR8082

The data quality for the sediment sample PCBs as Aroclors analyzed by GEHR8082 is good (Table 7-3). The percent usable data, percent unusable data, and percent completeness for the entire PCBs as Aroclors data set are 99.7%, 0.3%, and 76.2%, respectively. The percent usable data, percent unusable data, and percent completeness range narrowly for the individual Aroclors from 99.6% to 99.9%, 0.1% to 0.4%, and 72.6% to 77.3%, respectively (Table 7-3). The data quality for each individual Aroclor is good, with the exception of Aroclor 1221. The Aroclor 1221 data quality is ranked above average rather than good due the slightly lower percent completeness of 72.6% relative to the other Aroclors. The lower percent completeness for Aroclor 1221 was primarily caused by the number of results qualified due to blank contamination (qualifier code "U*"). The percent usable Aroclor 1221 data is very high at 99.9%.

The PCBs as Aroclors (GEHR8082) data quality generated by the individual laboratories was very good for Lab 16; good for Labs 1, 6, and 14; and above average for Labs 4 and 15 (Table 7-4). The Lab 15 percent completeness was low primarily due to the number of samples (approximately 680) that were qualified as estimated (qualifier code "J" or "UJ") because of low percent solids (<50%) in the sediment samples. This resulted in approximately 3,279 results qualified "UJ" and approximately 2,161 results qualified as "J". Lab 15 was the only laboratory that analyzed the uppermost core section samples (0-2 in. section), which had the highest proportion of samples with low percent solids. The percent usable data for the individual laboratories was very high, ranging from 99% to 100%. The only data qualified as unusable were 8 non-detect results (1 sample) from Lab 4 and 162 non-detect results (31 samples) from Lab 14 that were qualified as "UR" due to very low surrogate recoveries (< 10%).

The data verification module used to verify the PCB analysis data tracks the reason(s) sample results are qualified for the individual assessment measures (i.e., holding times). The GE database was queried to determine why those data were qualified, but results from manual validation are not tracked in the GE analytical database. Thus, the validation reports were also evaluated manually. This combined assessment indicated that the electronic data verification process identifies the primary quality control measures that resulted in qualification of data, as listed below in decreasing frequency:

- Low percent solids – Sediment samples that had less than 50% solids resulted in qualification of positive results and detection limits as estimated, "J" and "UJ", respectively, in accordance with USEPA Region 2 validation criteria. Positive results and detection limits are reported on a dry-weight basis for the sediment samples to reflect the solids content of the samples. However, GE complied with the USEPA Region 2 guidance to qualify the sediment sample results with less than 50% solids. Approximately, 20.5% of the sample results were qualified "J" or "UJ" from low percent solids.

- Surrogate recoveries outside of acceptance criteria – Sediment sample results associated with low surrogate recoveries (less than the lower control limit of 60% but above 10%)

resulted in qualification of positive results and detection limits as estimated, "J" and "UJ"; respectively. Sediment sample results associated with high surrogate recoveries (greater than the upper control limit of 140%) resulted in qualification of positive results as estimated ("J"). These two surrogate recovery situations, which occurred the most, resulted in qualification of approximately 2.8% of the samples results. The majority (1.9%) were qualified as "UJ" from low surrogate recovery. Sediment sample results associated with very low recoveries (<10%) resulted in qualification of positive results as estimated ("J") and detection limits as unusable ("UR") respectively. This qualification occurred for less than 0.3% of the sample results. Samples analyzed at a dilution factor of greater than or equal to five (≥5) are not evaluated for surrogate recovery since the surrogate compounds are diluted out of the sample. The percentage of Candidate Phase 1 Area samples analyzed for PCBs as Aroclors (GEHR8082) with a dilution factor greater than or equal to five (≥5) ranged from 18 – 27 % for the laboratories with the exception of Lab 15, which was 52%. Lab 15 analyzed all 0-2 in. depth samples, which tended to detect PCBs more frequently than other sample depths and therefore a higher percentage of Lab 15 samples were analyzed at dilutions. The labs complied with the approved analytical SOPs in that only one of two surrogates had to be in criteria (USEPA Method 8082 only requires the use of one surrogate). If both surrogates were out of criteria (60-140%), correction action was to be taken as described in the SOPs. One surrogate outside of criteria still may result in qualification of sample data.

- Blank contamination – Qualification of sample results resulting from blank contamination was limited to contamination that originated in field blanks. Positive sample results that exhibited PCB concentrations similar to that in the field blanks were qualified as "not-detected" and flagged "U*". Qualification due to blank contamination occurred for approximately 0.7% of the sample results and was limited to primarily Aroclor 1221 and Total PCBs. Qualification due to field blank contamination occurred with results from each laboratory with the exception of Labs 4 and 16. However, the highest frequency of blank qualification occurred at Lab 6. A more detailed discussion on field blank results is presented in Section 7.4.

- Field duplicate precision – Positive results or detection limits were qualified as estimated "J" or "UJ"; respectively, for the original and field duplicate sediment samples that did not meet the project field duplicate precision criteria. Qualification from field duplicate precision occurred for less than 0.4% of the sample results. A more detailed discussion on field duplicate results is presented in Section 7.3.

- Calibration bias – Select trace concentration level (generally less than 0.1 mg/kg) Aroclor positive results were qualified as estimated ("J") during validation (not verification) where a low bias was exhibited in the bottom of the initial calibration curve used for sample quantitation. The GE analytical database does not quantitatively track reasons for qualification arising from validation (as it does for verification), but it is estimated that approximately less than 0.1 % of the samples results were qualified due to this issue.

- Aroclor 1221 continuing calibration verification standards – as reported to USEPA by GE (GE 2003), Lab 15 identified an entry error for the Aroclor 1221 stock standard calibration concentration in the gas chromatograph (GC) data system software processing method used for three of four GC instruments used to analyze sediment samples associated with the 2002 SSAP. This entry error resulted in incorrect Aroclor 1221 initial calibration curves being used for sample data in 61 SDGs. Lab 15 corrected the Aroclor 1221 results for the impacted SDGs by entering the correct stock calibration standard concentration into the data system software processing method and generating new Aroclor 1221 calibration curves. The sample analysis results were reprocessed and quantitated using the updated Aroclor 1221 initial calibration curve. Additionally, Aroclor 1221 continuing calibration verification (CCV) standards were reprocessed using the updated initial calibration curve to determine if calibration stability was maintained. As a result of this error, the reported concentrations for Aroclor 1221 for the impacted samples were biased low by a factor of 14.6%. This bias in the Aroclor 1221 result also affects the result reported for Total PCBs. This error only impacted Aroclor 1221 (and therefore Total PCBs) for approximately 1220 samples (61 SDGs x 20 samples/SDG). The data were corrected and an updated copy of the database transmitted to USEPA on July 11, 2003. Evaluation and assessment of the data has been based on the corrected data.

- Five CCV standards exceeded the 15% difference (D) continuing calibration criterion after reprocessing. The positive sample results for Aroclor 1221 analyzed between a failing (%D>15%) Aroclor 1221 CCV standard and the preceding or subsequent compliant Aroclor 1221 CCV were qualified as estimated "J". The GE analytical database does not quantitatively track reasons for qualification arising from validation (as it does for verification), but it is estimated that approximately less than 0.1% of the samples results were qualified due to this issue.

As the above list indicates, qualification of data as estimated ("J" or "UJ") occurred primarily from the low percent solids and surrogate recoveries that were outside of criteria. The percent solids of the samples cannot be controlled. Likewise, surrogate recoveries that are outside of criteria are typically due to sample matrix interferences exhibited in complex environmental matrices such as river sediment. Additionally, approximately 3.0% of the data were qualified as estimated "J" due to the standard USEPA analytical data reporting convention of qualifying data as estimated that fall between the reporting limit and the MDL.

7.2.2 Data Verification and Validation Results for PCB Homologs by GEHR680

The data quality for Candidate Phase 1 Areas PCBs homologs analyzed by SOP GEHR680 is average (Table 7-5). The percent usable data, percent unusable data, and percent completeness for the entire PCBs homologs data set are 99.0%, 1.0%, and 60.5%, respectively. The percent usable data, percent unusable data, and percent completeness for the individual homologs range from 97.3% to 100.0%, 0.0% to 2.7%, and 58.4% to 66.6%, respectively (Table 7-5). The data quality for each individual homolog is average except hexachlorobiphenyl, which is above average.

The queries of the GE database revealed that qualification of the PCBs homolog sample results was limited to the following reasons listed in decreasing frequency:

- Low percent solids (as discussed in Section 7.2.1) – Approximately 31.0% of the sample results were qualified "J" or "UJ" from low percent solids.

- Surrogate recoveries outside of acceptance criteria (as discussed in Section 7.2.1) – Surrogate recoveries outside of acceptance criteria resulted in qualification of approximately 7.0% of the samples results with the majority having the qualification "J" (5.5%). Low surrogate recoveries resulted in qualification of detection limits as "UJ" in 1.5% of the sample results. Very low surrogate recoveries resulted in qualification of data as unusable ("UR") in 1.0% of the sample results.

- LCS recoveries outside of acceptance criteria – Low LCS recoveries outside of acceptance criteria (60-140%R) resulted in qualification of approximately 1.3% or the sample results as "J" or detection limits as "UJ".

- Field duplicate precision (as discussed in Section 6.2.1) – Qualification from field duplicate precision occurred for 0.6% of the sample results.

- Holding time – Positive results or detection limits were qualified as estimated "J" or "UJ", respectively, when an extraction or analysis holding time was exceeded. Qualification due to the extract injection analysis holding time from the date of extraction being exceeded occurred in two samples or approximately 0.4% of the sample results

- Blank contamination (as discussed in Section 6.2.1) – Qualification as "U*" due to field blank contamination occurred for less than 0.1% of the sample results and was limited to monochlorobiphenyl.

Similar to the PCB Aroclor data, qualification of the PCB homolog data as estimated ("J" or "UJ") occurred primarily from low percent solids and surrogate recoveries that were outside of criteria. The percent solids of the samples cannot be controlled. Likewise, surrogate recoveries that are outside of criteria were typically the result of sample matrix interferences exhibited in complex environmental matrices, such as river sediment. Additionally, approximately 13% of the data were qualified as estimated "J" due to the standard USEPA

analytical data reporting convention of qualifying data as estimated that fall between the reporting limit and the MDL.

7.2.3 Data Verification and Validation Results for Other Parameters

As shown in Table 7-2, the data quality for dioxins/dibenzofurans is good. The percent usable data, percent unusable data, and percent completeness for the dioxins/dibenzofurans data set are 100.0%, 0.0%, and 84.5%, respectively. The queries of the GE database revealed that dioxin/dibenzofurans sample results were qualified for the following reasons listed in decreasing frequency (note that the percents do not add up to the percentage qualified because some data may have been qualified for more than one reason):

- Low percent solids (as discussed in Section 7.2.1) – Approximately, 12.5% of the dioxins/dibenzofurans sample results were qualified "J" or "UJ" due to low percent solids.

- Blank contamination (as discussed in Section 7.2.1) – Qualification as "U*" due to field blank or method blank contamination occurred for 5.2% of the dioxins/dibenzofurans sample results.

- Holding time – Positive results or detection limits were qualified as estimated "J" or "UJ", respectively, when an extraction or analysis holding time was exceeded. Qualification due to an extraction or analysis holding time being exceeded occurred in one sample or approximately 4.3% of the sample results

Qualification of dioxins/dibenzofurans data as estimated ("J" or "UJ") occurred primarily due to the low percent solids. The percent solids of the samples cannot be controlled. Additionally, approximately 7.7% of the dioxins/dibenzofurans data were qualified as estimated "J" due to the standard USEPA analytical data reporting convention of qualifying data that fall between the reporting limit and the MDL as estimated.

The data quality for TOC is poor (Table 7-2). The percent usable data, percent unusable data, and percent completeness for the TOC data set are 100.0%, 0.0%, and 38.9%, respectively. The queries of the GE database revealed that TOC sample results were qualified for the following reasons listed in decreasing frequency (note that the percents do not add up to the percentage qualified because some data may have been qualified for more than one reason):

- Low percent solids (as discussed in Section 7.2.1) – Approximately 31.4% of the TOC sample results were qualified "J" or "UJ" due to low percent solids.

- Matrix spike recoveries outside of acceptance criteria – Sediment sample results associated with matrix spike recoveries outside of acceptance criteria (75-125%) resulted in qualification of positive results as estimated ("J") of approximately 23% of the TOC samples results.

- Laboratory replicate precision – Sediment sample results associated with original and laboratory replicate sediment samples that did not meet the project laboratory replicate precision criteria resulted in qualification of positive results as estimated ("J") of approximately 18.6% of the TOC samples results.

- Blank contamination (as discussed in Section 7.2.1) – Qualification as "U*" due to field blank contamination occurred for 4.0% of the TOC sample results.

- Field duplicate precision (as discussed in Section 7.2.1) – Qualification of positive results as estimated ("J") due to field duplicate imprecision occurred for approximately 2.6% of the TOC sample results.

All the TOC data are usable, but approximately 57% was qualified as estimated ("J") due to matrix issues (matrix issues include all items in the above bullet list except blank contamination). Qualification of TOC data as estimated ("J" or "UJ") occurred primarily due to the low percent solids, matrix spike recoveries outside of criteria, and laboratory replicate imprecision. The percent solids of the samples cannot be controlled and the majority of the TOC

samples are from 0-2 in. core segments where the percent solids are generally lower than other segments. Likewise, matrix spike recoveries and laboratory replicate precision that are outside of criteria are typically due to sample matrix interferences exhibited in complex environmental matrices such as river sediment. The small sample size (10 to 50 mg) used for the TOC analysis also contributes to the observed matrix problems.

The data quality for RCRA metals by SW-846 Method 6010B is very good (Table 7-2). The percent usable data, percent unusable data, and percent completeness for the RCRA metals by SW-846 Method 6010B data set are 100.0%, 0.0%, and 91.4%, respectively. The queries of the GE database revealed that RCRA metals sample results were qualified for the following reasons listed in decreasing frequency:

- Low percent solids (as discussed in Section 7.2.1) – Approximately 8.3% of the RCRA metals by SW-846 Method 6010B sample results were qualified "J" or "UJ" due to low percent solids.

Qualification of RCRA metals by SW-846 Method 6010B data as estimated ("J" or "UJ") occurred primarily due to the low percent solids. The percent solids of the samples cannot be controlled. Additionally, approximately 10.1% of the RCRA metals by SW-846 Method 6010B data were qualified as estimated "J" due to the standard USEPA analytical data reporting convention of qualifying data as estimated that fall between the reporting limit and the MDL.

The data quality for mercury is good (Table 7-2). The percent usable data, percent unusable data, and percent completeness for the mercury data set are 100.0%, 0.0%, and 75.0%, respectively. The queries of the GE database revealed that mercury sample results were qualified for the following reasons listed in decreasing frequency:

- Blank contamination – Qualification of sample results resulting due to blank contamination was limited to contamination that originated in method blanks. Positive sample results that exhibited mercury concentrations similar to that in the method blanks

were qualified as "not-detected" and flagged "U*". Qualification due to method contamination occurred for 12.5% of the sample results.

- Low percent solids (as discussed in Section 7.2.1) – Approximately, 8.3% of the mercury sample results were qualified "J" from low percent solids.

Qualification of mercury data occurred primarily from method blank contamination.

7.3 FIELD DUPLICATES

Field duplicates were submitted to the project laboratories for analysis by GEHR8082 and GEHR680 and Methods 6010B, 7471A, 1613, and 160.3, and gamma spectroscopy. Field duplicates were prepared in the field laboratory at the rate of 5% of the total number of environmental samples.

The precision criteria for field duplicate pairs are presented in the QAPP (ESI and QEA 2002). For field duplicate pairs where both results were greater than or equal to five-times the reporting limit, the precision criterion is that the relative percent difference (%RPD) between the results should be less than or equal to 40%. For field duplicate pairs where at least one of the results was less than five-times the reporting limit (including when one result was a not-detect), the precision criterion is that the difference between the results should be less than or equal to two-times the reporting limit. A value of ½ the reporting limit was used for not-detected results in the difference calculation. If the analyte is not detected in the sample or the field duplicate sample, the RPD is not calculated and a quantitative evaluation is not made since neither sample had a positive result.

7.3.1 Field Duplicate Results for PCBs as Aroclors by GEHR8082

A total of 420 field duplicate pairs among all the SSAP laboratories were analyzed by GEHR8082; a high percentage (92%) of the results met the field duplicate precision criteria (Table 7-6). For the individual analytes, the overall percentage of results that met the field duplicate precision criteria ranged from 75% to 100%. All results (100%) for Aroclors 1016, 1232, 1248, and 1260 met the field duplicate precision criteria, in that these Aroclors were not detected in any of the field duplicate pairs. The percentage of results that met field duplicate criteria decreased with decreasing chlorination for the Aroclors with positive results (Aroclors 1254, 1242, and 1221). This trend is probably directly related to the general trend of increasing concentration with decreasing chlorination.

Each SSAP laboratory performing analysis by GEHR8082 analyzed a portion of the field duplicate pairs:

- Lab 1 – 65 duplicate pairs;
- Lab 4 – 7 duplicate pairs;
- Lab 6 - 112 duplicate pairs;
- Lab 14 - 111 duplicate pairs;
- Lab 15 - 111 duplicate pairs; and
- Lab 16 - 14 duplicate pairs.

The overall percentages of results that met field duplicate precision criteria for each individual laboratory were similar, ranging from 90% to 94%; however, some variance in the percentage of field duplicate pairs with positive results that met criteria was observed among the laboratories. The percentage of field duplicate pairs with positive results in either sample that met the field duplicate precision criteria was 76% for all laboratories. A higher percentage of

field duplicate pairs with positive results in either sample that met the field duplicate precision criteria were observed for Lab 15 (86%). For Labs 1, 6, 14, and 16 the percentages of field duplicate pairs with positive results in either sample that met the field duplicate precision criteria were close to the average (67-74%). None (0%) of the field duplicate pairs with positive results in either sample met field duplicate precision criteria for Lab 4; however, only samples with not detected results were reported for Lab 4. The Year 1 DSR, Section 6.1.1, explains why positive results for Lab 4 are excluded from use and replaced with re-analyses performed by Lab 15. For individual analytes, the only exception to these laboratory trends was for Aroclor 1254. A wide variance in the percentage of field duplicate pairs with positive results in either sample that met the field duplicate precision criteria was observed among the laboratories for Aroclor 1254 (0-100%). The wide variance is generally related to the low occurrence of positive results for Aroclor 1254 in the field duplicate pairs (the overall percentage of Aroclor 1254 results that met criteria ranged from 71% to 100%). Inconsistencies in Aroclor 1254 results will not impact the estimation of Tri+ PCBs, as Aroclor 1254 is summed with Aroclor 1242 in the Tri+ PCB regression model.

7.3.2 Field Duplicate Results for PCB Homologs by GEHR680

Lab 15 performed all GEHR680 PCB homolog analyses for the SSAP; however, the field duplicate extracts originated from the laboratories performing the Aroclor PCB analyses. A total of 26 field duplicate pairs were analyzed by SOP GEHR680 and 90% of the results met the field duplicate precision criteria (Table 7-7). For the individual analytes, the percentage of results that met the field duplicate precision criteria ranged from 73% to 100%. The percentage of results that met field duplicate criteria generally decreased with the decreasing chlorination of each analyte (Table 7-7). This trend is probably directly related to the general trend of increasing concentration with decreasing chlorination.

7.3.3 Field Duplicate Results for Other Parameters

A total of 132 field duplicate pairs were analyzed for TOC by Lloyd Kahn Method and 58% of the results met the field duplicate precision criteria (Table 7-8). Positive results for TOC were observed for all field duplicate pairs. The low percentage of results meeting criteria is probably due to the fact that TOC was only analyzed in samples collected from the top 2-in. of sediment and that the analysis uses only a small amount of sample (1.0 - 50 mg).

Only one field duplicate pair was analyzed for RCRA metals by SW-846 Method 6010B and 7471A and for dioxin/furans by USEPA Method 1613 (Table 7-8). Good precision was demonstrated by the results of this field duplicate pair in that 100% of the metals results and 96% of the dioxin/furan results met the field duplicate precision criteria.

Very good precision was demonstrated by the field duplicate pair results for Cesium-137 and bulk density (Table 7-8). A total of 97 field duplicate pairs were analyzed for Cesium-137 by gamma spectroscopy and 99% of the results met the field duplicate precision criteria. A total of 98 field duplicate pairs were analyzed for bulk density by ASTM Method D4531-8 and 100% of the results met the field duplicate precision criteria. In addition, bulk density was calculated for a total of 322 field duplicate pairs and 100% of the results met criteria (Table 7-8).

A total of 425 field duplicate pairs among all the SSAP laboratories were analyzed for percent moisture by Method 160.3; a very high percentage (98%) of the results met the field duplicate precision criteria (Table 7-9). The overall percentages of results that met field duplicate precision criteria for each individual laboratory were similar, ranging from 93% to 100%. Each SSAP laboratory performing analysis by Method 160.3 analyzed the following portion of the field duplicate pairs:

- Lab 1 – 64 duplicate pairs;
- Lab 4 – 7 duplicate pairs;
- Lab 6 - 112 duplicate pairs;

- Lab 14 - 111 duplicate pairs;
- Lab 15 - 117 duplicate pairs; and
- Lab 16 - 14 duplicate pairs.

7.4 FIELD BLANKS

Field blanks were prepared by each of the five sample collection crews in a designated location (concrete slab near the shoreline) at the staging area by filling Lexan® or aluminum tubing with approximately 2 ft. of clean play sand at the end of each workday. The core tubes used in field blank preparation were stored on each sampling vessel in the same container as the rest of the core tubes used for core collection. As the field blank was filled with sand, distilled water was added to keep it moist during processing. The field blanks were then capped and transferred to the processing laboratory with the rest of the cores collected that day. In the laboratory, the field blanks were processed using the same procedures and equipment that was used for the rest of cores – they were cut into segments (approximately 4 in. long), homogenized, and spooned into 4 oz. jars.

At the end of the day, each SDG (batches of 20 environmental samples), accompanied by one field blank and other QA/QC samples was sent to one of the six analytical laboratories. Unlike sediment samples, field blanks were not archived for possible future analysis.

7.4.1 Field Blank PCB Contamination

A total of 583 field blanks were analyzed for PCBs by GEHR8082 in association with Candidate Phase 1 Areas sediment samples. Aroclors were detected at concentrations greater than the MDL in 14 percent (83 out of 583) of the field blanks analyzed (Table 7-10). The Total PCBs concentration in the 83 field blanks ranged from 0.010 to 16 ppm with the average and median concentration being 0.342 ppm and 0.041 ppm, respectively. The majority (80 field

blanks) had Total PCB concentrations that were less than 1 ppm ranging from 0.010 to 0.83 ppm with the average and median concentration being 0.086 ppm and 0.042 ppm, respectively (Table 7-10).

In general, the field blank results collected in association with the Candidate Phase 1 Areas improved between 2002 and 2003. Lab 4 and Lab 16 did not detect positive results for Total PCBs in field blanks analyzed in association with Candidate Phase 1 Areas samples collected during the 2002 SSAP. The percentage of field blanks that were contaminated with Total PCBs decreased from 2002 to 2003 for the remaining labs, with the exception of Lab 15 (Table 7-10). The average and median Total PCB concentration for field blanks with results greater than the MDL decreased for each lab from 2002 to 2003 with the exception of Lab 6 and Lab 15. The 2003 average and median Total PCB concentration of 6.4 ppm and 3.2 ppm, respectively, for the Lab 6 field blanks with positive results is driven by the two highest concentrations reported for field blanks associated with Candidate Phase 1 Areas (16 and 3.2 ppm). Although the Lab 15 percent of field blanks contaminated with Total PCBs increased from 14% in 2002 to 27% in 2003, the average Total PCB concentration decreased from 2002 (0.098 ppm) to 2003 (0.047 ppm) while the median concentration remained similar (0.300 ppm in 2002 compared to 0.040 ppm in 2003).

A detailed assessment of the potential sources of PCB contamination was conducted for the 2002 SSAP field blank data in the Year 1 DSR (QEA et al. 2003). The two general sources of field blank contamination that were evaluated included contamination of the samples in the field or during processing with residual sediment on equipment and/or personal protective equipment (PPE) and analytical error or contamination introduced in the analytical laboratories during sample preparation and/or analysis. This detailed evaluation concluded that the potential for introduction of PCBs into field blanks during collection and processing was low and that the typically low-level field blank contamination is most influenced by variability in the analytical laboratories during sample preparation and/or analysis (QEA et al. 2003). The potential for detectable PCBs at low concentrations in the field blanks is probably due to the high number of samples that have positive results being handled at the laboratories. Qualification of PCB

sediment sample results for the Candidate Phase 1 Areas from blank contamination ("U*" in Table 7-3) was low ranging from 0.16% (Lab 14) to 2.2% (Lab 6).

A review of the database reveals that very few samples within Candidate Phase 1 Areas had a concentration above 1 mg/kg "U*" that impedes verification that the bottom of a core section is clean and the core complete. The specific samples and cores effected, and resolution of this issue is relevant to discussion between GE and USEPA on the Dredge Area Delineation Report.

7.5 USEPA SPLIT SAMPLES

GE received data from USEPA on April 2, 2004 from 61 of the split samples collected from Candidate Phase 1 and Phase 2 Areas. In accordance with the QAPP, these samples were compared to the Method 680 results on the same samples analyzed by GE. The median relative percent difference of the Total PCBs and Tri+ PCB was calculated for each River Section. The precision goal for these split sample results is 25% (median) within each River Section and within 75% on an individual basis. In River Section 2, individual RPD ranged from approximately 21% to 129% for Total PCBs and 0.4 to 122% for Tri+ PCBs. In River Section 3, individual RPD ranged from 0 to 162% for Total PCBs and 0.6 to 139.5% for Tri+PCBs. Of the five samples from River Section 2, two had individual RPDs greater than 75% for Total and Tri+PCBs, with an additional sample greater than 75% for Tri+PCBs. The median RPD for Total and Tri+PCBs in River Section 2 were greater than 25%. In River Section 3, 11 of the 56 Total PCBs samples and 9 of the 53 Tri+PCBs samples had individual RPDs greater than 75%. The median RPD for Total PCB was 26.8% and 22.6% for Tri+PCBs in River Section 3 (Table 7-11).

SECTION 8
DATA ASSESSMENT FOR MPA

The dataset collected during the sediment sampling program will be used to define the extent of the dredging areas in the Hudson River. The delineation of the dredging areas requires the estimation of the Tri+ PCB MPA at each of the locations that were targeted for core sampling. Uncertainties exist regarding the accuracy of, and ability to calculate, MPA. These uncertainties are associated with bulk density measurements, potential data gaps due to abandoned core sampling locations, and the existence of a significant number of incomplete cores (defined in Section 4.1).

8.1 CALCULATED DRY BULK DENSITY

The dataset collected during the 2002 and 2003 sediment sampling programs will be used to define the areal extent and the depth of dredging in the Candidate Phase 1 Areas. Delineation of these dredging areas requires the calculation of Tri+ PCB MPA at each core location. Because it is used in the calculation of MPA, the accuracy of calculated dry bulk density impacts the accuracy of Tri+ PCB MPA. Uncertainties are inherent to the procedure used to calculate dry bulk density.

Dry bulk density was directly measured in grab samples and in the top 2-in. segment of each sediment core; as for the remaining sections, dry bulk density values were calculated from data obtained during core processing. The relevant data generated during core processing include the weight of the wet sediment obtained from a core section and the container in which it is weighed, the core section length, and the tare weight of the container. The wet sediment weight is obtained by subtracting from the sample weight the tare weight and the tubing weight (which is calculated from the section length measured in the processing lab and a calculated average for the tubing weight per unit length). The wet volume of the sediment sample is computed using the section length and the estimated inner radius of the tubing (based on manufacturer specifications). The ratio of wet sediment weight and the wet volume is the wet

bulk density. Dry bulk density is calculated from wet bulk density using the moisture content of the sediment as measured by the analytical laboratories conducting the PCB measurements.

The accuracy and precision of calculated dry bulk density values depend on the accuracy and precision of the measured moisture content and the calculated wet bulk density of the sediment. In response to USEPA comments on the 2002 DSR, GE issued a technical memorandum dated October 21, 2003, that presented a method of employing logical and statistical tests to identify outliers or spurious values of moisture content, wet bulk density, and dry bulk density (QEA 2003d). First, moisture content values were reviewed to ensure that reported values: 1) fell between physical limits (i.e., 0 – 100%) during data verification; and 2) were absent of statistical outliers. Wet bulk density values were then reviewed to determine: 1) outliers based on the range of values that might reasonably be observed in different sediments; and 2) statistical outliers. Wet density values were rejected as "unreasonable" if the calculated value was greater than or equal to 2.5 g/cm^3, a value approaching that of mineral solids, or if the calculated value was less than or equal to 1.0 g/cm^3 for all samples other than those containing a primary or secondary component of silt or organics. The upper limit (2.5 g/cm^3) is representative of the wet density of shale, which is significantly denser than that of saturated soils (typical wet densities less than 2.3 g/cm^3). The lower limit (1.0 g/cm^3) represents the density of water. In samples containing silt and/or organics, lower wet density values are plausible due to a higher organic carbon content and the evolution of gas from microbial decomposition. Dry bulk density measurements were flagged as outliers if the associated moisture content or wet density were judged to be outliers. The remaining dry bulk density values were then subjected to the statistical outlier testing to identify any remaining statistical outliers (see Appendix 5 for details).

This same method was applied to all available data from the 2002 and 2003 sediment sampling programs contained in the November 13, 2003 QEA Export (i.e., not just Candidate Phase 1 Areas) to determine moisture content, wet bulk density, and dry bulk density outliers in the Candidate Phase 1 Areas. This approach resulted in the removal of 168 of 6,603 calculated dry bulk density values in the three Candidate Phase 1 Areas (see Sections 5.2.2, 5.3.2, and 5.4.2 for outliers identified in Northern TIP, Griffin Island, and Northumberland Dam, respectively;

see Appendix 5). Outliers were removed from the Candidate Phase 1 Areas data set and replaced with the average dry bulk density of the remaining core sections based on primary and secondary sediment type (calculated from all available data in the 2002 and 2003 sediment sampling programs). In addition, average values of dry bulk density were also assigned to those core sections that lack the necessary data to calculate dry bulk density (e.g., moisture content and wet sediment weight). Because dry bulk density is calculated for or assigned to every core section, data gaps in the Tri+ PCB MPA calculation due to unknown dry bulk density are eliminated.

The bulk density data set, after outlier identification and replacement, contains a wide range of values, reflecting the varied nature of the Hudson River sediments. Values at the lower end of the range (i.e., those less than 0.5 g/cm^3) typically are found in sediments with higher organic matter content as documented in an October 21, 2003 technical memorandum to USEPA (Appendix 5). This fact is further illustrated in Figure 8-1 which presents the relationship between bulk density and TOC as observed in Hudson River subsurface sediments collected in 1998 and 1999 and Figure 8-2 which presents the same relationship for subsurface samples collected in 2003 and 2004 in the Lower Grasse River. In both data sets, bulk densities less than 0.5 g/cm^3 are commonly observed for sediments with TOC greater than 3%. This finding is supported by a compilation of bulk densities from numerous water bodies which yielded a relationship between bulk density and TOC that crossed below a value of 0.5 g/cm^3 at a TOC of 3.4% (Avnimelech et al. 2001). The SSAP calculated bulk densities lack paired TOC measurements to make a direct demonstration that the lower values are associated with sediments of higher TOC. However, such correspondence is inferred by the concurrence of the lower values and relatively high TOC in the surface sediments of the matched core. Figures 8-3a to 8-3c present side by side comparisons of measured TOC (top 2-in. segment) and calculated bulk density values (in the core segment just below 2 in.) in three areas of the Hudson River where clusters of sediments with bulk densities less than 0.5 g/cm^3 are observed: 1) near RM 193 - a shallow, vegetated backwater area adjacent to a wetland; 2) on the west side of Griffin Island - a backwater area that is routinely choked with SAV; and 3) on the southeast side of the Route 4 Bridge at Northumberland Dam - a densely vegetated backwater area. In these areas of silty Type I sediment, low bulk densities are associated with high (>5%) organic carbon contents. Outside of these areas – particularly in coarser sediments – bulk densities greater than

0.5 g/cm^3 predominate. These results support the usability of the bulk density data. Further evidence of the common occurrence of relatively low bulk densities can be found in data from the Fox River remedial investigation where more than 50% of the samples had densities less than 0.5 g/cc (RETEC and NRT 2002).

Finally, USEPA has noted that the bulk density calculation is sensitive to measurement errors of sample moisture content, weight, and volume. In some cases, slight measurement errors may result in paired bulk density and moisture contents that yield unrealistic particle density estimates. While spurious, these results do not warrant further outlier testing as variation of moisture content within the level of analytical method precision can swing the estimate in or out of the reasonable particle density range. Only gross measurement errors of sample weight can significantly impact the MPA calculations; such errors are unlikely as the current outlier tests constrain calculated bulk densities to reasonable values.

8.2 ABANDONED LOCATIONS

Abandoned sampling locations constitute apparent data gaps that could potentially limit the accuracy of the dredge area delineation in or adjacent to areas that exceed the MPA criteria of the ROD. However, side scan sonar based interpretation of sediment type and local probing data exist for these locations and provide a basis to assess whether the absence of sediment PCB data is significant. In general, abandoned locations tend to be in rocky areas with little or no sediment or areas with coarse sediment that are not likely to be targeted for dredging. A significant number of sampling locations were abandoned in 2002; however, after reviewing the 2002 data, locations at which sample collection were believed to be feasible and which constitute a significant data gap were targeted for re-sampling in 2003. Nearly all these locations were successfully sampled in 2003. Improvements in sampling techniques, and the elimination of attempting sample collection in areas that were identified as being gravelly or rocky by the side scan sonar survey resulted in fewer abandoned locations in 2003 (Section 4.1.3). As a result, the percentage of sampling locations that were abandoned decreased approximately 4% between the 2002 and Candidate Phase 1 Areas data sets.

8.3 INCOMPLETE CORES

Accurately delineating the vertical extent of PCB contamination is dependent upon limiting the number of incomplete cores. As documented in the 2002 DSR (QEA et al. 2003), cores that contain Total PCB concentrations greater than 1 mg/kg in the bottom core segment are defined as incomplete. As incomplete cores do not fully capture the PCB inventory, the Tri+ PCB MPA cannot be calculated directly for these cores. However, Tri+ PCB MPA can be estimated reasonably at a large number of the incomplete core locations by extrapolating the Tri+ PCB concentration and averaging the bulk density from values calculated in the sampled sections. The additional depth to be included in the Tri+ PCB MPA calculation is the maximum of the probing or penetration depth recorded in the field.

At locations where MPA exceeds the dredging criteria solely as a result of extrapolation, resampling may be warranted. A subset of incomplete cores collected in 2002 were selected for resampling in 2003 after preliminary data evaluation indicated that reliable extrapolations could not be performed and significant data gaps occurred as a result. Further explanation and validation of the extrapolation method will be provided in the forthcoming Phase 1 Dredge Area Delineation Report.

SECTION 9
SUMMARY

The objective of the SSAP was to provide sediment data for the design of the remedy set forth in the ROD (USEPA 2002). The program consisted of sediment coring and geophysical mapping of the sediment bed. The collected sediments were analyzed for PCBs and other physical and chemical properties. These data will be used to delineate the locations (areal extent and depth) of sediment to be removed and to provide measurements of chemical and physical properties of the sediment that are important for the design of the remedy. Additionally, the data are being reviewed to determine whether cultural resources may be present in or near the sediment to be removed.

Sampling in the Candidate Phase 1 Areas was performed on a priority basis in an effort to provide data for these areas as early in the program as possible. SSAP field operations were initiated on October 2, 2002. Sediment sampling for PCB analysis continued until October 31, 2002 in anticipation of the seasonal closure of the Champlain Canal by the New York State Canal Corporation and deteriorating weather conditions. Geophysical survey operations continued until November 25, 2002 in areas of the river that could be reached without relying on passage through the canal locks. Field operations resumed on May 19, 2003. Sample collection in the Candidate Phase 1 Areas was completed on September 18, 2003.

Data from the Candidate Phase 1 Areas collected in 2002 and 2003 will be used to develop the Phase 1 Dredge Area Delineation Report. This report will define the proposed dredge areas in each of the three Candidate Phase 1 Areas. Additionally, a Target Area Identification Report will be prepared which identifies the best Candidate Phase 1 Area in which to conduct the first phase of dredging.

SECTION 10
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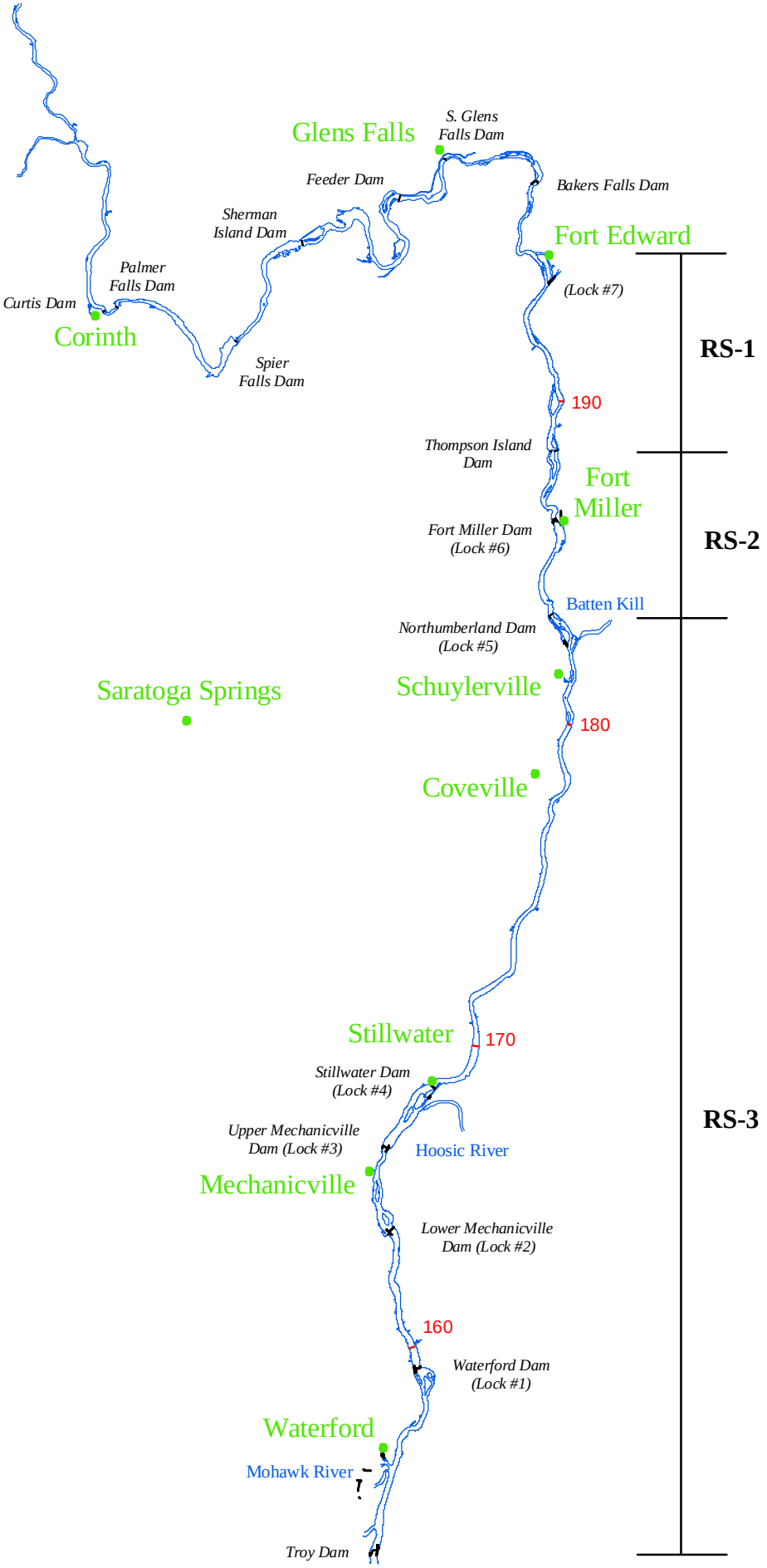
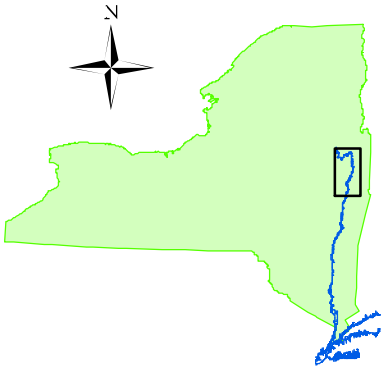
FIGURES

Quantitative Environmental Analysis, LLC



LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 2 4 Miles

LEGEND

- Cities and Towns
- Dams and Locks
- River Miles
- Shore Line

General Electric Company
Hudson River Project

Figure 1-1. River sections as defined by USEPA.

Note:
1. River Miles measured from the Battery (0.0).
2. RS = River Section.

Quantitative Environmental Analysis, LLC

GENrem September 2004

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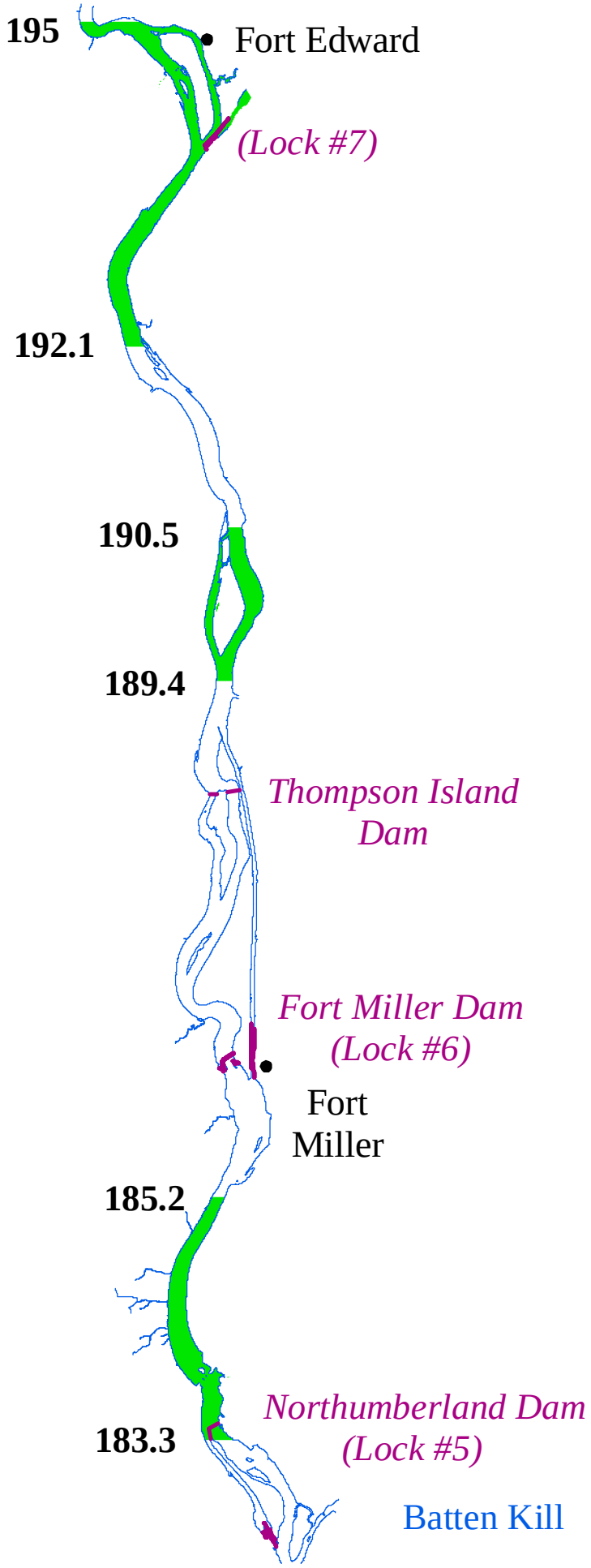
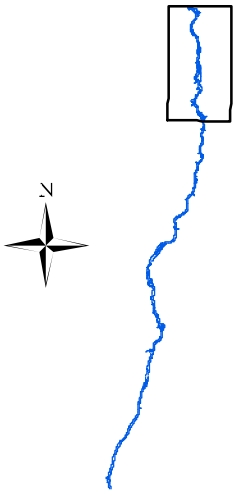


LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 0.5 1 Miles

LEGEND

- Cities and Towns
- Dams and Locks
- Shore Line
- Candidate Phase 1 Areas

General Electric Company
Hudson River Project

Figure 2-1. Candidate Phase 1 Areas.

Note: Numbers shown to the left of the Hudson River represent River Mile boundaries for the Candidate Phase 1 Areas.

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September 2004

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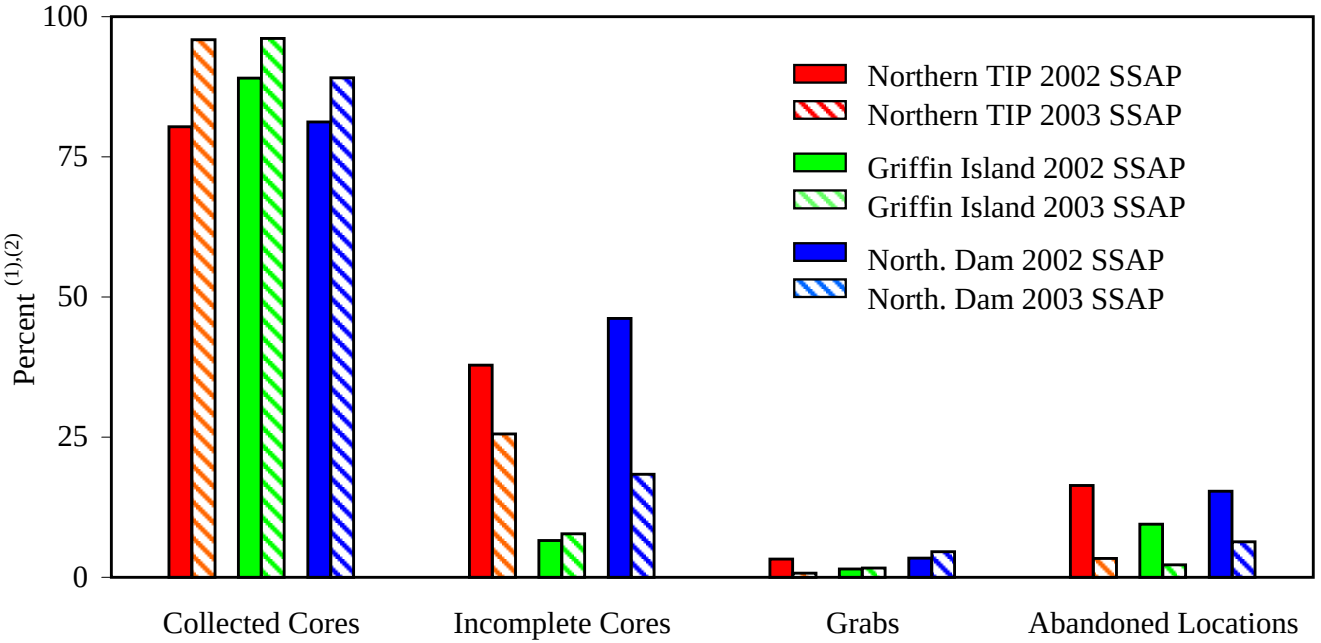
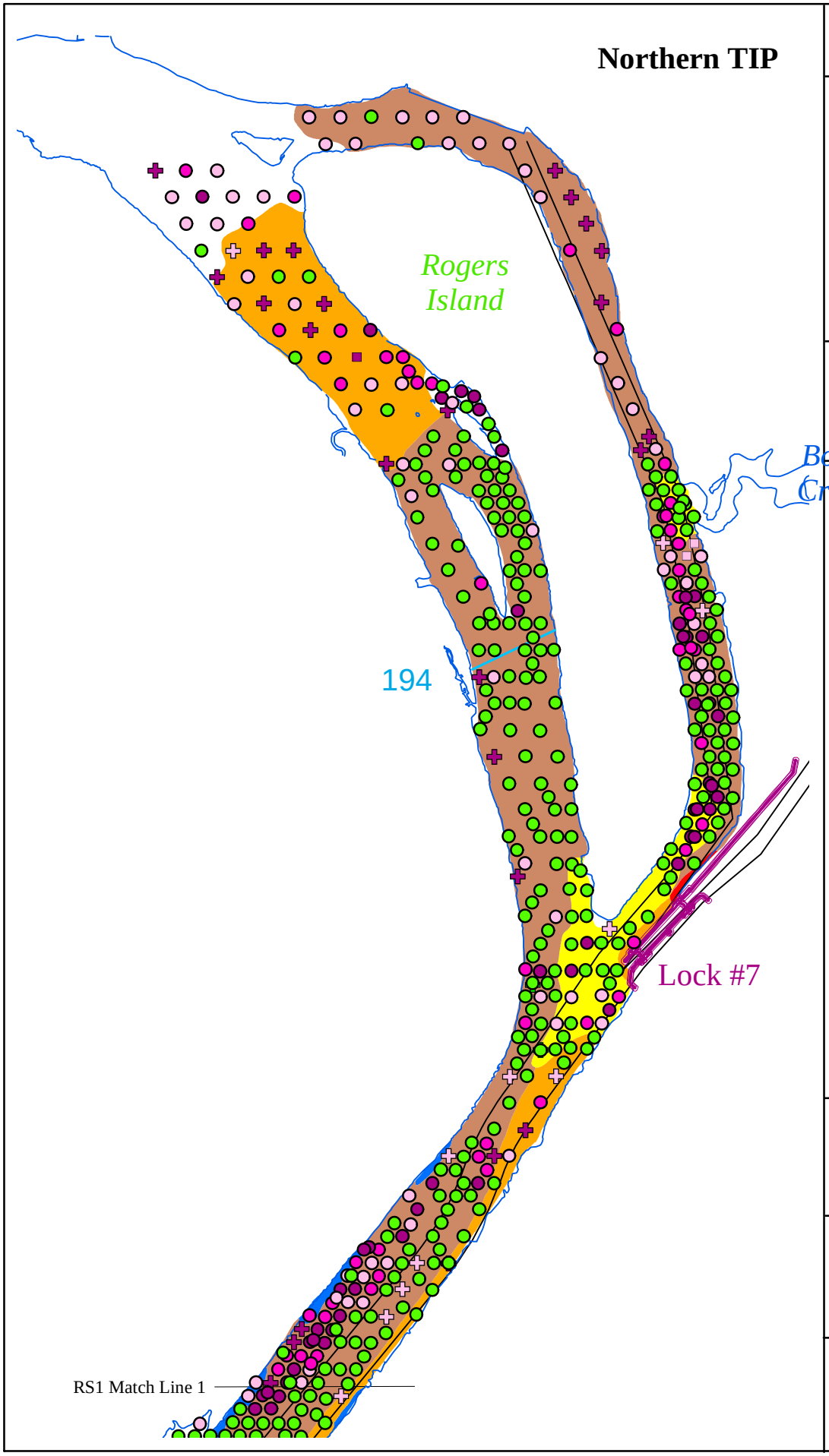


Figure 4-1. Summary of field sampling activities in the Candidate Phase 1 Areas in 2002 and 2003.

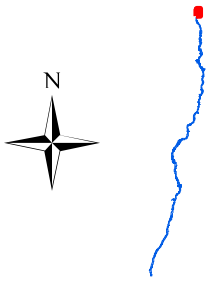
Notes:

(1) Collected cores, grabs, and abandoned locations are summarized in % of targeted accessible locations.

(2) Incomplete cores are summarized as a percentage of collected cores.
Data export from November 13, 2003 used in analysis.



LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 250 500 Feet

LEGEND

Core Classification

- Complete (<=1ppm)
- Incomplete (1-10 ppm)
- Incomplete (10-100 ppm)
- Incomplete (>100 ppm)

Grab Classification

- Grabs (<=1ppm)
- Grabs (1-10 ppm)
- Grabs (>10 ppm)

Likelihood of Re-sampling Abandoned Location

- Likely
- Some
- None

Sediment Types

- Fine grained / silty
- Sandy
- Gravel / Cobbles
- Variable / Transitional
- Rocky
- Dams and Locks
- River miles
- Shoreline
- Navigational Channel
- Match Lines

Notes:

1. *Values in parentheses represent bottom section Total PCB concentration.*
2. *Data collected in 2002 and 2003 SSAP were used in the analysis.*
3. *Core classification based on 12/09/03 data export.*

General Electric Company
Hudson River SSAP

Figure 4-2a. Classification of targeted locations.

QEA Quantitative Environmental Analysis, LLC

GENrem September 2004

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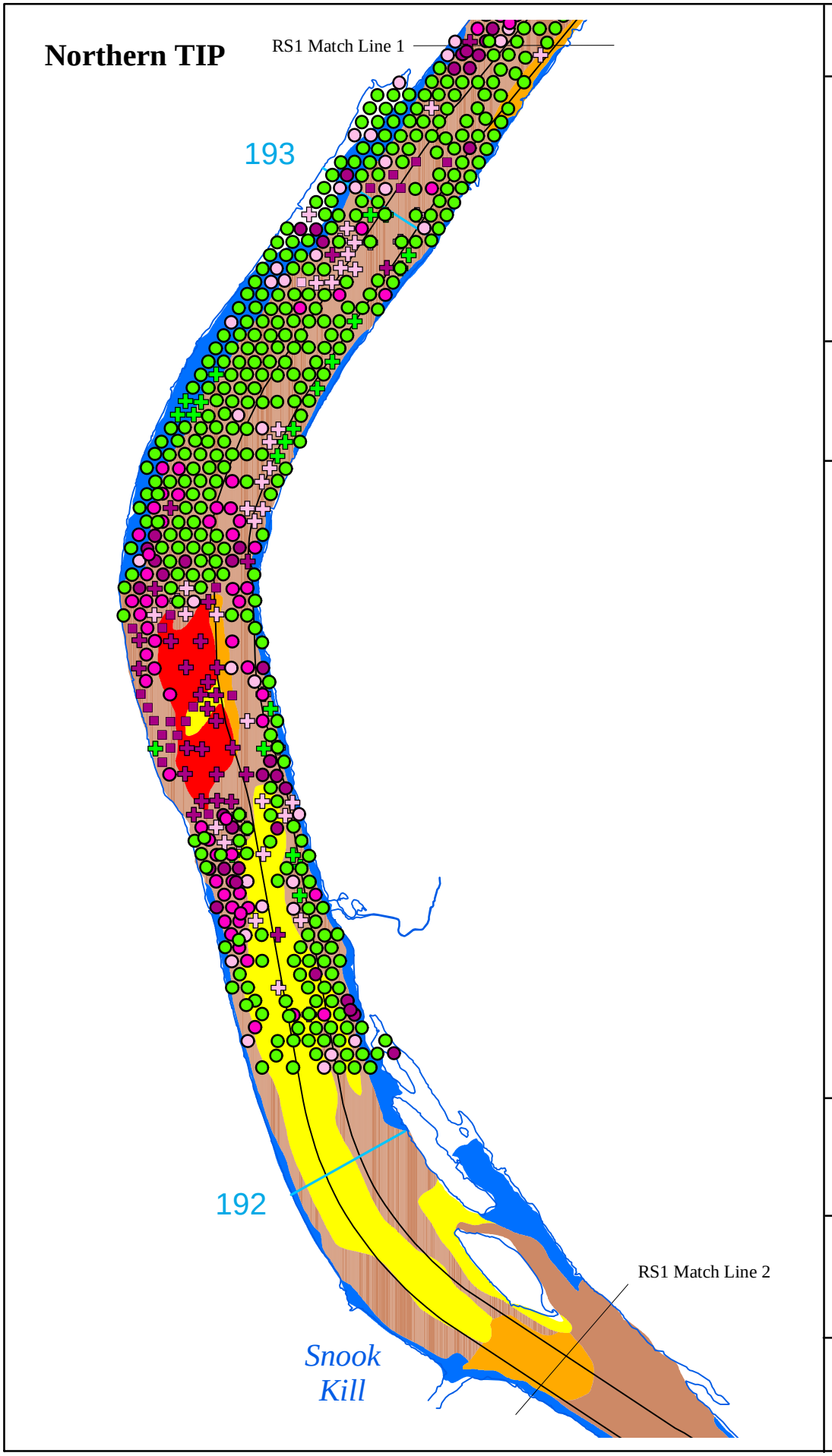
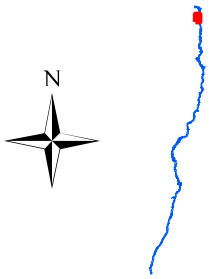


LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 250 500 Feet

LEGEND

Core Classification

- Complete (<=1ppm)
- Incomplete (1-10 ppm)
- Incomplete (10-100 ppm)
- Incomplete (>100 ppm)

Grab Classification

- Grabs (<=1ppm)
- Grabs (1-10 ppm)
- Grabs (>10 ppm)

Likelihood of Re-sampling Abandoned Location

- Likely
- Some
- None

Sediment Types

- Fine grained / silty
- Sandy
- Gravel / Cobbles
- Variable / Transitional
- Rocky
- Dams and Locks
- River miles
- Shoreline
- Navigational Channel
- Match Lines

Notes:

1. *Values in parentheses represent bottom section Total PCB concentration.*
2. *Data collected in 2002 and 2003 SSAP were used in the analysis.*
3. *Core classification based on 12/09/03 data export.*

General Electric Company
Hudson River SSAP

Figure 4-2b. Classification of targeted locations.

QEA Quantitative Environmental Analysis, LLC

GENrem September 2004

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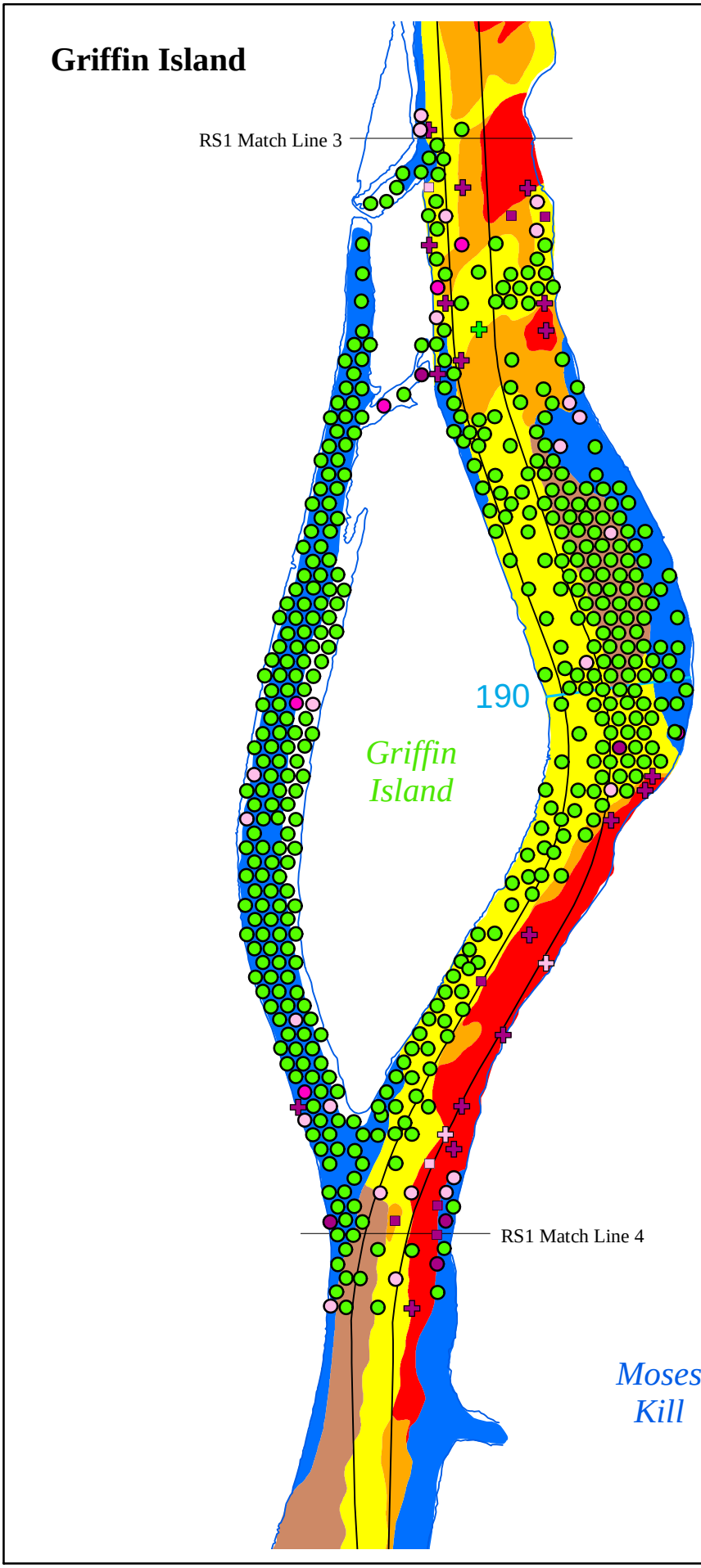
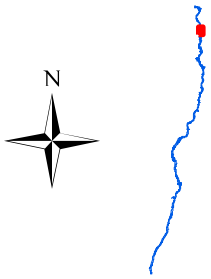


LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 250 500 Feet

LEGEND

Core Classification

- Complete (<=1ppm)
- Incomplete (1-10 ppm)
- Incomplete (10-100 ppm)
- Incomplete (>100 ppm)

Grab Classification

- Grabs (<=1ppm)
- Grabs (1-10 ppm)
- Grabs (>10 ppm)

Likelihood of Re-sampling Abandoned Location

- Likely
- Some
- None

Sediment Types

- Fine grained / silty
- Sandy
- Gravel / Cobbles
- Variable / Transitional
- Rocky
- Dams and Locks
- River miles
- Shoreline
- Navigational Channel
- Match Lines

Notes:

1. *Values in parentheses represent bottom section Total PCB concentration.*
2. *Data collected in 2002 and 2003 SSAP were used in the analysis.*
3. *Core classification based on 12/09/03 data export.*

General Electric Company
Hudson River SSAP

Figure 4-2c. Classification of targeted locations.

QEA Quantitative Environmental Analysis, LLC

GENrem Septemer 2004

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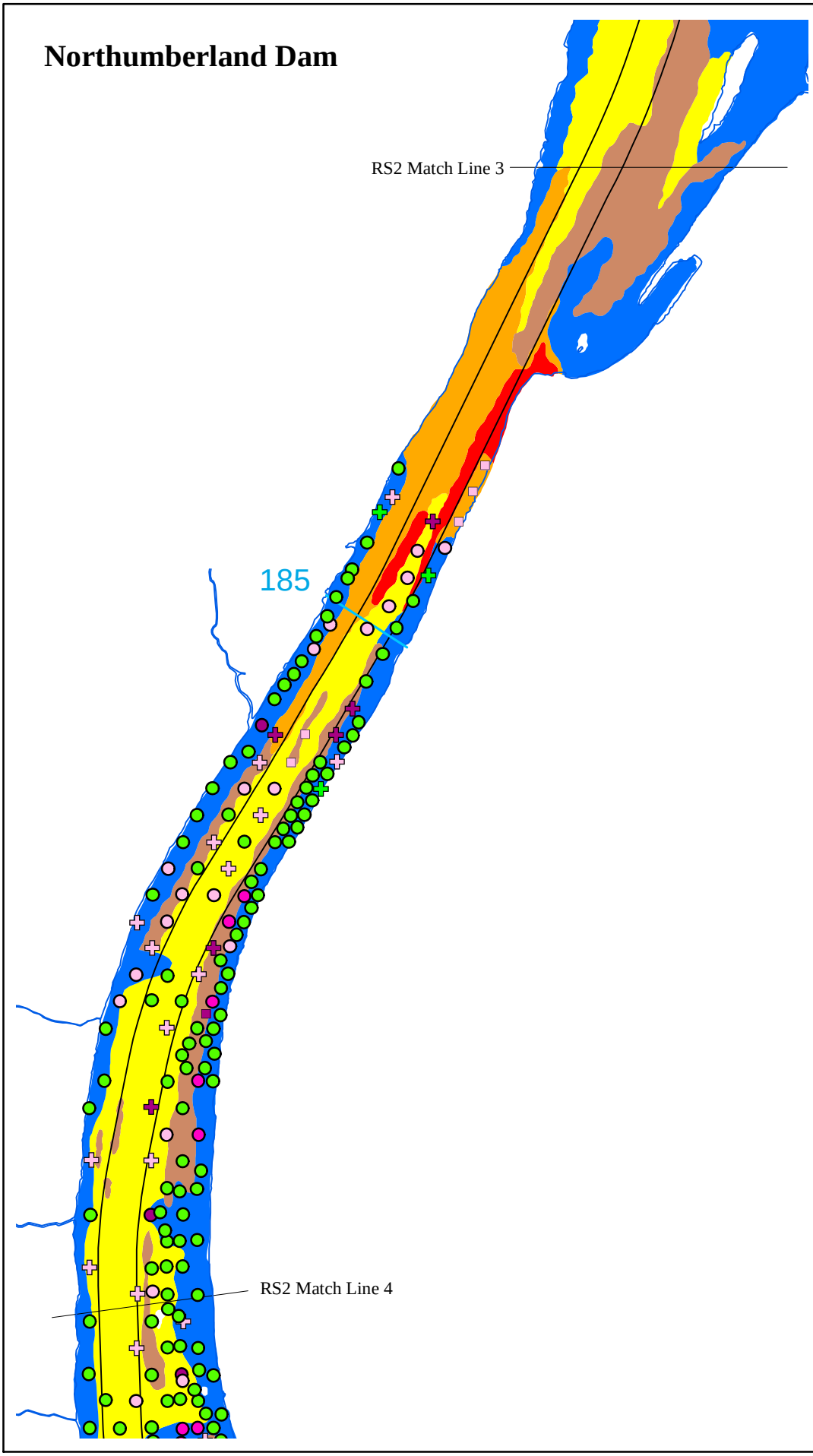
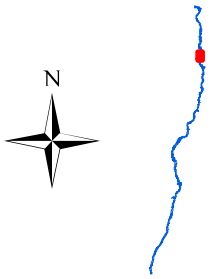


LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 250 500 Feet

LEGEND

Core Classification

- Complete (<=1ppm)
- Incomplete (1-10 ppm)
- Incomplete (10-100 ppm)
- Incomplete (>100 ppm)

Grab Classification

- Grabs (<=1ppm)
- Grabs (1-10 ppm)
- Grabs (>10 ppm)

Likelihood of Re-sampling Abandoned Location

- Likely
- Some
- None

Sediment Types

- Fine grained / silty
- Sandy
- Gravel / Cobbles
- Variable / Transitional
- Rocky
- Dams and Locks
- River miles
- Shoreline
- Navigational Channel
- Match Lines

Notes:

1. *Values in parentheses represent bottom section Total PCB concentration.*
2. *Data collected in 2002 and 2003 SSAP were used in the analysis.*
3. *Core classification based on 12/09/03 data export.*

General Electric Company
Hudson River SSAP

Figure 4-2d. Classification of targeted locations.

QEA Quantitative Environmental Analysis, LLC

GENrem September 2004

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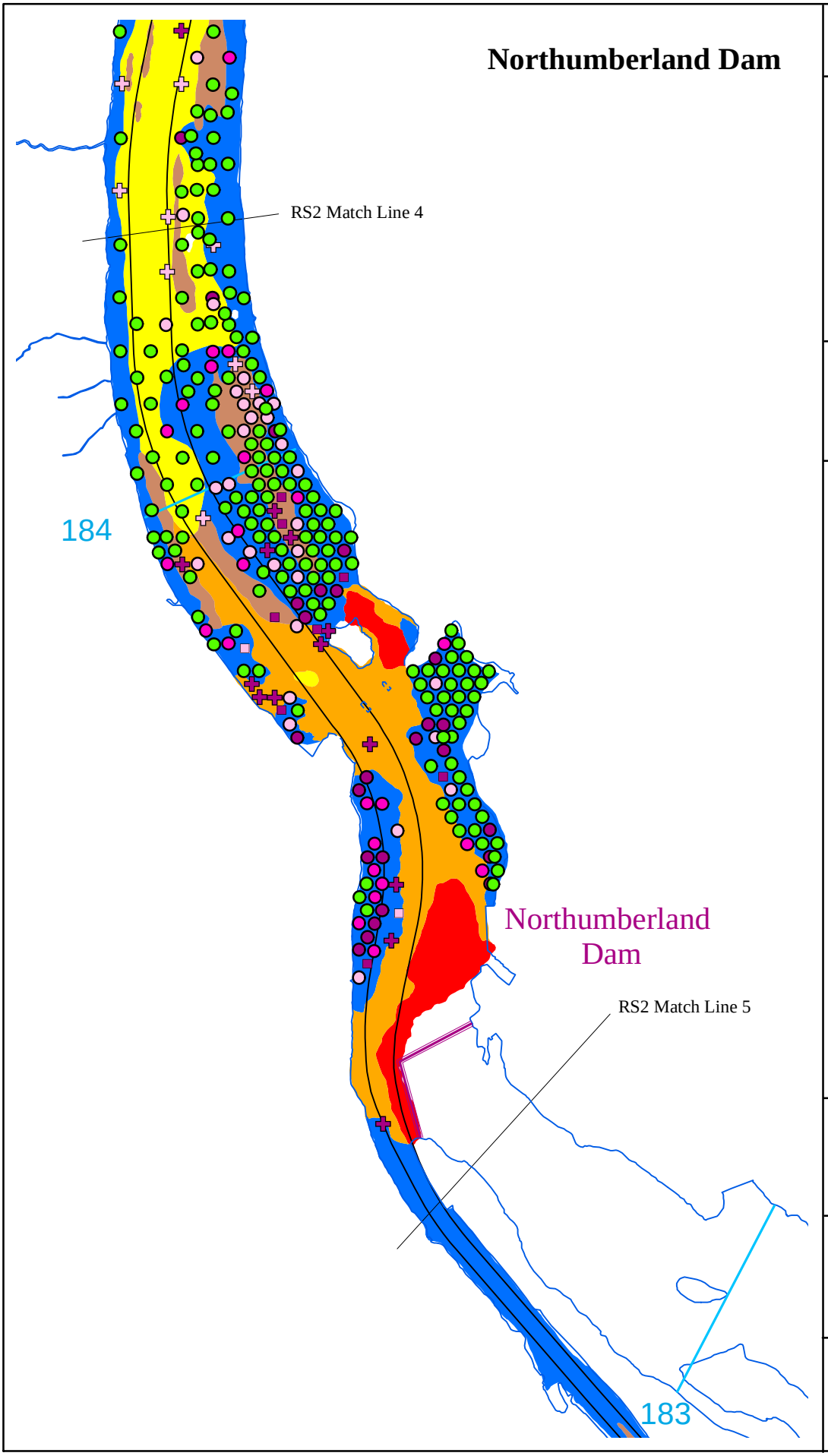
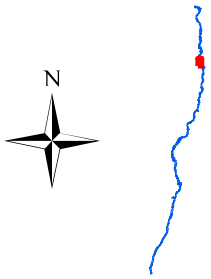


LOCATOR MAP OF THE UPPER HUDSON RIVER



GRAPHIC SCALE

0 250 500 Feet

LEGEND

Core Classification

- Complete (<=1ppm)
- Incomplete (1-10 ppm)
- Incomplete (10-100 ppm)
- Incomplete (>100 ppm)

Grab Classification

- Grabs (<=1ppm)
- Grabs (1-10 ppm)
- Grabs (>10 ppm)

Likelihood of Re-sampling Abandoned Location

- Likely
- Some
- None

Sediment Types

- Fine grained / silty
- Sandy
- Gravel / Cobbles
- Variable / Transitional
- Rocky
- Dams and Locks
- River miles
- Shoreline
- Navigational Channel
- Match Lines

Notes:

1. *Values in parentheses represent bottom section Total PCB concentration.*
2. *Data collected in 2002 and 2003 SSAP were used in the analysis.*
3. *Core classification based on 12/09/03 data export.*

General Electric Company
Hudson River SSAP

Figure 4-2e. Classification of targeted locations.

QEA Quantitative Environmental Analysis, LLC

GENrem September 2004

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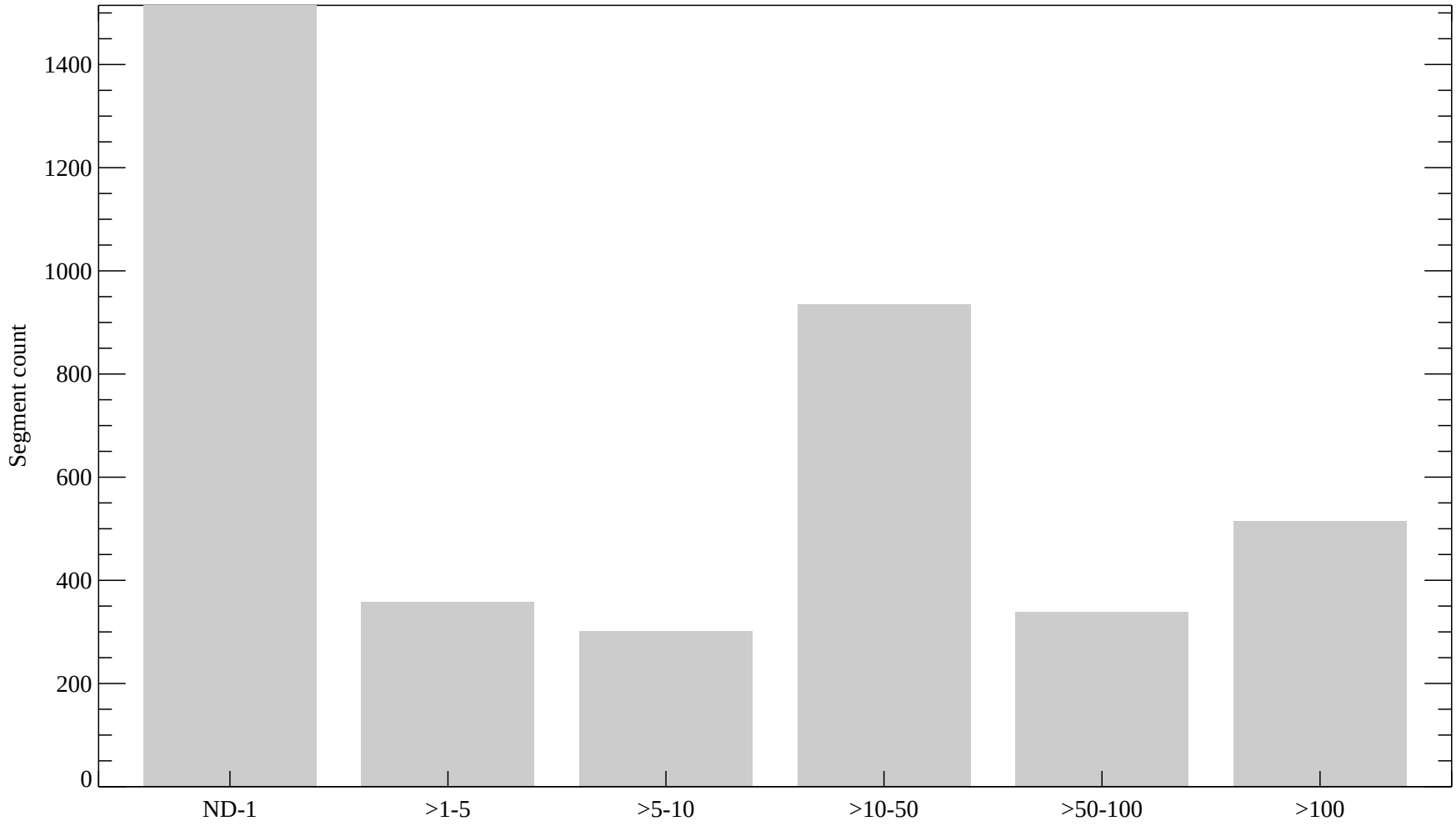


Figure 5-1. Distribution of Total PCB concentrations in core segments collected in the Candidate Phase 1 Area for Northern TIP.

Notes: Duplicates averaged with parent samples before anlaysis. Both cores and grabs included in the analysis. Posted Total PCB values are in ppm.

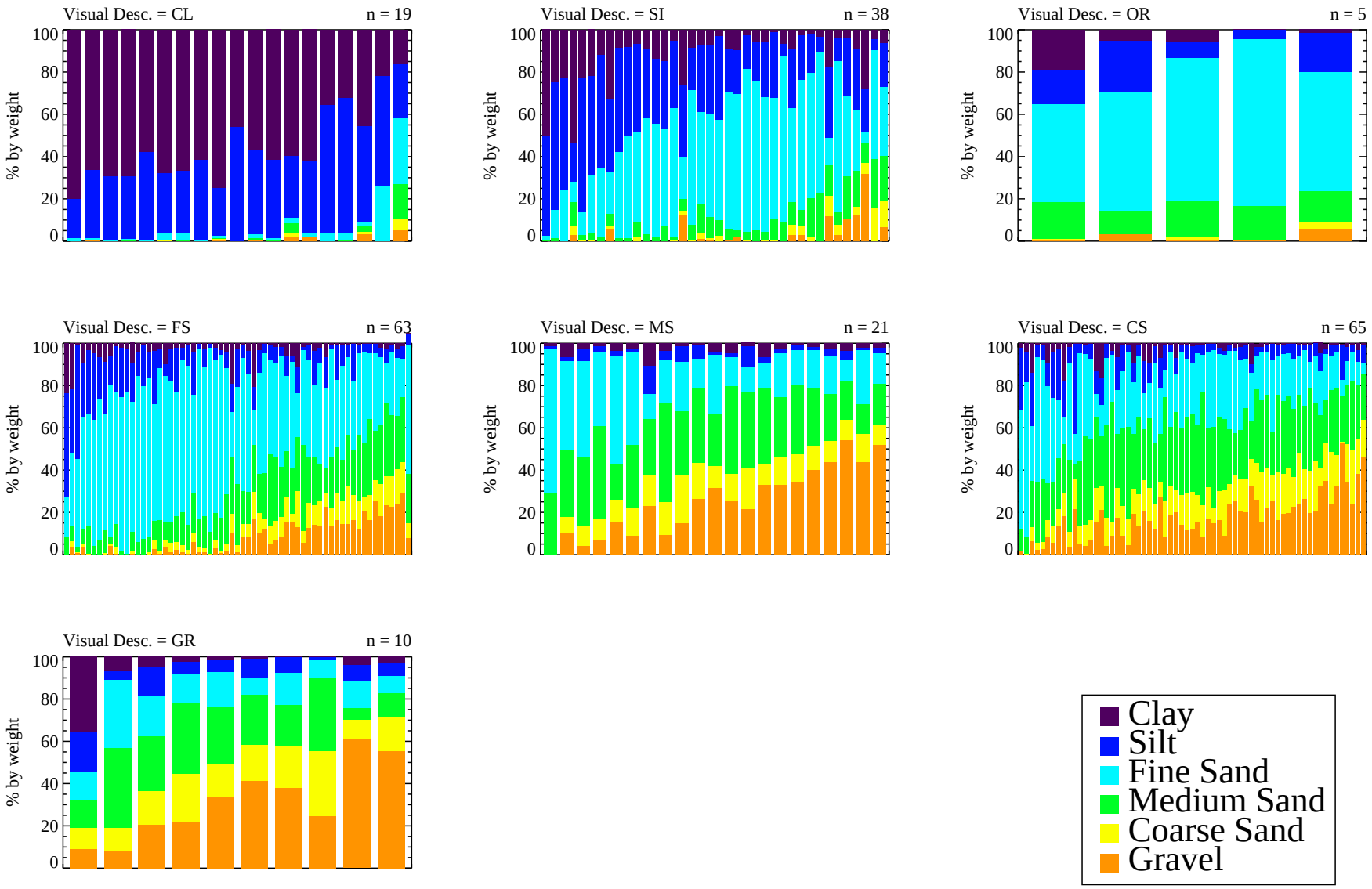


Figure 5-2. Comparison between field visual descriptions and grain size data in Northern TIP.

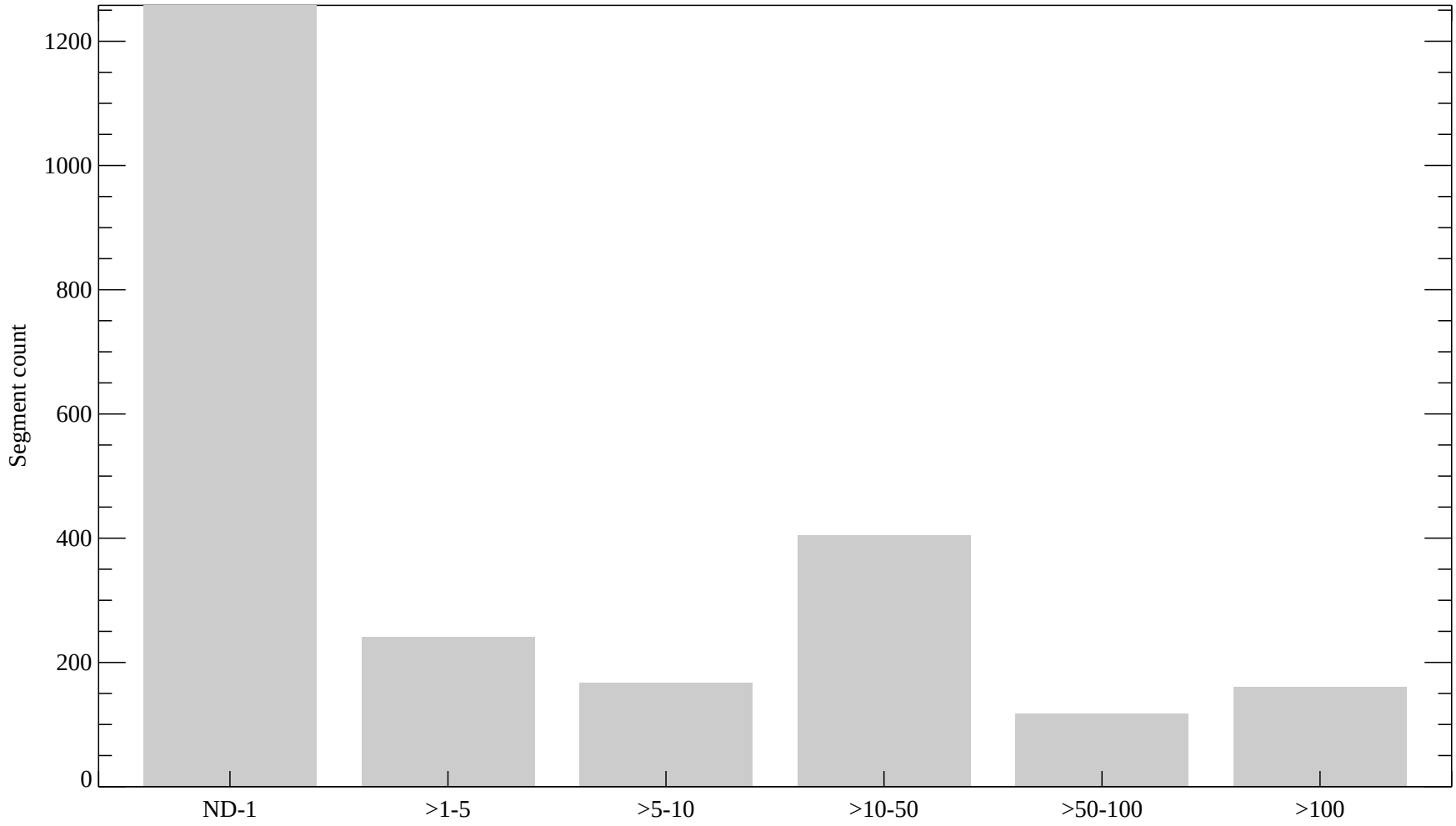


Figure 5-3. Distribution of Total PCB concentrations in core segments collected in the Candidate Phase 1 Area for Griffin Island.

Notes: Duplicates averaged with parent samples before anlaysis. Both cores and grabs included in the analysis. Posted Total PCB values are in ppm.

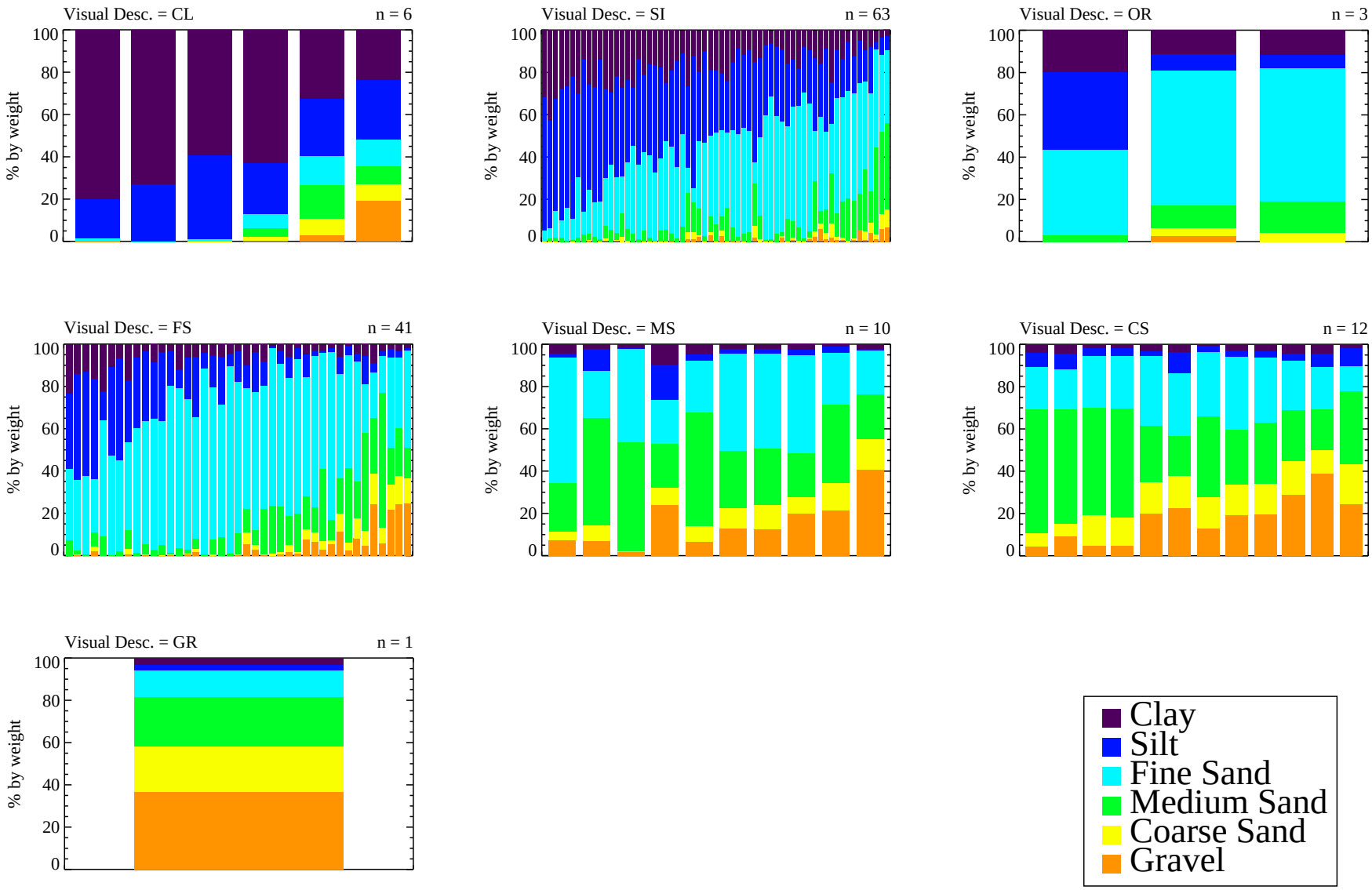


Figure 5-4. Comparison between field visual descriptions and grain size data in Griffin Island.

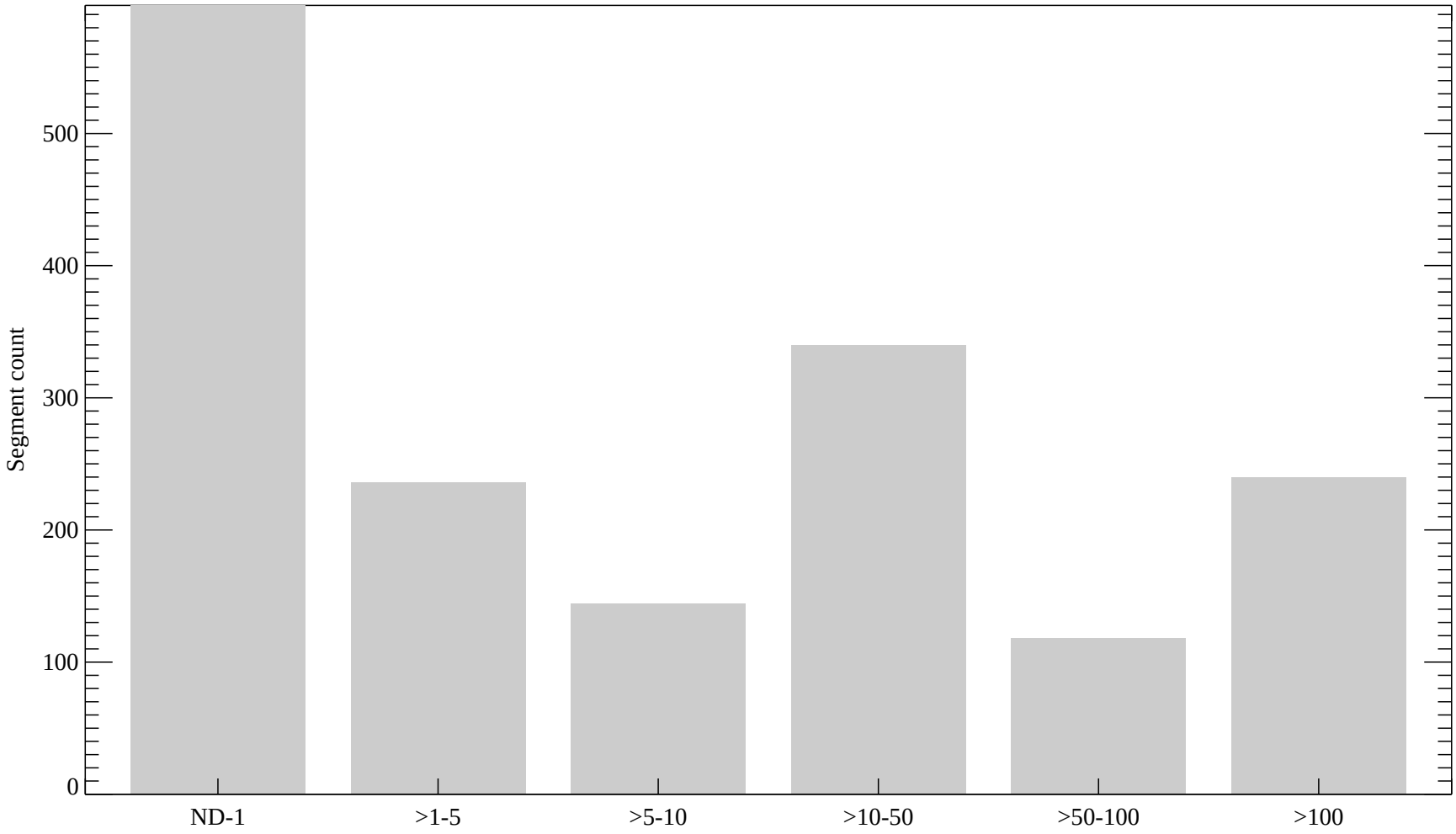


Figure 5-5. Distribution of Total PCB concentrations in core segments collected in the Candidate Phase 1 Area for Northumberland Dam.

Notes: Duplicates averaged with parent samples before anlaysis. Both cores and grabs included in the analysis. Posted Total PCB values are in ppm.

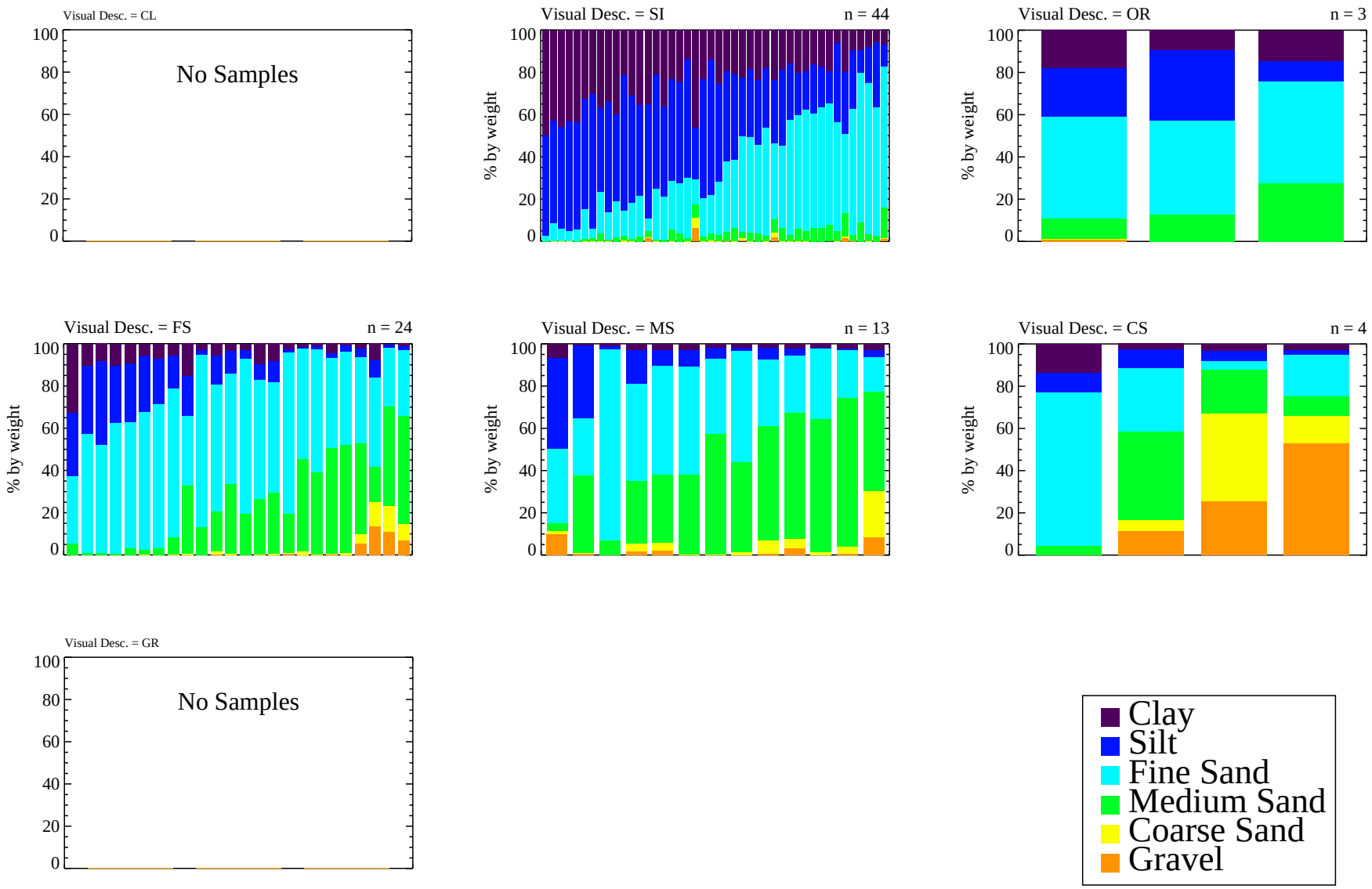
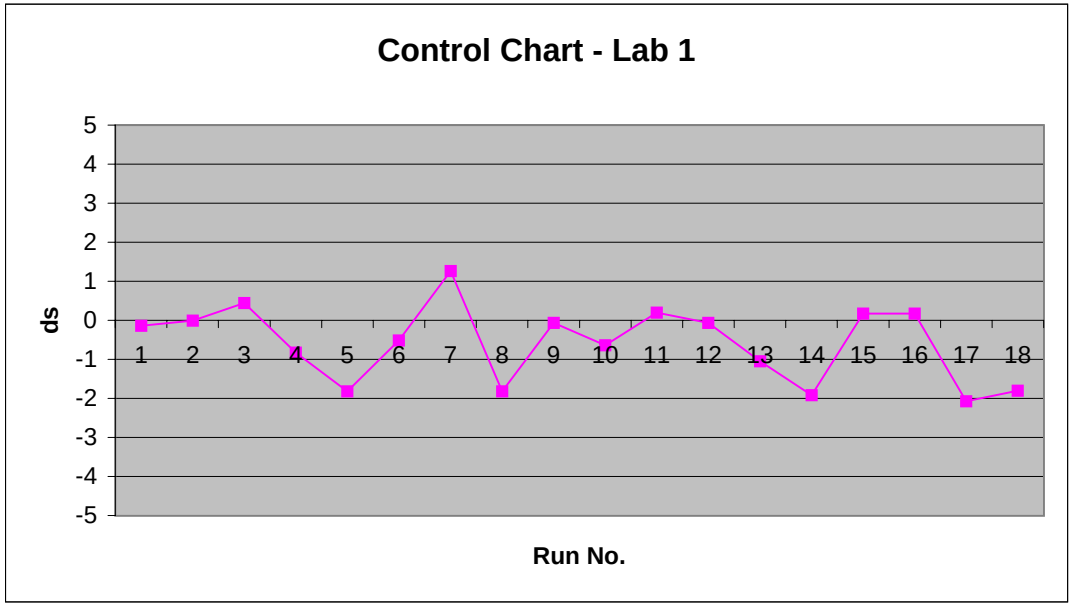


Figure 5-6. Comparison between field visual descriptions and grain size data in Northumberland Dam.

Date	PE #	Run#	s	PCB (ppm)
5/22/03	PE1	1	-0.141509434	1.4
5/29/03	PE2	2	-0.007905138	16.78
6/5/03	PE5	3	0.445609436	41
6/12/03	PE1	4	-0.827358491	1.2546
6/18/03	PE3	5	-1.821950257	71.15
6/25/03	PE5	6	-0.513761468	33.68
7/2/03	PE1	7	1.262264151	1.6976
7/11/03	PE4	8	-1.816521048	520.7
7/17/03	PE5	9	-0.065530799	37.1
7/23/03	PE1	10	-0.641509434	1.294
7/30/03	PE2	11	0.196442688	17.297
8/6/03	PE5	12	-0.065530799	37.1
8/13/03	PE1	13	-1.047169811	1.208
8/20/03	PE3	14	-1.917489143	68.73
8/27/03	PE5	15	0.170380079	38.9
9/4/03	PE1	16	0.169811321	1.466
9/10/03	PE4	17	-2.070691025	488.7
9/18/03	PE5	18	-1.803407602	23.84

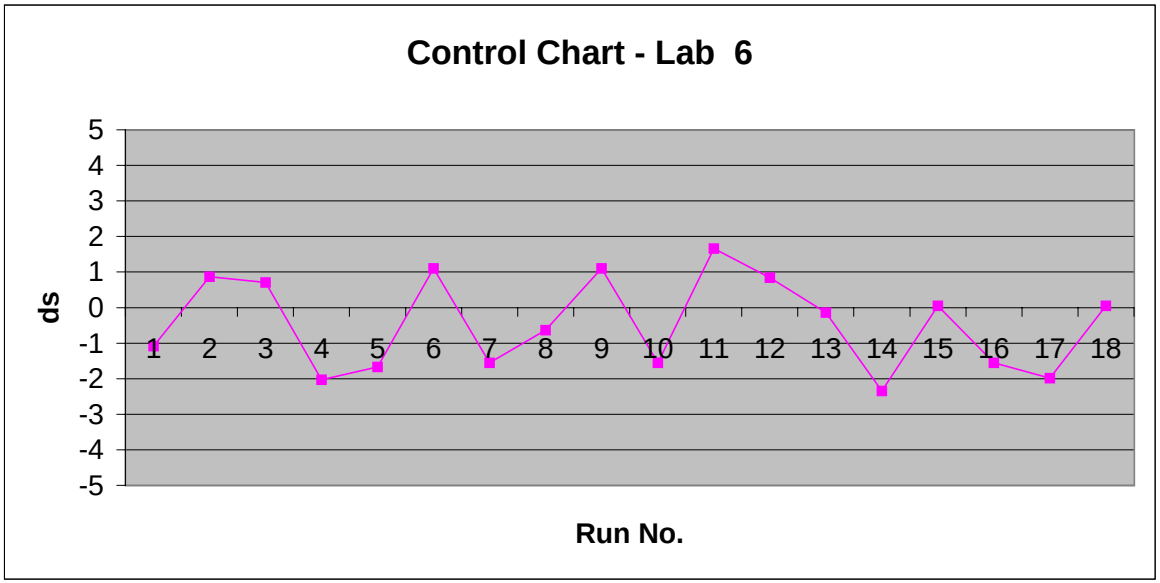


No Current Point outside +/- 3 Sigma?
No 2 of last 3 points outside +/- 2 Sigma on same side of mean?
No 4 of last 5 points outside +/- 1 Sigma on same side of mean?
No 9 consecutive ponts on the same side of mean?
No 6 points in a row all increasing or decreasing?
No 14 points in a row alternating up and down?

The “yes/no” above indicates the real-time status as of the last data point, not whether or not the condition ever occurred.

Figure 7-1. Lab 1 GEHR8082 PE control chart.

Date	PE #	Run#	s	PCB (ppm)
5/22/03	PE1	1	-1.08490566	1.2
5/29/03	PE2	2	0.869565217	19
6/5/03	PE5	3	0.707732634	43
6/12/03	PE1	4	-2.02830189	1
6/18/03	PE3	5	-1.66995657	75
6/25/03	PE5	6	1.100917431	46
7/2/03	PE1	7	-1.55660377	1.1
7/11/03	PE4	8	-0.63065925	670
7/17/03	PE5	9	1.100917431	46
7/23/03	PE1	10	-1.55660377	1.1
7/30/03	PE2	11	1.660079051	21
8/6/03	PE5	12	0.838794233	44
8/13/03	PE1	13	-0.14150943	1.4
8/20/03	PE3	14	-2.34109751	58
8/27/03	PE5	15	0.05242464	38
9/4/03	PE1	16	-1.55660377	1.1
9/10/03	PE4	17	-1.98093725	500
9/18/03	PE5	18	0.05242464	38

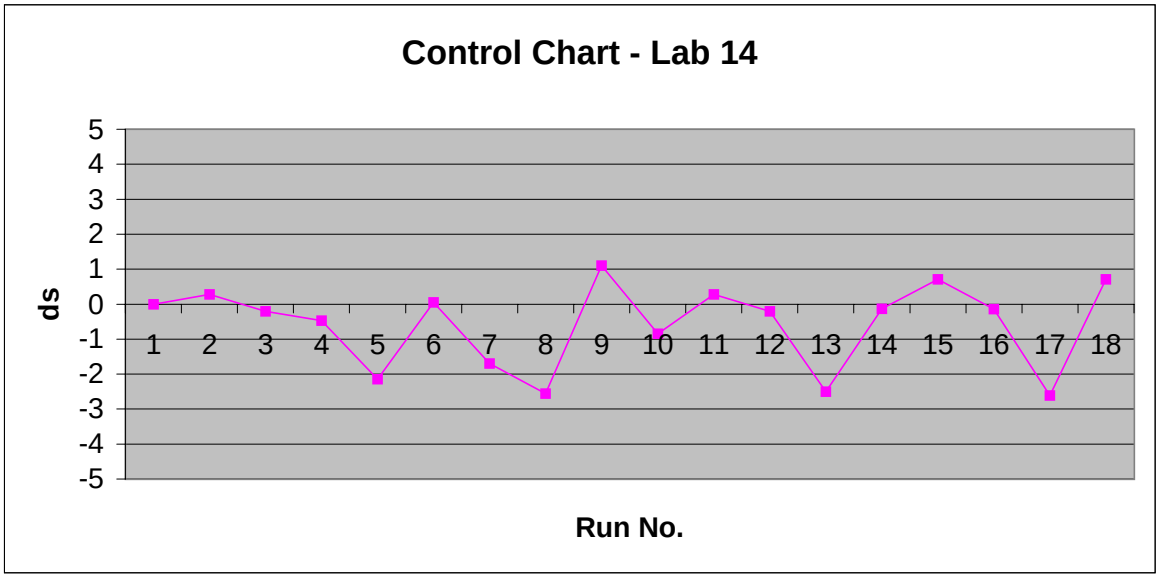


No Current Point outside +/- 3 Sigma?
No 2 of last 3 points outside +/- 2 Sigma on same side of mean?
No 4 of last 5 points outside +/- 1 Sigma on same side of mean?
No 9 consecutive ponts on the same side of mean?
No 6 points in a row all increasing or decreasing?
No 14 points in a row alternating up and down?

The “yes/no” above indicates the real-time status as of the last data point, not whether or not the condition ever occurred.

Figure 7-2. Lab 6 GEHR8082 PE control chart.

Date	PE #	Run#	s	PCB (ppm)
5/22/03	PE1	1	0	1.43
5/29/03	PE2	2	0.276679842	17.5
6/5/03	PE5	3	-0.20969856	36
6/12/03	PE1	4	-0.47169811	1.33
6/18/03	PE3	5	-2.14370312	63
6/25/03	PE5	6	0.05242464	38
7/2/03	PE1	7	-1.69811321	1.07
7/11/03	PE4	8	-2.56076251	427
7/17/03	PE5	9	1.100917431	46
7/23/03	PE1	10	-0.8490566	1.25
7/30/03	PE2	11	0.276679842	17.5
8/6/03	PE5	12	-0.20969856	36
8/13/03	PE1	13	-2.5	0.9
8/20/03	PE3	14	-0.1302803	114
8/27/03	PE5	15	0.707732634	43
9/4/03	PE1	16	-0.14150943	1.4
9/10/03	PE4	17	-2.61636219	420
9/18/03	PE5	18	0.707732634	43

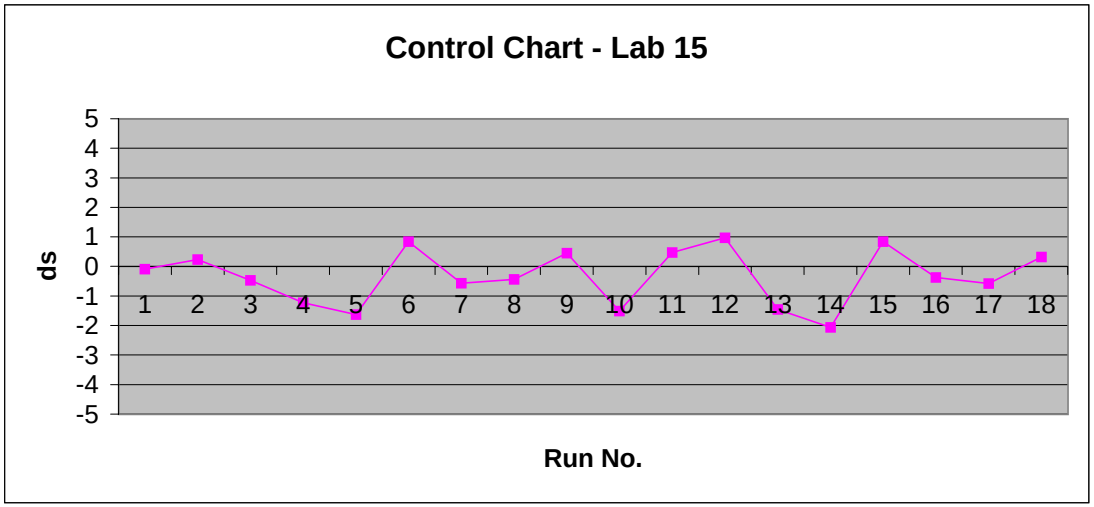


No	Current Point outside +/- 3 Sigma?
No	2 of last 3 points outside +/- 2 Sigma on same side of mean?
No	4 of last 5 points outside +/- 1 Sigma on same side of mean?
No	9 consecutive ponts on the same side of mean?
No	6 points in a row all increasing or decreasing?
No	14 points in a row alternating up and down?

The “yes/no” above indicates the real-time status as of the last data point, not whether or not the condition ever occurred.

Figure 7-3. Lab 14 GEHR8082 PE control chart.

Date	PE #	Run#	s	PCB (ppm)
5/22/03	PE1	1	-0.09433962	1.41
5/29/03	PE2	2	0.23715415	17.4
6/6/03	PE5	3	-0.47182176	34
6/12/03	PE1	4	-1.22641509	1.17
6/18/03	PE3	5	-1.63047769	76
6/25/03	PE5	6	0.838794233	44
7/2/03	PE1	7	-0.56603774	1.31
7/11/03	PE4	8	-0.44003177	694
7/17/03	PE5	9	0.445609436	41
7/23/03	PE1	10	-1.50943396	1.11
7/30/03	PE2	11	0.4743083	18
8/6/03	PE5	12	0.969855832	45
8/13/03	PE1	13	-1.46226415	1.12
8/20/03	PE3	14	-2.06474536	65
8/27/03	PE5	15	0.838794233	44
9/4/03	PE1	16	-0.37735849	1.35
9/10/03	PE4	17	-0.57505957	677
9/18/03	PE5	18	0.314547837	40

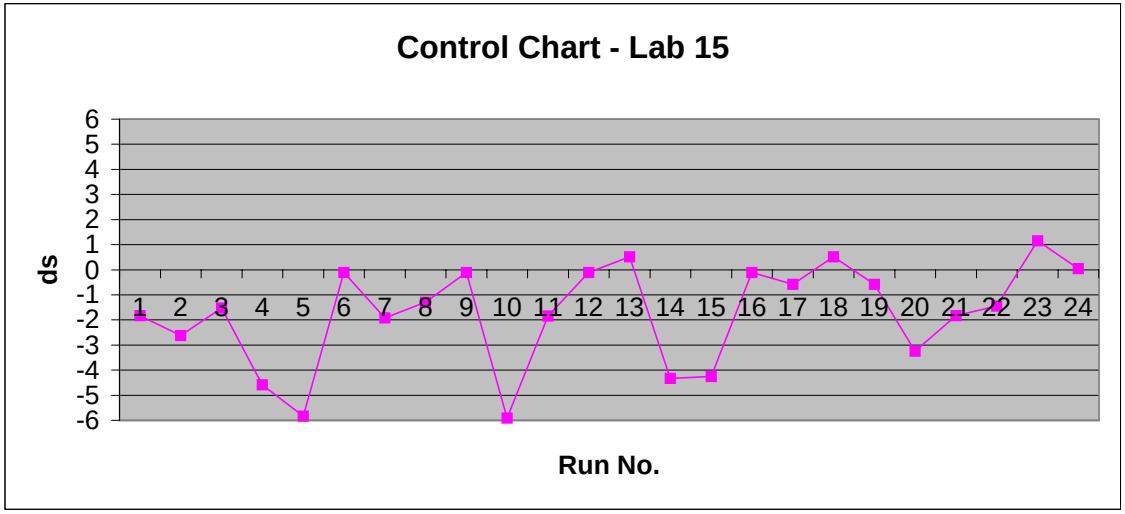


No Current Point outside +/- 3 Sigma?
No 2 of last 3 points outside +/- 2 Sigma on same side of mean?
No 4 of last 5 points outside +/- 1 Sigma on same side of mean?
No 9 consecutive ponts on the same side of mean?
No 6 points in a row all increasing or decreasing?
No 14 points in a row alternating up and down?

The “yes/no” above indicates the real-time status as of the last data point, not whether or not the condition ever occurred.

Figure 7-4. Lab 15 GEHR8082 PE control chart.

Date	PE #	Run#	s	PCB (ppm)
5/22/03	PE1	1	-1.83333333	0.9
5/29/03	PE2	2	-2.61538462	11
6/5/03	PE5	3	-1.52515723	20
6/12/03	PE1	4	-4.58333333	0.57
6/12/03	PE1	5	-5.83333333	0.42
6/25/03	PE5	6	-0.11006289	29
7/2/03	PE1	7	-1.91666667	0.89
7/11/03	PE4	8	-1.29850746	550
7/17/03	PE5	9	-0.11006289	29
7/23/03	PE1	10	-5.91666667	0.41
7/30/03	PE2	11	-1.84615385	12
8/6/03	PE5	12	-0.11006289	29
8/6/03	PE5	13	0.518867925	33
8/13/03	PE1	14	-4.33333333	0.6
8/13/03	PE1	15	-4.25	0.61
8/27/03	PE5	16	-0.11006289	29
8/27/03	PE5	17	-0.58176101	26
8/27/03	PE5	18	0.518867925	33
8/27/03	PE5	19	-0.58176101	26
9/4/03	PE1	20	-3.25	0.73
9/4/03	PE1	21	-1.83333333	0.9
9/10/03	PE4	22	-1.44776119	530
9/18/03	PE5	23	1.147798742	37
9/18/03	PE5	24	0.047169811	30



No Current Point outside +/- 3 Sigma?
No 2 of last 3 points outside +/- 2 Sigma on same side of mean?
No 4 of last 5 points outside +/- 1 Sigma on same side of mean?
No 9 consecutive ponts on the same side of mean?
No 6 points in a row all increasing or decreasing?
No 14 points in a row alternating up and down?

The “yes/no” above indicates the real-time status as of the last data point, not whether or not the condition ever occurred.

Figure 7-5. Lab 15 GEHR680 PE control chart.

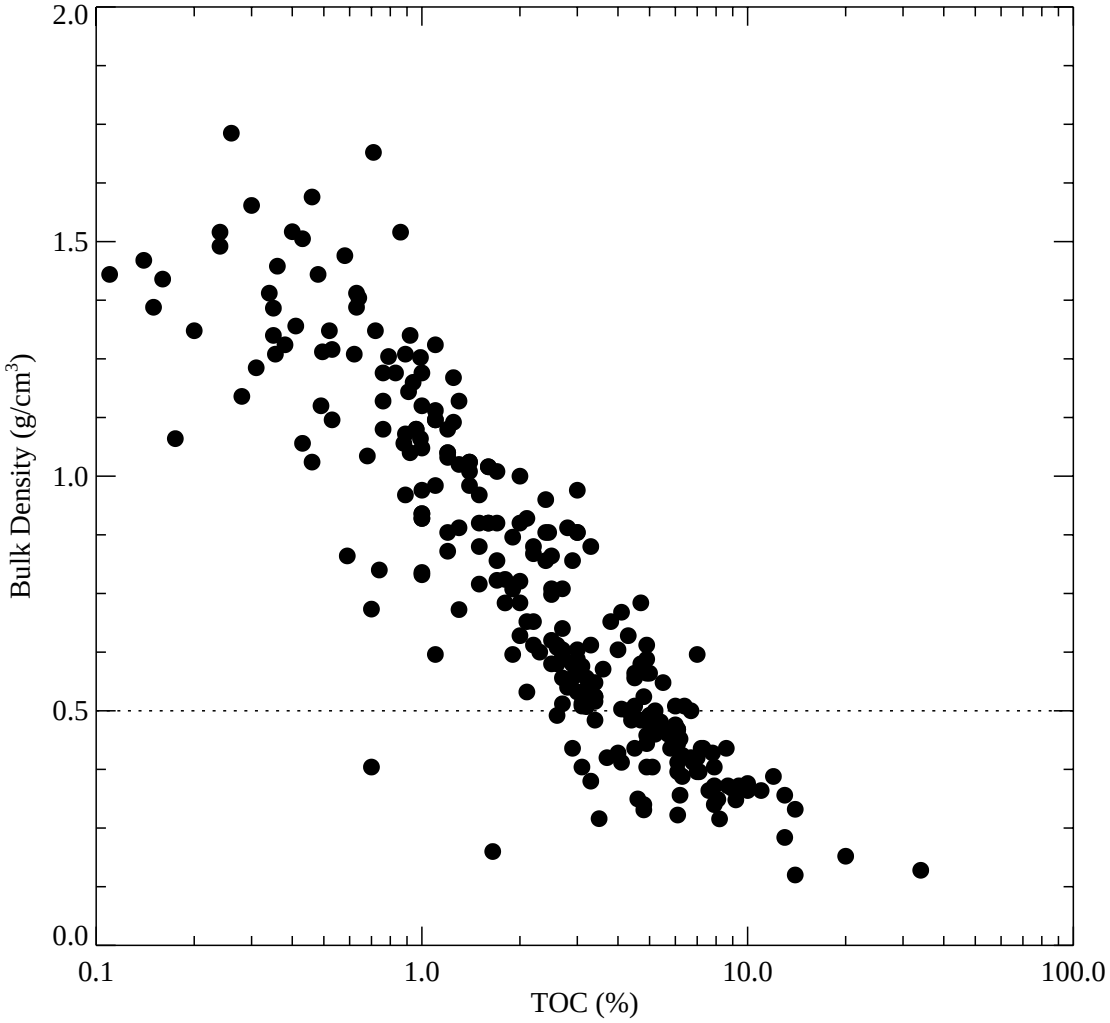


Figure 8-1. Relationship between dry bulk density and total organic carbon for Hudson River sediments collected in 1998 and 1999.

Data source: January 2004 GE Hudson River database.

Sub-surface sediments collected below a depth of 2 inches.

Non-detect TOC samples are plotted at one-half the sample detection limit.

Results for duplicate samples are plotted as averages.

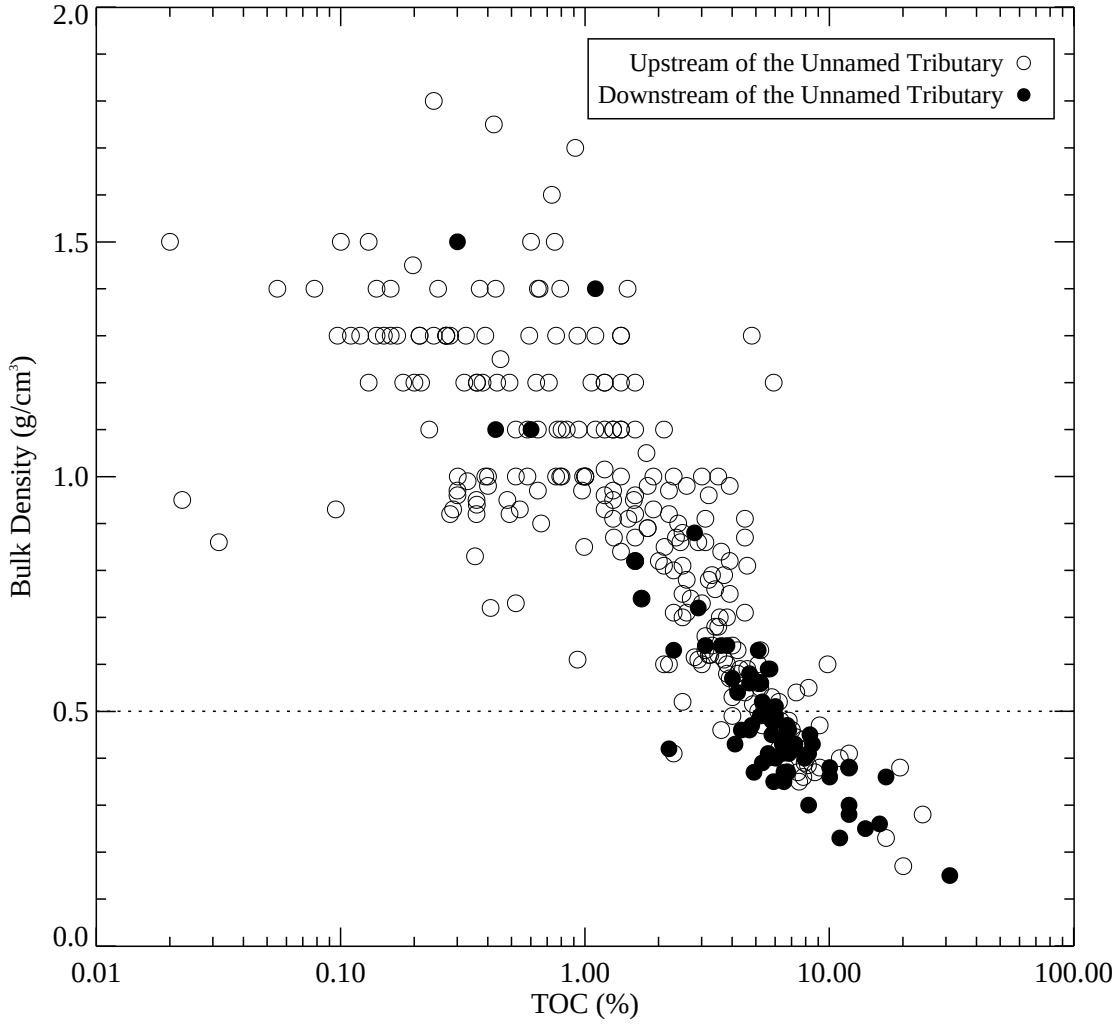


Figure 8-2. Relationship between bulk density and total organic carbon in sub-surface sediments in the Lower Grasse River.

Data from the 2003 Phase 1 and 2 and January 2004 programs (main channel and side slope areas).

Sub-surface sediments collected below a depth of 3 inches.

River divided into two sections: upstream and downstream of the Unnamed Tributary.

TOC samples below the detection limit plotted at half the detection limit.

Duplicate samples averaged; high-resolution cores excluded in sub-surface sediment samples.

Data sources: sediment_aro and sediment_bz.

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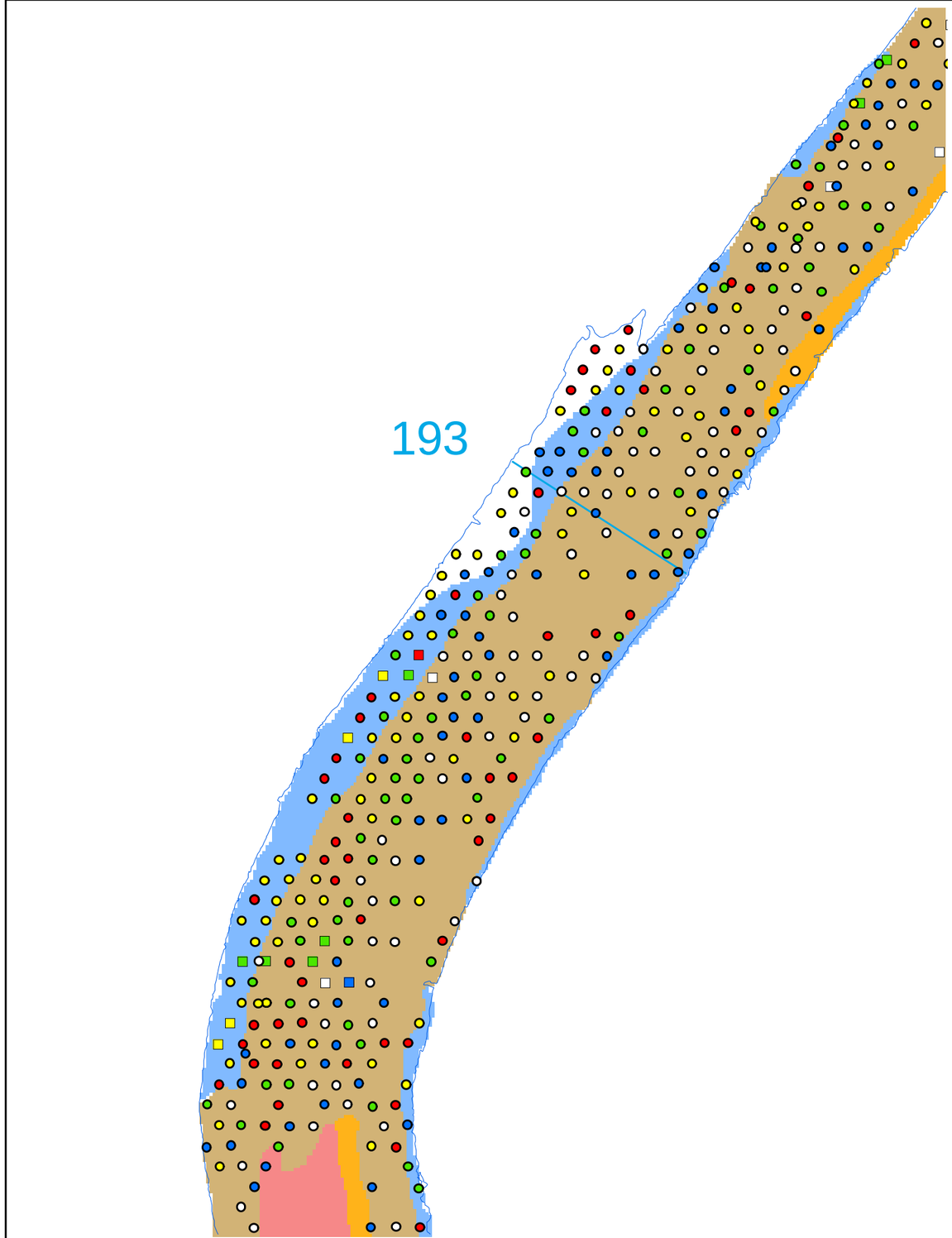
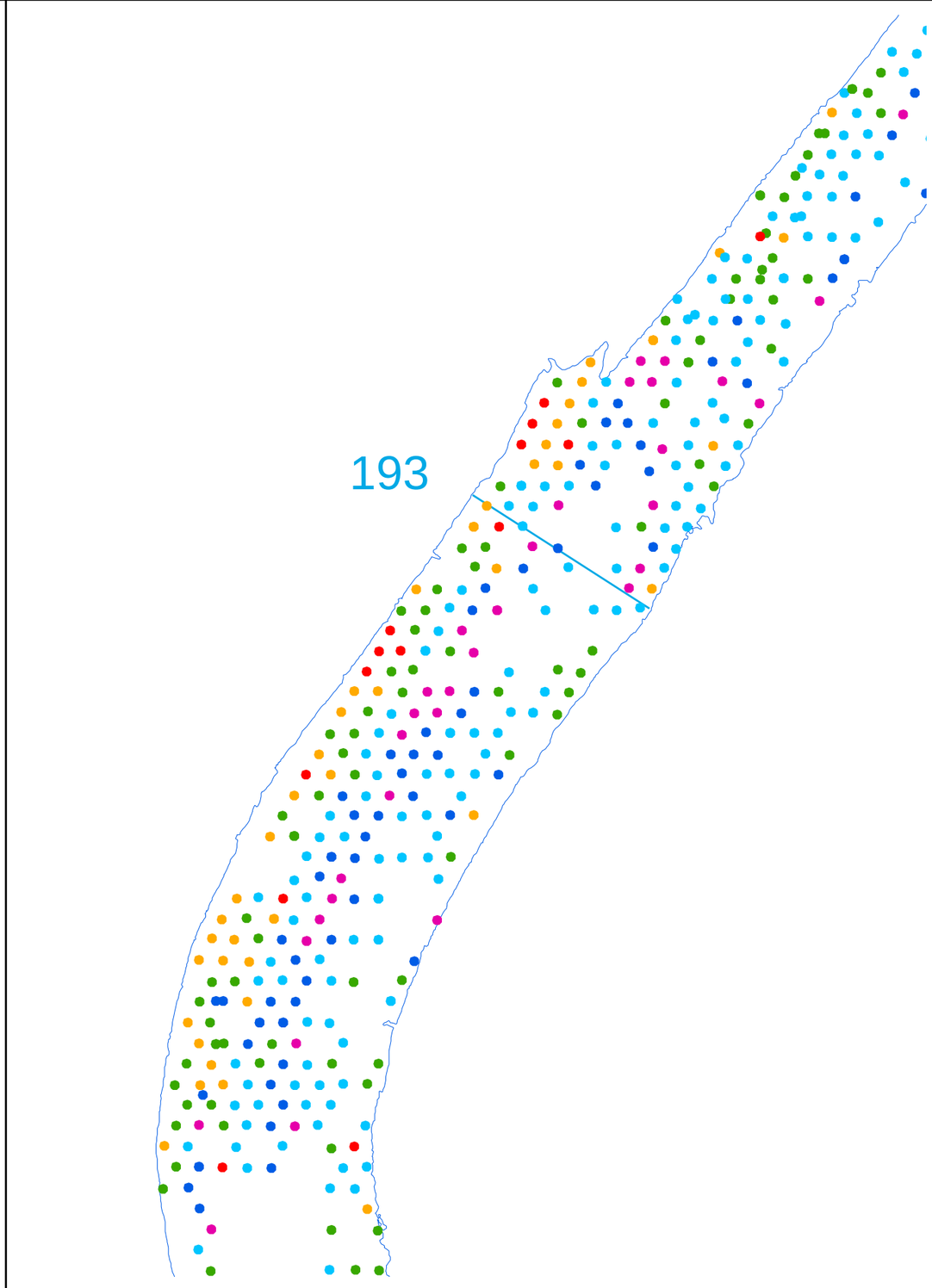
Thu Apr 22 17:52:40 2004

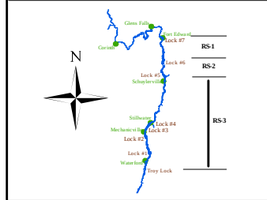
Surface Sediment (0 - 2 in.) Percent Organic Carbon



Sub-surface Sediment (2 - 6, 12, or 24 in.) Dry Bulk Density



LOCATOR MAP OF THE HUDSON RIVER



LEGEND

foc (%)	ND foc (%)
0.0 - 0.5	0.0 - 0.5
0.5 - 1.0	0.5 - 1.0
1.0 - 2.0	1.0 - 2.0
2.0 - 5.0	2.0 - 5.0
> 5.0	> 5.0

SSS Sediment Type

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment

SubSurf. Bulk Density (g/cm3)

- 0.18 - 0.5
- 0.5 - 0.8
- 0.8 - 1.2
- 1.2 - 1.6
- 1.6 - 1.8
- 1.8 - 2.2
- River Miles
- Shore Line
- Dams and Locks

General Electric Company
Hudson River Project

Figure 8-3a.

Comparison of surface organic carbon and underlying subsurface bulk density.

Notes:

1. *Based on the January 26, 2004 edition of QeaExport.*
2. *Note: Sub-surface measurements begin 2 inches below the sediment surface.*
3. *Outliers were replaced with average values for that sediment type.*
4. *Sub-surface dry bulk density values were calculated.*

QEA Quantitative Environmental Analysis, LLC

GENrem **September 2004**

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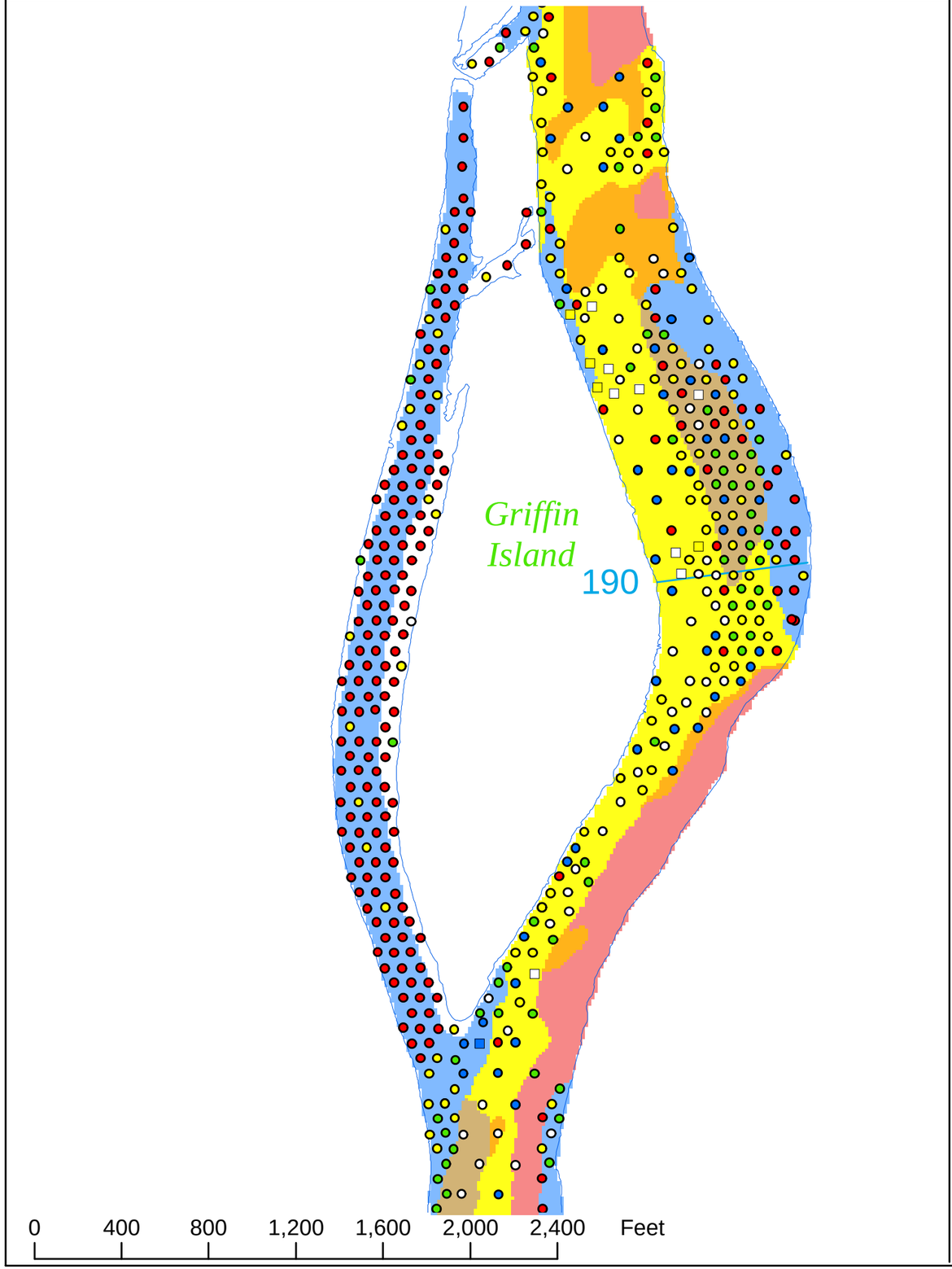
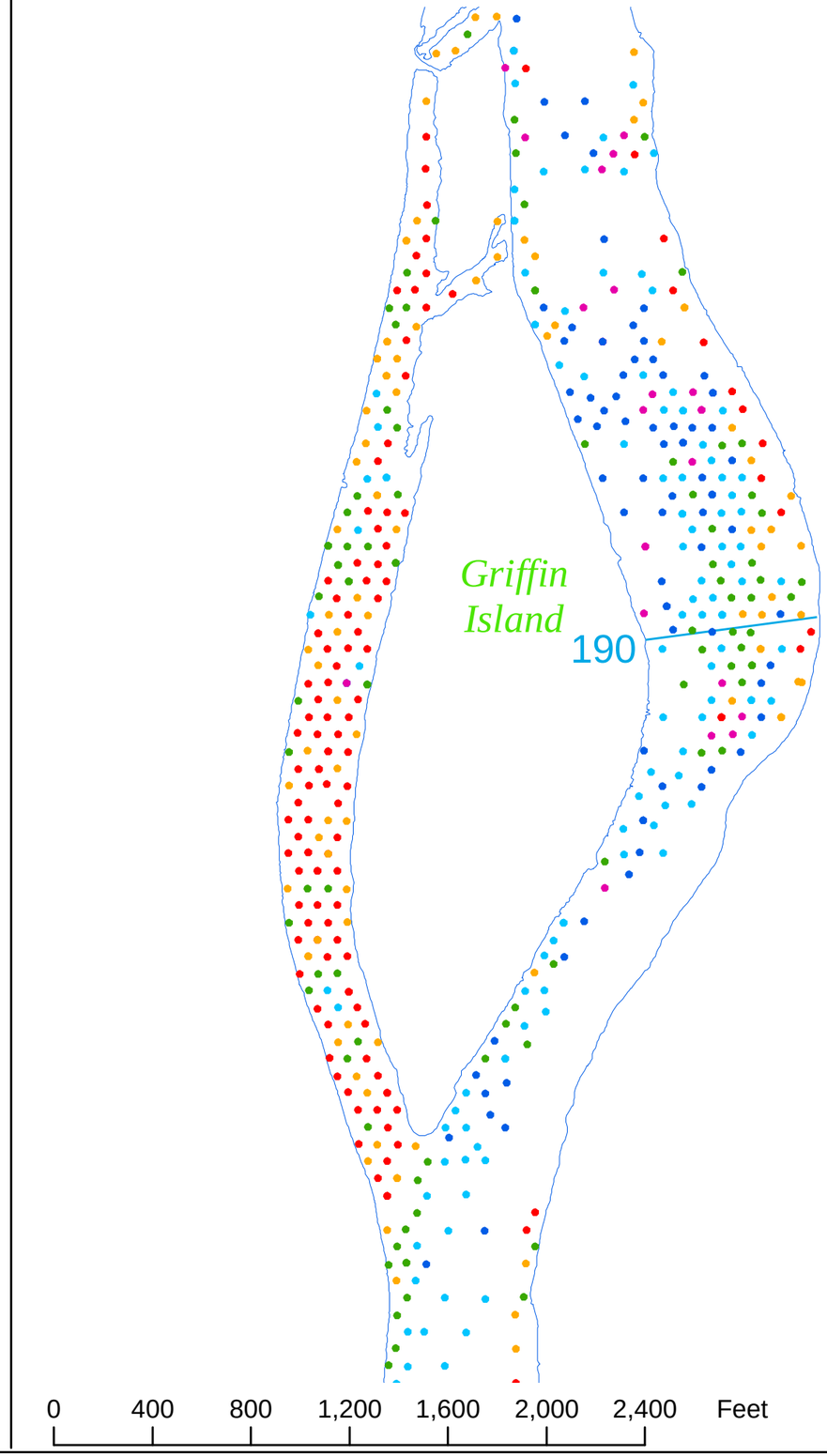
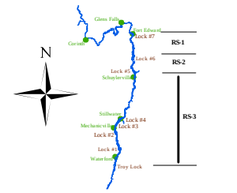
Surface Sediment (0 - 2 in.) Percent Organic Carbon



Sub-surface Sediment (2 - 6, 12, or 24 in.) Dry Bulk Density



LOCATOR MAP OF THE HUDSON RIVER



LEGEND

foc (%)	ND foc (%)
0.0 - 0.5	0.0 - 0.5
0.5 - 1.0	0.5 - 1.0
1.0 - 2.0	1.0 - 2.0
2.0 - 5.0	2.0 - 5.0
> 5.0	> 5.0

SSS Sediment Type

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment

SubSurf. Bulk Density (g/cm3)

- 0.18 - 0.5
- 0.5 - 0.8
- 0.8 - 1.2
- 1.2 - 1.6
- 1.6 - 1.8
- 1.8 - 2.2
- River Miles
- Shore Line
- Dams and Locks

General Electric Company
Hudson River Project

Figure 8-3b.

Comparison of surface organic carbon and underlying subsurface bulk density.

Notes:

1. *Based on the January 26, 2004 edition of QeaExport.*
2. *Note: Sub-surface measurements begin 2 inches below the sediment surface.*
3. *Outliers were replaced with average values for that sediment type.*
4. *Sub-surface dry bulk density values were calculated.*

QEA Quantitative Environmental Analysis, LLC

GENrem **September 2004**

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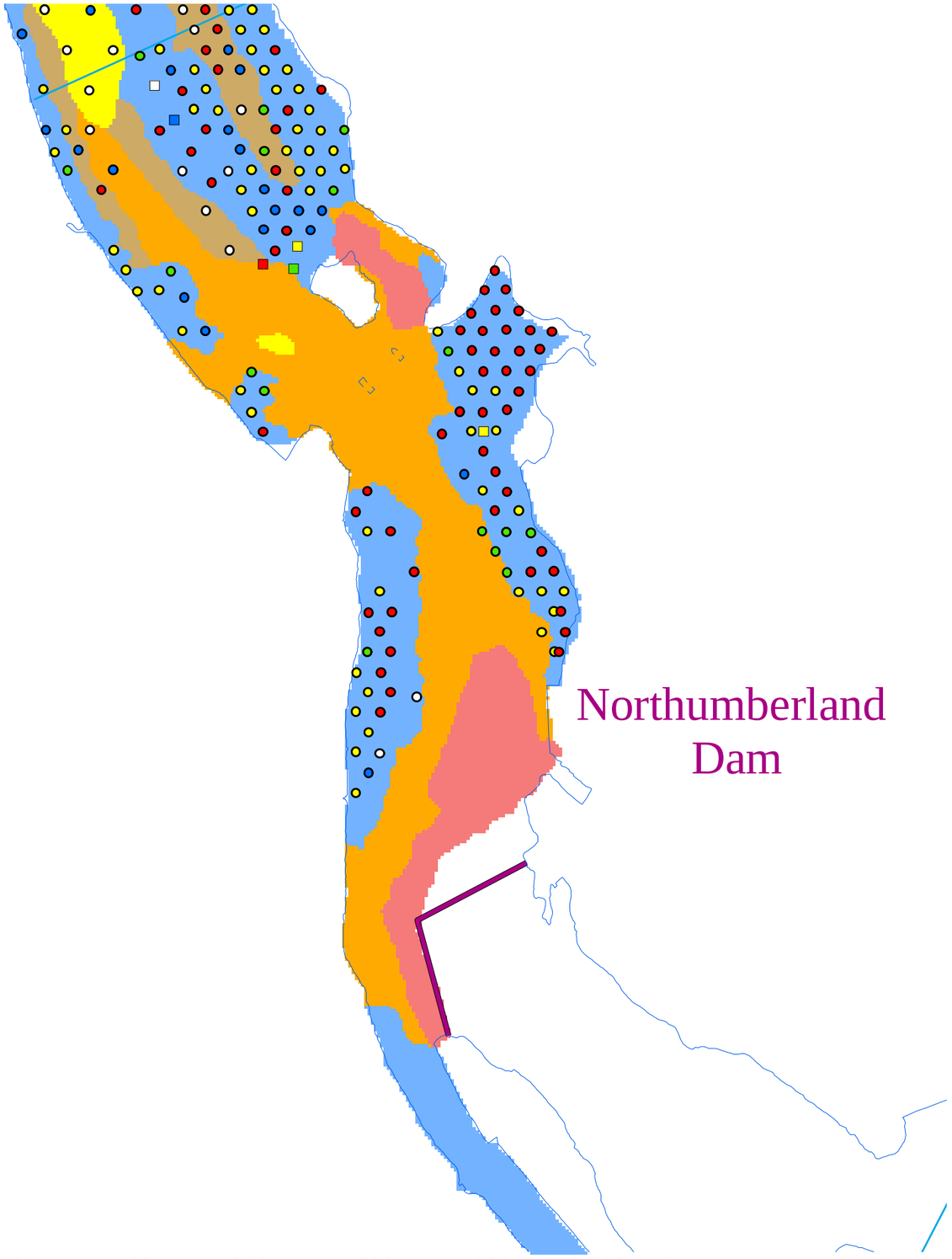
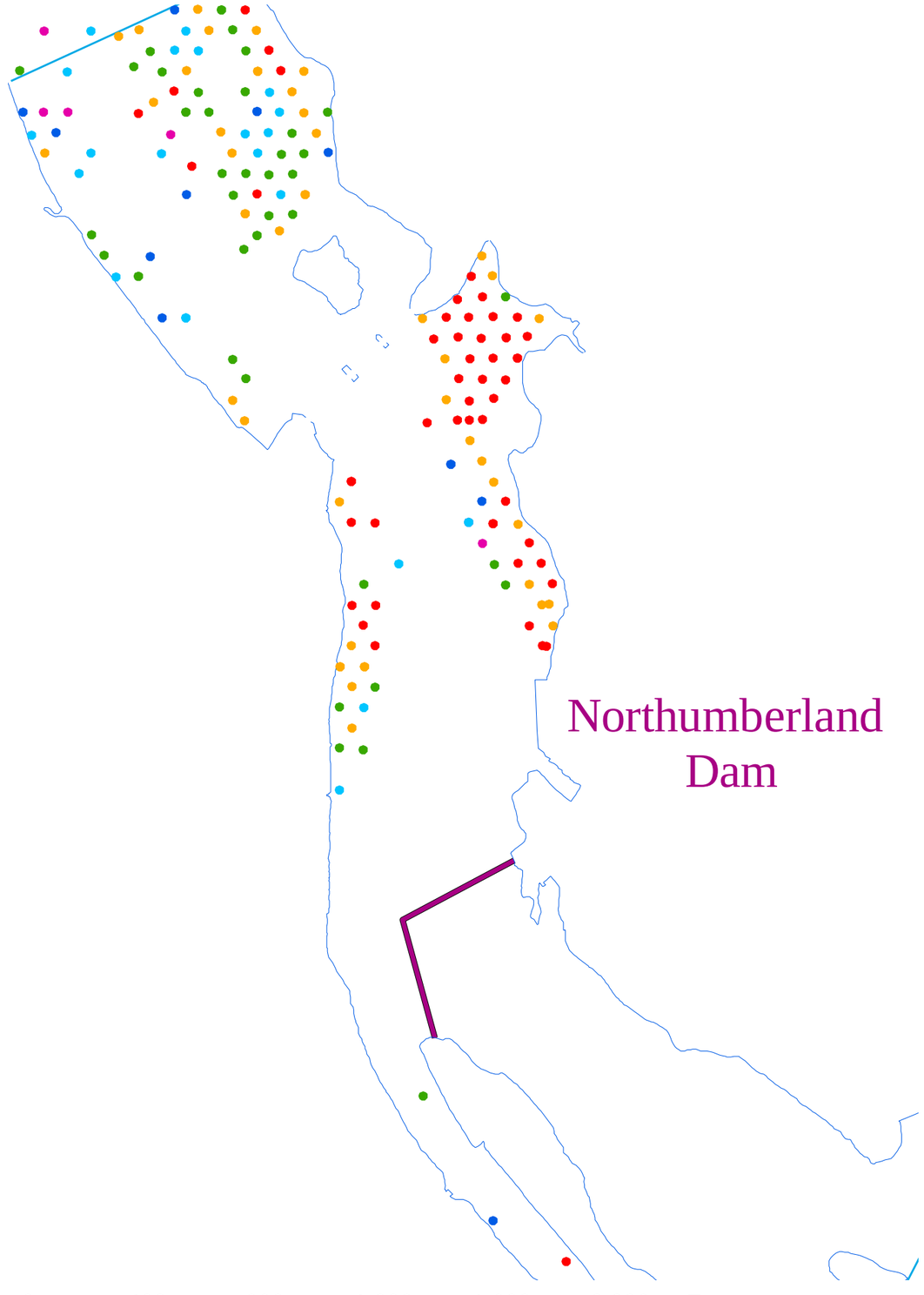
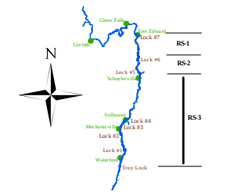
Surface Sediment (0 - 2 in.) Percent Organic Carbon



Sub-surface Sediment (2 - 6, 12, or 24 in.) Dry Bulk Density



LOCATOR MAP OF THE HUDSON RIVER



LEGEND

foc (%)	ND foc (%)
0.0 - 0.5	0.0 - 0.5
0.5 - 1.0	0.5 - 1.0
1.0 - 2.0	1.0 - 2.0
2.0 - 5.0	2.0 - 5.0
> 5.0	> 5.0

SSS Sediment Type

- Type I Sediment
- Type II Sediment
- Type III Sediment
- Type IV Sediment
- Type V Sediment

SubSurf. Bulk Density (g/cm3)

- 0.18 - 0.5
- 0.5 - 0.8
- 0.8 - 1.2
- 1.2 - 1.6
- 1.6 - 1.8
- 1.8 - 2.2
- River Miles
- Shore Line
- Dams and Locks

General Electric Company
Hudson River Project

Figure 8-3c.

Comparison of surface organic carbon and underlying subsurface bulk density.

Notes:

1. *Based on the January 26, 2004 edition of QeaExport.*
2. *Note: Sub-surface measurements begin 2 inches below the sediment surface.*
3. *Outliers were replaced with average values for that sediment type.*
4. *Sub-surface dry bulk density values were calculated.*

QEA Quantitative Environmental Analysis, LLC

GENrem **September 2004**

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TABLES

Quantitative Environmental Analysis, LLC

Table 3-1. 2002/2003 SSAP summary of the number of GEHR8082 sediment sample extracts selected for GEHR680 analysis.

Lab	Number of GEHR8082 Analyses Performed of First 3000 Samples[1] Collected	% Analyzed of first 3000	Number of Analyses to Select for GEHR680 based on Rate of GEHR8082 #s	Number of GEHR8082 Extracts Selected for GEHR680 from First 3000 Samples Collected	Number of GEHR8082 Analyses Performed AFTER First 3000 Samples Collected	% Analyzed of AFTER First 3000	Number of Analyses to Select for GEHR680 based on Rate of GEHR8082 #s	Number of GEHR8082 Extracts Selected for GEHR680 from AFTER First 3000 Samples Collected	Target Total Number of GEHR8082 Extracts for GEHR680 Analysis	2002/2003 SSAP Total of GEHR8082 Extracts Selected For GEHR680 Analysis	Number of Archived GEHR8082 Analyses Performed	Target Total Number of Archived GEHR8082 Extracts for GEHR680 Analysis	2002/2003 SSAP Total of GEHR8082 Extracts Selected For GEHR680 Analysis
Lab 1	353	11.8%	47	22	4369	17%	175	204	222	226			
Lab 4[2]	421	14.0%	56	49	233	0.9%	9	16	65	65			
Lab 6	775	25.8%	103	74	6252	24%	250	280	353	354			
Lab 14	588	19.6%	78	44	6463	25%	259	292	337	336			
Lab 15	709	23.6%	95	42	8815	34%	353	409	448	451			
Lab 16	156	5.2%	21	18	111	0.4%	4	6	25	24			
Lab 15[2]											338	30	30
Total	**3002**		**400**	**249**	**26243**		**1050**	**1207**	**1450**	**1456**			
Revised Total[2]											**29245**	**1415**	**1421**

Notes:

[1] - Numbers of samples includes environmental sediment samples and field duplicate samples.

[2] - Lab 4 GEHR680 data was not used as discussed in Section 6.1.1 of the text of the Year 1 DSR. Lab 15 analyzed archived samples in replacement for the Lab 4 data that was not used.

The Revised Totals do not include Lab 4 data and do include Lab 15 archive sample data.

Table 3-2. 2002/2003 SSAP number of GEHR8082 extracts selected for GEHR680 analysis by lab and GEHR8082 Total PCB concentration range.

GEHR8082 Total PCB Conc. Range (mg/Kg)	Lab 1	Lab 4[1]	Lab 6	Lab 14	Lab 15	Lab 15[1]	Lab 16	Totals
0-10	43	27	78	76	93	4	8	329
11-25	31	9	47	58	77	4	3	229
26-50	33	8	53	53	76	5	1	229
51-75	24	8	39	29	46	3	3	152
76-100	22	2	36	29	36	3		128
101-150	16	6	22	20	31	3	5	103
151-200	16	1	19	21	26	2	1	86
201-300	14	3	19	16	27	3		82
301-500	13	1	21	17	19	2	1	74
>500	14		20	17	20	1	2	74
Target Total:	222	65	353	337	448	NA	25	**1450**
Revised Target Total[1]:	222	NA	353	337	448	30	25	**1415**
Total:	226	65	354	336	451	30	24	**1421**

Note:

[1] - Lab 4 GEHR680 data were not used as discussed in Section 6.1.1 of the text of the Year 1 DSR. Lab 15 analyzedarchived samples in replacement for the Lab 4 data that were not used. The Revised Totals do not include Lab 4 data and do include Lab 15 archive sample data.

Table 3-3. 2003 PE submission schedule.

Week of	Aroclor PCB Analysis by GEHR8082			
	Lab 1	Lab 6	Lab 14	Lab 15
5/19/03	PE1	PE1	PE1	PE1
5/26/03	PE2	PE2	PE2	PE2
6/2/03	PE5	PE5	PE5	PE5
6/9/03	PE1	PE1	PE1	PE1
6/16/03	PE3	PE3	PE3	PE3
6/23/03	PE5	PE5	PE5	PE5
6/30/03	PE1	PE1	PE1	PE1
7/7/03	PE4	PE4	PE4	PE4
7/14/03	PE5	PE5	PE5	PE5
7/21/03	PE1	PE1	PE1	PE1
7/28/03	PE2	PE2	PE2	PE2
8/4/03	PE5	PE5	PE5	PE5
8/11/03	PE1	PE1	PE1	PE1
8/18/03	PE3	PE3	PE3	PE3
8/25/03	PE5	PE5	PE5	PE5
9/1/03	PE1	PE1	PE1	PE1
9/8/03	PE4	PE4	PE4	PE4
9/15/03	PE5	PE5	PE5	PE5
9/22/03	PE1	PE1	PE1	PE1
9/29/03	PE2	PE2	PE2	PE2
10/6/03	PE5	PE5	PE5	PE5
10/13/03	PE1	PE1	PE1	PE1
10/20/03	PE5	PE5	PE5	PE5
10/27/03	NA	NA	NA	NA
11/3/03	NA	NA	NA	NA
11/10/03	NA	NA	NA	NA
11/17/03	NA	NA	NA	PE5

Extract Selection Week	Homolog PCB Analysis by GEHR680
	Lab 15
1	PE1
1	PE2
2	PE5
3	PE1
4	PE1
5	PE5
6	PE1
7	PE4
8	PE5
9	PE1
10	PE2
11	PE5, PE5
12	PE1, PE1, PE5
13	PE5, PE5
14	PE5, PE5
15	PE1, PE1
16	PE4
17	PE5, PE5
18	PE1, PE1
19	PE2
20	PE5
21	PE1, PE5

Table 3-4. Number of samples in Candidate Phase 1 Areas selected for full data validation by lab and parameter.

Analytical Method/SOP	Parameter(s)	Lab	Total Number of Samples Analyzed	Number of Samples Validated		
				a	b	Total
SOP GEHR8082	Aroclors and Total PCBs	Lab 1	1308	137	84	221
		Lab 4	276	151	0	151
		Lab 6	2327	41	97	138
		Lab 14	2287	433	115	548
		Lab 15	2699	55	108	163
		Lab 16	262	126	0	126
		All Labs	9159	943	404	1347
SOP GEHR680	Homologs and Total PCBs	Lab 15	587	63	39	102
Lloyd Kahn	TOC	Lab 15	2403	34	10	44
SW-846 6010B and 7471A	RCRA Metals	Lab 6	25	11	3	14
EPA 1613B	Dioxin/Furans	Lab 18	30	12	4	16

Notes:
a – Data validation reports for this number of samples have been provided in previous report or letter submissions to USEPA (refer to Appendix 7).
b – Data validation reports for this number of samples are included in Appendix 8.
Total – The total number of samples validated associated with Candidate Phase 1 Areas and discussed in this report.

Table 3-5. Split samples collected by USEPA in Candidate Phase 1 Areas.

Core Identification	Sample Interval	GEHR8082	GEHR680
RS1-9089-WT118	2 - 24"	X	X
RS1-9089-WT184	2 - 24"	X	
RS1-9190-ET320	2 - 24"	X	X
RS1-9190-ET403	2 - 24"	X	X
RS1-9190-WT240	2 - 24"	X	X
RS1-9190-WT386	2 - 24"	X	
RS1-9190-WT429	2 - 24"	X	X
RS1-9392-ET230	2 - 24"	X	X
RS1-9392-WT129	2 - 24"	X	X
RS1-9392-WT136	2 - 24"	X	
RS1-9392-WT143	2 - 24"	X	X
RS1-9392-WT150	2 - 24"	X	
RS1-9392-WT190	2 - 6"	X	
RS1-9392-WT198	2 - 12"	X	
RS1-9392-WT213	2 -12"	X	
RS1-9493-WS712	2 - 13"	X	X[1]
RS1-9493-WT081	2 - 24"	X	
RS2-8483-ET040	2 - 24"	X	
RS2-8483-ET123	2 - 24"	X	X[2]
RS2-8483-ET126	2 - 24"	X	X
RS2-8584-ET156	2 - 6"	X	X
RS2-8685-WS275	2 - 24"	X	X

Notes:

[1] - USEPA did not select this split sample for GEHR680 analysis; however, the sample was selected for GEHR680 analysis as part of the required GEHR680 analysis frequency.

[2] - Sample RS2-8483-ET123-002024 was originally extracted and analyzed by GEHR8082 by Lab 4 and the Lab 4 extract was subsequently analyzed by GEHR680 by Lab 15. Lab 15 has since reextracted and reanalyzed this sample by GEHR8082 as addressed in Section 6.1.1 of the text of the Year 1 DSR. The Lab 15 extract was not selected for GEHR680 analysis.

Table 4-1a. Field data statistics for cores collected in the Northern TIP area.

Northern TIP	Count			Mean			Median			Maximum			Minimum			Std. Deviation		
Year	02	03[1]	02/03	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03
Probing Depth (in.)	589	258	847	46	48	46	42	48	44	124	96	124	1	5	1	25	17	23
Penetration Depth (in.)				44	60	49	39	60	48	121	108	121	4	8	4	23	19	23
Recovered Core Length (in.)				32	46	37	29	46	33	115	106	115	4	5	4	19	20	20
Field Recovery Ratio (%)				72	76	73	73	76	74	100	100	100	14	32	14	15	15	15
Lab Recovery Ratio (%)				68	75	70	67	76	69	246	103	246	12	32	12	19	16	18
Abandoned Locations	120	9	129	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incomplete Cores [2]	223	66	289	101	216	127	28	73	34	1200	2500	2500	1	1	1	182	435	266
% Incomplete Cores	38%	26%	34%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grabs [3]	24	2	26	31	56	33	25	56	26	102	83	102	3	29	3	24	38	25

Notes:

[1] - Core ID "RS1-9594-WT714" collected in 2003 was excluded from analysis because its field recovery << lab recovery.

[2] - PCB concentration in bottom core segment (mg/kg); all analyzed segments, including "archives only" were used in the analysis.

[3] - PCB concentration (mg/kg).

Data export from November 13, 2003 used for calculations.

Table 4-1b. Field data statistics for cores collected in the Griffin Island area.

Griffin Island	Count			Mean			Median			Maximum			Minimum			Std. Deviation		
Year	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03
Probing Depth (in.)	123	347	470	72	49	55	70	48	48	138	200	200	3	2	2	28	17	23
Penetration Depth (in.)				68	59	62	68	60	60	102	120	120	24	10	10	20	19	20
Recovered Core Length (in.)				50	44	46	52	43	45	90	93	93	3	7	3	18	17	17
Field Recovery Ratio (%)				74	74	74	75	73	74	98	100	100	8	30	8	15	13	14
Lab Recovery Ratio (%)				71	73	72	73	72	72	97	106	106	29	22	22	15	14	14
Abandoned Locations	13	8	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incomplete Cores [1]	8	27	35	8	62	50	4	5	4	30	670	670	1	1	1	10	142	127
% Incomplete Cores	7%	8%	7%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grabs [2]	2	6	8	23	13	16	23	12	15	27	22	27	19	6	6	5	6	7

Notes:

[1] *- PCB concentration in bottom core segment (mg/kg); all analyzed segments, including "archives only" were used in the analysis.*

[2] *- PCB concentration (mg/kg).*

Data export from November 13, 2003 used for calculations.

Table 4-1c. Field data statistics for cores collected in the Northumberland Dam area.

Northumberland Dam	Count			Mean			Median			Maximum			Minimum			Std. Deviation		
Year	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03	02	03	02/03
Probing Depth (in.)	142	196	338	55	66	61	48	64	58	156	155	156	5	1	1	31	27	29
Penetration Depth (in.)				42	63	54	36	60	50	96	120	120	6	8	6	24	26	27
Recovered Core Length (in.)				28	47	39	23	44	33	89	104	104	4	7	4	20	22	23
Field Recovery Ratio (%)				66	74	70	65	73	70	100	100	100	18	32	18	17	14	16
Lab Recovery Ratio (%)				63	73	69	62	73	69	136	106	136	14	32	14	19	14	17
Abandoned Locations	27	14	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Incomplete Cores [1]	66	36	102	118	94	110	18	9	16	1605	520	1605	1	2	1	273	141	234
% Incomplete Cores	46%	18%	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grabs [2]	6	10	16	25	17	20	18	10	12	68	76	76	6	2	2	23	23	22

Notes:

[1] - PCB concentration in bottom core segment (mg/kg); all analyzed segments, including "archives only" were used in the analysis.

[2] - PCB concentration (mg/kg).

Data export from November 13, 2003 used for calculations.

Table 4-2a. Field statistics for cores with similar bottom segment composition collected in the Northern TIP area.

Northern TIP	Gravel			Coarse Sand			Medium Sand			Fine Sand			Silt			Clay			Organic		
Year	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**
# Cores per grain size	22	9	**31**	160	20	**180**	-	39	**39**	215	64	**279**	48	22	**70**	126	89	**215**	16	15	**31**
% Cores per grain size	4%	3%	**4%**	27%	8%	**21%**	-	15%	**5%**	37%	25%	**33%**	8%	9%	**8%**	21%	34%	**25%**	3%	6%	**4%**
# Incomplete cores per grain size	13	5	**18**	78	9	**87**	-	12	**14**	85	16	**101**	26	10	**36**	11	5	**16**	9	9	**18**
% Incomplete per grain size	59%	56%	**58%**	49%	45%	**48%**	-	31%	**36%**	40%	25%	**36%**	54%	45%	**51%**	9%	6%	**7%**	56%	60%	**58%**
Probing depth (in.)	41	32	**38**	43	49	**44**	-	48	**48**	45	49	**46**	46	45	**46**	49	48	**49**	52	52	**52**
Penetration depth (in.)	40	41	**41**	40	54	**42**	-	57	**57**	43	57	**46**	44	52	**46**	53	70	**60**	46	54	**50**
Field recovery (in.)	29	28	**29**	28	34	**28**	-	40	**40**	30	41	**32**	33	38	**34**	44	61	**51**	29	35	**32**
Lab recovery (in.)	27	28	**27**	25	34	**26**	-	39	**39**	28	40	**31**	31	38	**33**	43	60	**50**	27	34	**31**
Field recovery ratio (%)	68	67	**68**	69	64	**69**	-	69	**69**	69	72	**70**	74	75	**75**	83	87	**85**	66	65	**66**
Lab recovery ratio (%)	65	67	**66**	63	63	**63**	-	68	**68**	64	70	**65**	71	74	**72**	82	87	**84**	59	65	**62**

Notes:

[1] *- The primary composition in the bottom core segment of each core was used in this analysis (in 2003 the primary composition in the bottom two inch segment was used).*

[2] *- Cores with no information on bottom segment composition were excluded from analysis.*

[3] *- The Core ID "RS1-9594-WT714" collected in 2003 was excluded from analysis because its field recovery << lab recovery.*

[4] *- Statistics shown for cores collected in the 2002 SSAP, 2003 SSAP, and both years combined.*

Data export from November 13, 2003 used in analysis (archive segments from all incomplete cores have been analyzed).

Table 4-2b. Field statistics for cores with similar bottom segment composition collected in the Griffin Island area.

Griffin Island	Gravel			Coarse Sand			Medium Sand			Fine Sand			Silt			Clay			Organic		
Year	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**
# Cores per grain size	2	8	**10**	25	33	**58**	-	66	**66**	51	103	**154**	8	33	**41**	33	73	**106**	3	31	**34**
% Cores per grain size	2%	2%	**2%**	20%	10%	**12%**	-	19%	**14%**	42%	30%	**33%**	7%	10%	**9%**	27%	21%	**23%**	2%	9%	**7%**
Incomplete cores	0	3	**3**	1	4	**5**	-	2	**2**	3	5	**8**	3	9	**12**	1	1	**2**	0	3	**3**
% Incomplete per grain size	0%	38%	**30%**	4%	12%	**9%**	-	3%	**3%**	6%	5%	**5%**	38%	27%	**29%**	3%	1%	**2%**	0%	10%	**9%**
Probing depth (in.)	63	51	**53**	84	44	**61**	-	47	**47**	74	48	**57**	57	46	**48**	63	52	**55**	77	54	**56**
Penetration depth (in.)	72	59	**61**	75	58	**65**	-	58	**58**	70	61	**64**	54	52	**52**	62	66	**65**	69	54	**55**
Field recovery (in.)	40	41	**41**	56	37	**45**	-	41	**41**	51	45	**47**	41	39	**39**	49	52	**51**	44	42	**42**
Lab recovery (in.)	41	33	**34**	55	37	**45**	-	40	**40**	49	44	**46**	38	38	**38**	45	52	**50**	37	41	**41**
Field recovery ratio (%)	54	71	**68**	74	65	**69**	-	71	**71**	71	73	**72**	78	76	**76**	78	79	**79**	63	76	**75**
Lab recovery ratio (%)	55	62	**61**	73	64	**68**	-	70	**70**	69	72	**71**	73	75	**74**	72	79	**77**	56	75	**73**

Notes:

1 - The primary composition in the bottom core segment of each core was used in this analysis (in 2003 the primary composition in the bottom two inch segment was used).

2 - Cores with no information on bottom segment composition were excluded from analysis.

3 - Statistics shown for cores collected in the 2002 SSAP, 2003 SSAP, and both years combined.

Data export from November 13, 2003 used in analysis (archive segments from all incomplete cores have been analyzed).

Table 4-2c. Field statistics for cores with similar bottom segment composition collected in the Northumberland Dam area.

Northumberland Dam	Gravel			Coarse Sand			Medium Sand			Fine Sand			Silt			Clay			Organic		
Year	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**	02	03	**02/03**
# Cores per grain size	2	4	**6**	9	11	**20**	-	37	**37**	62	66	**128**	52	26	**78**	3	24	**27**	14	28	**42**
% Cores per grain size	1%	2%	**2%**	6%	6%	**6%**	-	19%	**11%**	44%	34%	**38%**	37%	13%	**23%**	2%	12%	**8%**	10%	14%	**12%**
Incomplete cores	2	1	**3**	4	4	**8**	-	6	**6**	23	11	**34**	29	6	**35**	1	0	**1**	7	8	**15**
% Incomplete per grain size	100%	25%	**50%**	44%	36%	**40%**	-	16%	**16%**	37%	17%	**27%**	56%	23%	**45%**	33%	0%	**4%**	50%	29%	**36%**
Probing depth (in.)	29	53	**45**	37	60	**50**	-	66	**66**	49	68	**59**	57	62	**59**	23	58	**55**	93	75	**81**
Penetration depth (in.)	19	60	**46**	30	59	**46**	-	54	**54**	38	62	**51**	46	61	**51**	25	77	**71**	65	68	**67**
Field recovery (in.)	10.5	42	**32**	19	44	**33**	-	38	**38**	25	46	**36**	29	46	**35**	20	65	**60**	46	48	**47**
Lab recovery (in.)	12	39	**30**	18	44	**32**	-	38	**38**	24	45	**35**	27	46	**33**	20	65	**60**	45	47	**47**
Field recovery ratio (%)	56	71	**66**	66	76	**72**	-	71	**71**	67	72	**69**	64	75	**67**	75	84	**83**	65	71	**69**
Lab recovery ratio (%)	70	65	**67**	62	76	**70**	-	71	**71**	64	71	**68**	60	75	**65**	76	83	**82**	63	70	**68**

Notes:

The primary composition in the bottom core segment of each core was used in this analysis (in 2003 the primary composition in the bottom two inch segment was used).

Cores with no information on bottom segment composition were excluded from analysis.

Statistics shown for cores collected in the 2002 SSAP, 2003 SSAP, and both years combined.

Data export from November 13, 2003 used in analysis (archive segments from all incomplete cores have been analyzed).

Table 5-1. Results of dioxin analysis on core bottom samples in Candidate Phase 1 Areas.

Field Sample ID	2,3,7,8-TCDD	Total TCDDs	1,2,3,7,8-PeCDD	Total PeCDDs	1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD	Total HxCDDs	Total HpCDDs	OCDD
Northern Thompson Island Pool											
RS1-9392-WT126-024030	< 0.1325	< 0.1325	< 0.1529	< 0.1529	< 0.4902	< 0.2973	< 0.243	< 0.1258	< 0.4902	< 0.2973	< 1.0349
RS1-9392-WT129-024030	< 0.1574	< 0.1574	< 0.1817	< 0.1817	< 0.5825	< 0.3532	< 0.2887	< 0.1494	< 0.5825	< 0.3532	< 84
RS1-9392-WT132-024030	< 0.1259	< 0.1259	< 0.1453	< 0.1453	< 0.4657	< 0.2824	< 0.2308	< 0.1195	< 0.4657	< 0.2824	< 0.9832
RS1-9392-WT657-024030	< 0.0672	< 0.0672	< 0.174	< 0.174	< 0.296	< 0.222	< 0.127	< 0.24	< 0.127	< 0.248	< 3.05
RS1-9392-WT705-024030	< 0.101	0.118	< 0.262	< 0.262	< 0.445	< 0.834	< 0.19	< 0.359	< 0.19	< 1.39	< 4.64
RS1-9493-CT662-024030	< 0.102	< 0.102	< 0.265	0.806	< 0.451	< 0.338	< 0.193	< 0.364	< 0.594	< 0.651	< 4.75
RS1-9493-CT674-024030	< 0.1	< 0.1	< 0.26	< 0.26	< 0.443	< 1.54	< 0.189	< 0.358	1.38	< 2.97	< 10.1
RS1-9493-WT059-042048	< 0.1209	< 0.1209	< 0.1394	< 0.1394	< 0.4471	< 0.2711	< 0.2216	< 0.1147	< 0.4471	< 0.2711	< 0.9439
RS1-9493-WT060-024030	< 0.1132	< 0.1132	< 0.1306	< 0.1306	< 0.4187	< 0.2539	< 0.2075	< 0.1074	< 0.4187	< 0.2539	< 33.6
RS1-9493-WT062-024030	< 0.1281	< 0.1281	< 0.1478	< 0.1478	< 0.4739	< 0.2874	< 0.2349	< 0.1216	< 0.4739	< 0.2874	< 13.4
RS1-9493-WT067-024030	< 0.1285	< 0.1285	< 0.1483	< 0.1483	< 0.4753	< 0.2882	< 0.2356	< 0.1219	< 0.4753	< 0.2882	< 1.0035
Griffin Island											
RS1-9089-CT153-018024	< 0.098	< 0.098	< 0.254	< 0.254	< 0.432	< 2.08	< 0.185	< 0.349	< 0.185	< 3.91	< 14.9
RS1-9089-CT166-024030	< 0.0496	< 0.0496	< 0.0572	< 0.0572	< 0.1837	< 0.1113	< 0.091	< 0.0471	< 0.1837	< 0.1113	< 0.3878
RS1-9089-CT178-036042	< 0.1429	< 0.1429	< 0.1649	< 0.1649	< 0.529	< 0.3207	< 0.2621	< 0.1356	< 0.529	< 0.3207	< 1.1167
RS1-9089-WT030-030036	< 0.0996	0.112	< 0.258	0.901	0.592	13.2	0.261	0.58	7.52	34.1	698
RS1-9089-WT152-024030	< 0.103	< 0.103	< 0.266	< 0.266	< 0.453	< 1.73	< 0.194	< 0.366	0.21	< 3.62	< 85.7
RS1-9089-WT152-BD0001	< 0.102	< 0.102	< 0.265	< 0.265	< 0.451	< 3.29	< 0.193	< 0.365	1.05	< 6.81	< 116
RS1-9190-ET193-024028	< 2.7	< 2.7	< 7	< 7	< 11.9	34.6	< 5.08	< 9.62	8.12	34.6	1,220
RS1-9190-ET405-030036	< 0.1071	< 0.1071	< 0.1236	< 0.1236	< 0.3963	< 0.2403	< 0.1965	< 0.1016	< 0.3963	< 0.2403	< 62.8
RS1-9190-WT271-024030	< 0.1492	< 0.1492	< 0.1722	< 0.1722	< 0.5524	< 0.335	< 0.2737	< 0.1417	< 0.5524	< 0.335	< 1.1663
RS1-9190-WT453-024030	< 0.077	< 0.077	< 0.2	< 0.2	< 0.339	< 0.898	< 0.145	< 0.274	< 0.194	< 1.9	< 59.8
Northumberland Dam											
RS2-8483-ET106-024030	< 0.3533	< 0.3533	< 0.4077	< 0.4077	< 1.3073	20.5	< 0.6479	< 0.3353	< 1.3073	47.5	1,620
RS2-8483-ET144-024030	< 0.129	1.01	< 0.1499	< 0.1499	< 0.4808	25.9	< 0.238	< 0.1233	7.67	51.2	< 161
RS2-8584-ET008-018024	< 0.1315	< 0.1315	< 0.1517	< 0.1517	< 0.4865	5.55	< 0.2411	< 0.1248	< 0.4865	12.8	< 463
RS2-8584-ET019-012018	< 0.1324	< 0.1324	< 0.1528	< 0.1528	< 0.4898	10.1	< 0.2427	< 0.1256	< 0.4898	22.4	< 363

Note: All results in picograms/gram (pg/g).

Table 5-2. Results of furan analysis on core bottom samples in Candidate Phase 1 Areas.

Field Sample ID	2,3,4,6,7,8-HxCDF	1,2,3,4,7,8,9-HpCDF	2,3,7,8-TCDF	Total TCDFs	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	Total PeCDFs	1,2,3,7,8,9-HxCDF	1,2,3,4,6,7,8-HpCDF	1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF	Total HxCDFs	Total HpCDFs	OCDF
Northern Thompson Island Pool														
RS1-9392-WT126-024030	< 0.2387	< 0.199	< 0.1629	< 0.1629	< 0.3263	< 0.3114	< 0.3263	< 0.2673	< 0.2503	< 0.2928	< 0.2396	< 0.2928	< 0.2503	< 0.5385
RS1-9392-WT129-024030	< 0.2836	< 0.2365	1.4	1.43	< 0.3877	< 0.37	< 0.3877	< 0.3175	< 0.2974	< 0.3479	< 0.2847	< 0.3479	< 0.2974	< 0.6398
RS1-9392-WT132-024030	< 0.2267	< 0.1891	< 0.1547	< 0.1547	< 0.31	< 0.2958	< 0.31	< 0.2539	< 0.2378	< 0.2781	< 0.2276	< 0.2781	< 0.2378	< 0.5116
RS1-9392-WT657-024030	< 0.141	< 0.165	< 0.0809	< 0.0809	< 0.101	< 0.189	< 0.101	< 0.257	< 0.265	< 0.128	0.0966	< 0.0966	< 0.165	< 0.373
RS1-9392-WT705-024030	< 0.212	< 0.248	< 0.121	0.184	< 0.152	< 0.284	< 0.152	< 0.385	< 0.398	< 0.192	< 0.0911	< 0.294	< 0.248	< 0.559
RS1-9493-CT662-024030	< 0.214	< 0.251	< 0.123	0.28	< 0.154	< 0.288	< 0.154	< 0.39	< 0.403	< 0.195	< 0.0923	< 0.0923	< 0.251	< 0.567
RS1-9493-CT674-024030	< 0.211	< 0.247	< 0.121	0.729	< 0.151	< 0.283	0.183	< 0.383	< 0.396	< 0.191	< 0.0907	< 0.0907	< 0.247	< 0.557
RS1-9493-WT059-042048	< 0.2177	< 0.1815	< 0.1486	< 0.1486	< 0.2976	< 0.284	< 0.2976	< 0.2437	< 0.2283	< 0.267	< 0.2185	< 0.267	< 0.2283	< 0.4911
RS1-9493-WT060-024030	< 0.2039	< 0.17	< 0.1391	< 0.1391	< 0.2787	< 0.266	< 0.2787	< 0.2283	< 0.2138	< 0.2501	< 0.2047	< 0.2501	< 0.2138	< 0.46
RS1-9493-WT062-024030	< 0.2307	< 0.1924	< 0.1575	< 0.1575	< 0.3154	< 0.3011	< 0.3154	< 0.2584	< 0.242	< 0.283	< 0.2316	< 0.283	< 0.242	< 0.5206
RS1-9493-WT067-024030	< 0.2314	< 0.193	< 0.1579	< 0.1579	< 0.3164	< 0.302	< 0.3164	< 0.2591	< 0.2427	< 0.2839	< 0.2323	< 0.2839	< 0.2427	< 0.5221
Griffin Island														
RS1-9089-CT153-018024	< 0.206	< 0.241	< 0.118	< 0.118	< 0.148	< 0.276	< 0.148	< 0.374	< 0.387	< 0.187	< 0.089	0.213	0.988	1.41
RS1-9089-CT166-024030	< 0.0894	< 0.0745	< 0.061	< 0.061	< 0.1222	< 0.1167	< 0.1222	< 0.1001	< 0.0937	< 0.1097	< 0.0897	< 0.1097	< 0.0937	< 0.2018
RS1-9089-CT178-036042	< 0.2575	< 0.2147	< 0.1757	< 0.1757	< 0.3521	< 0.336	< 0.3521	< 0.2883	< 0.27	< 0.3159	< 0.2585	< 0.3159	< 0.27	< 0.581
RS1-9089-WT030-030036	0.524	0.449	9.99	28.7	2.8	2.08	10.7	0.512	2.45	1.78	0.712	6.14	5.55	3.01
RS1-9089-WT152-024030	< 0.216	< 0.252	1.71	8.61	0.587	0.425	2.36	< 0.392	0.595	0.355	0.226	0.858	1.08	< 0.57
RS1-9089-WT152-BD0001	< 0.215	< 0.251	0.837	2.84	0.316	< 0.288	1.28	< 0.391	0.904	0.27	< 0.092	1.25	1.83	1.09
RS1-9190-ET193-024028	< 5.66	< 6.63	< 3.25	< 3.25	< 4.06	< 7.6	< 4.06	< 10.3	31.3	< 5.14	< 2.44	6.03	60.3	31.2
RS1-9190-ET405-030036	< 0.1935	< 0.1609	2.44	4.03	< 0.2638	< 0.2517	< 0.263	< 0.2161	< 0.2023	< 0.2367	< 0.1937	< 0.2367	< 0.2023	< 0.4354
RS1-9190-WT271-024030	< 0.2689	< 0.2243	< 0.1835	< 0.1835	< 0.3677	< 0.3509	< 0.3677	< 0.3012	< 0.282	< 0.3299	< 0.2699	< 0.3299	< 0.282	< 0.6068
RS1-9190-WT453-024030	< 0.161	< 0.189	0.641	0.995	0.136	< 0.217	0.471	< 0.294	< 0.303	< 0.146	0.108	< 0.36	0.214	< 0.427
Northumberland Dam														
RS2-8483-ET106-024030	< 0.6365	< 0.53	2.29	7.36	< 0.8701	< 0.8305	< 0.8701	< 0.7127	< 0.667	< 0.7807	< 0.6389	< 0.7807	< 0.667	< 1.436
RS2-8483-ET144-024030	< 0.234	< 0.1952	< 0.1597	8.82	< 0.32	< 0.3054	11	< 0.2621	179	< 0.2871	< 0.235	89.6	309	61.3
RS2-8584-ET008-018024	< 0.2368	< 0.1975	< 0.1616	< 0.1616	< 0.3238	< 0.309	< 0.3238	< 0.2652	< 0.2484	< 0.2905	< 0.2378	< 0.2905	< 0.2484	< 0.5344
RS2-8584-ET019-012018	< 0.2385	< 0.1988	< 0.1627	< 0.1627	< 0.326	< 0.3111	< 0.326	< 0.267	7.2	< 0.2925	< 0.2394	< 0.2925	12.2	< 0.538

Note: All results in picograms/gram (pg/g).

Table 5-3. Results of RCRA metals analysis on core bottom samples in Candidate Phase 1 Areas.

Field Sample ID	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Northern Thompson Island Pool								
RS1-9392-WT126-024030	5.2	40	0.11	4.7	6.1	0.025	< 0.32	< 0.075
RS1-9392-WT129-024030	4.3	39.3	0.15	6.8	7.3	0.79	< 0.51	< 0.12
RS1-9392-WT132-024030	4.4	43	0.15	4.2	5.3	< 0.017	< 0.3	< 0.072
RS1-9392-WT657-024030	5.6	154	0.08	5	5.2	0.034	< 0.28	< 0.07
RS1-9392-WT705-024030	2.1	194	0.17	16	5.3	< 0.0053	< 0.3	< 0.074
RS1-9493-CT662-024030	5.1	114	0.32	18.7	9.1	0.025	< 0.31	< 0.078
RS1-9493-CT674-024030	5.8	93.9	0.25	18.5	9	0.025	< 0.31	< 0.078
RS1-9493-WT059-042048	4.3	147	0.44	27	11	< 0.022	< 0.4	< 0.094
RS1-9493-WT060-024030	4.6	197	0.55	37.3	14.2	< 0.025	< 0.44	< 0.1
RS1-9493-WT062-024030	1.1	25.5	0.044	3.6	9.8	0.029	< 0.34	< 0.082
RS1-9493-WT067-024030	2.6	35.4	0.063	3.7	13.5	0.025	< 0.38	< 0.09
Griffin Island								
RS1-9089-CT153-018024	0.88	23.9	< 0.048	3.6	2.8	0.0071	< 0.28	< 0.07
RS1-9089-CT166-024030	0.65	12	< 0.03	2	1.9	< 0.033	< 0.33	< 0.08
RS1-9089-CT178-036042	4.2	112	0.29	19.4	10.3	< 0.045	< 0.39	< 0.092
RS1-9089-WT030-030036	1.5	55	0.11	12.9	22.6	0.57	< 0.46	< 0.12
RS1-9089-WT152-024030	1.6	61.1	< 0.068	8.7	27	0.1	< 0.4	< 0.1
RS1-9089-WT152-BD0001	2.3	74.2	0.083	11.3	35.3	0.11	< 0.4	< 0.1
RS1-9190-ET193-024028	4.4	133	6.5	201	775	0.84	< 0.64	1.4
RS1-9190-ET405-030036	1.4	17.7	0.07	4.1	13	0.7	< 0.37	< 0.088
RS1-9190-WT271-024030	1.5	17.5	0.068	3	3.5	< 0.02	< 0.36	< 0.086
RS1-9190-WT453-024030	1.7	42.7	0.11	6.7	11.3	0.046	< 0.32	< 0.079
Northumberland Dam								
RS2-8483-ET106-024030	5	127	0.44	23.3	113	0.42	< 0.89	< 0.21
RS2-8483-ET144-024030	1.2	24.5	0.15	23.3	36	< 0.059	< 0.36	< 0.085
RS2-8584-ET008-018024	1.2	33.6	0.14	6.4	3.3	< 0.022	< 0.39	< 0.093
RS2-8584-ET019-012018	1.3	31.2	0.46	31.8	85.9	0.13	< 0.43	0.12

Note: All results in milligrams/liter (mg/L).

Table 5-4. Atterberg Limits and specific gravity in Northern Thompson Island Pool.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9392-WT215-002024	ENV	17	11	5	2.7
RS1-9392-CT607-030036	ENV	18	NA		2.72
RS1-9594-WT133-002024	ENV	19	NA		2.6
RS1-9493-WS602-002024	ENV	20	15	6	2.69
RS1-9493-WS082-002012	ENV	21	15	6	2.65
RS1-9493-WS090-024030	ENV	23	NA	23	2.67
RS1-9493-WT014-002024	ENV	23	15	9	2.57
RS1-9594-WS602-006024	ENV	24	17	6	2.68
RS1-9493-WS020-016024	ENV	25	16	9	2.7
RS1-9392-WT355-002024	ENV	26	NA		2.54
RS1-9392-WT222-002024	ENV	27	15	12	2.55
RS1-9493-WT027-008024	ENV	27	15	11	2.74
RS1-9594-WS110-010024	ENV	30	19	11	2.75
RS1-9594-WS609-006024	ENV	31	20	11	2.72
RS1-9493-CT182-002024	ENV	33	17	16	2.69
RS1-9493-WS098-018024	ENV	35	21	14	2.56
RS1-9594-WS161-012018	ENV	36	19	17	2.67
RS1-9493-CS133-012018	ENV	37	22	15	2.6
RS1-9493-CT662-007024	ENV	37	17	20	2.61
RS1-9493-WT210-002024	ENV	38	19	18	2.73
RS1-9392-WT143-002024	ENV	39	NA		2.43
RS1-9493-WT113-002012	ENV	39	17	22	2.7
RS1-9493-WT201-002024	ENV	39	18	21	2.68
RS1-9493-ET254-012018	ENV	42	21	21	2.7
RS1-9493-WS715-024030	ENV	43	24	19	2.36
RS1-9493-WS715-030036	ENV	44	NA		2.52
RS1-9493-WT117-012018	ENV	50	19	31	2.7
RS1-9493-WT211-002024	ENV	67	NA		1.99
RS1-9392-CS667-002024	ENV	NA	NA		2.74
RS1-9392-CT060-002012	ENV	NA	NA		2.6
RS1-9392-CT076-002012	ENV	NA	NA		2.54
RS1-9392-CT121-012018	ENV	NA	NA		2.58
RS1-9392-CT601-002012	ENV	NA	NA		2.66
RS1-9392-CT603-002012	ENV	NA	NA		2.5
RS1-9392-CT609-002024	ENV	NA	NA		2.76

Table 5-4. Atterberg Limits and specific gravity in Northern Thompson Island Pool.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9392-CT618-002024	ENV	NA	NA		2.5
RS1-9392-CT633-002012	ENV	NA	NA		2.55
RS1-9392-CT651-002024	ENV	NA	NA		2.4
RS1-9392-CT655-024030	ENV	NA	NA		2.71
RS1-9392-CT660-002024	ENV	NA	NA		2.66
RS1-9392-ET093-002024	ENV	NA	NA		2.58
RS1-9392-ET142-002024	ENV	NA	NA		2.59
RS1-9392-ET157-002012	ENV	NA	NA		2.7
RS1-9392-ET172-002024	ENV	NA	NA		2.63
RS1-9392-ET216-002024	ENV	NA	NA		2.54
RS1-9392-ET230-002024	ENV	NA	NA		2.66
RS1-9392-ET254-030036	ENV	NA	NA		2.6
RS1-9392-ET273-002024	ENV	NA	NA		2.65
RS1-9392-ET285-002012	ENV	NA	NA		2.52
RS1-9392-ET291-006010	ENV	NA	NA		2.28
RS1-9392-ET307-006010	ENV	NA	NA		2.78
RS1-9392-ET353-006012	ENV	NA	NA		2.74
RS1-9392-ET354-002012	ENV	NA	NA		2.68
RS1-9392-ET381-006012	ENV	NA	NA		2.76
RS1-9392-ET404-006012	ENV	NA	NA		2.87
RS1-9392-ET406-012018	ENV	NA	NA		2.64
RS1-9392-ET411-002012	ENV	NA	NA		2.9
RS1-9392-ET661-002024	ENV	NA	NA		2.83
RS1-9392-ET712-006012	ENV	NA	NA		2.43
RS1-9392-WT001-002024	ENV	NA	NA		2.38
RS1-9392-WT002-030036	ENV	NA	NA		1.81
RS1-9392-WT006-002024	ENV	NA	NA		2.11
RS1-9392-WT016-002024	ENV	NA	NA		2.1
RS1-9392-WT022-002024	ENV	NA	NA		2.21
RS1-9392-WT032-002012	ENV	NA	NA		2.29
RS1-9392-WT042-006012	ENV	NA	NA		2.55
RS1-9392-WT057-002024	ENV	NA	NA		2.55
RS1-9392-WT058-002012	ENV	NA	NA		2.84
RS1-9392-WT059-002012	ENV	NA	NA		2.83
RS1-9392-WT066-002024	ENV	NA	NA		2.7
RS1-9392-WT067-002024	ENV	NA	NA		2.78

Table 5-4. Atterberg Limits and specific gravity in Northern Thompson Island Pool.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9392-WT072-002024	ENV	NA	NA		2.49
RS1-9392-WT087-002024	ENV	NA	NA		2.42
RS1-9392-WT095-002012	ENV	NA	NA		2.42
RS1-9392-WT097-002024	ENV	NA	NA		2.72
RS1-9392-WT111-002024	ENV	NA	NA		2.63
RS1-9392-WT114-002012	ENV	NA	NA		2.72
RS1-9392-WT125-002024	ENV	NA	NA		2.62
RS1-9392-WT129-002024	ENV	NA	NA		2.29
RS1-9392-WT133-002024	ENV	NA	NA		2.7
RS1-9392-WT136-002024	ENV	NA	NA		2.29
RS1-9392-WT137-002024	ENV	NA	NA		2.75
RS1-9392-WT140-002012	ENV	NA	NA		2.54
RS1-9392-WT150-002024	ENV	NA	NA		2.5
RS1-9392-WT152-002012	ENV	NA	NA		2.42
RS1-9392-WT154-002024	ENV	NA	NA		2.72
RS1-9392-WT167-002024	ENV	NA	NA		2.51
RS1-9392-WT168-002012	ENV	NA	NA		2.69
RS1-9392-WT174-002024	ENV	NA	NA		2.52
RS1-9392-WT177-002024	ENV	NA	NA		2.69
RS1-9392-WT182-002024	ENV	NA	NA		2.37
RS1-9392-WT184-002012	ENV	NA	NA		2.79
RS1-9392-WT191-002024	ENV	NA	NA		2.66
RS1-9392-WT192-002024	ENV	NA	NA		2.64
RS1-9392-WT193-002024	ENV	NA	NA		2.69
RS1-9392-WT196-002024	ENV	NA	NA		2.51
RS1-9392-WT199-002024	ENV	NA	NA		2.7
RS1-9392-WT201-002024	ENV	NA	NA		2.64
RS1-9392-WT203-002012	ENV	NA	NA		2.48
RS1-9392-WT206-002024	ENV	NA	NA		2.57
RS1-9392-WT214-002012	ENV	NA	NA		2.74
RS1-9392-WT343-006012	ENV	NA	NA		2.67
RS1-9392-WT374-006012	ENV	NA	NA		2.75
RS1-9392-WT602-002024	ENV	NA	NA		2.79
RS1-9392-WT704-002012	ENV	NA	NA		2.47
RS1-9392-WT706-002012	ENV	NA	NA		2.43
RS1-9493-CS112-002012	ENV	NA	NA		2.61

Table 5-4. Atterberg Limits and specific gravity in Northern Thompson Island Pool.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9493-CS112-012018	ENV	NA	NA		2.58
RS1-9493-CS121-018024	ENV	NA	NA		2.8
RS1-9493-CS133-006012	ENV	NA	NA		1.4
RS1-9493-CS175-002006	ENV	NA	NA		2.61
RS1-9493-CS634-002012	ENV	NA	NA		2.49
RS1-9493-CS650-002012	ENV	NA	NA		2.55
RS1-9493-CS713-002012	ENV	NA	NA		2.77
RS1-9493-CT665-002018	ENV	NA	NA		2.61
RS1-9493-CT675-002018	ENV	NA	NA		2.59
RS1-9493-CT736-002024	ENV	NA	NA		2.86
RS1-9493-ES157-006012	ENV	NA	NA		2.54
RS1-9493-ET268-012018	ENV	NA	NA		2.27
RS1-9493-WS066-002024	ENV	NA	NA		2.76
RS1-9493-WS091-024030	ENV	NA	NA		2.53
RS1-9493-WS092-002024	ENV	NA	NA		2.74
RS1-9493-WS094-002012	ENV	NA	NA		2.53
RS1-9493-WS115-006012	ENV	NA	NA		2.74
RS1-9493-WS604-002018	ENV	NA	NA		2.73
RS1-9493-WS605-002012	ENV	NA	NA		2.59
RS1-9493-WS611-002024	ENV	NA	NA		2.55
RS1-9493-WS614-006012	ENV	NA	NA		2.56
RS1-9493-WS615-002024	ENV	NA	NA		2.72
RS1-9493-WS617-002024	ENV	NA	NA		2.75
RS1-9493-WS619-002024	ENV	NA	NA		2.68
RS1-9493-WS626-002024	ENV	NA	NA		2.6
RS1-9493-WS635-002024	ENV	NA	NA		2.73
RS1-9493-WS647-002024	ENV	NA	NA		2.74
RS1-9493-WS651-002024	ENV	NA	NA		2.61
RS1-9493-WS710-002024	ENV	NA	NA		2.68
RS1-9493-WS715-002024	ENV	NA	NA		2.59
RS1-9493-WT003-002024	ENV	NA	NA		2.39
RS1-9493-WT004-002024	ENV	NA	NA		2.36
RS1-9493-WT009-002024	ENV	NA	NA		2.77
RS1-9493-WT011-002024	ENV	NA	NA		2.53
RS1-9493-WT013-002024	ENV	NA	NA		2.46
RS1-9493-WT017-002024	ENV	NA	NA		2.54

Table 5-4. Atterberg Limits and specific gravity in Northern Thompson Island Pool.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9493-WT025-002024	ENV	NA	NA		2.33
RS1-9493-WT031-002012	ENV	NA	NA		2.03
RS1-9493-WT033-002024	ENV	NA	NA		2.62
RS1-9493-WT034-002024	ENV	NA	NA		2.71
RS1-9493-WT036-002024	ENV	NA	NA		2.61
RS1-9493-WT043-002024	ENV	NA	NA		2.77
RS1-9493-WT044-002024	ENV	NA	NA		2.52
RS1-9493-WT050-002024	ENV	NA	NA		2.81
RS1-9493-WT051-002024	ENV	NA	NA		2.55
RS1-9493-WT052-002013	ENV	NA	NA		2.73
RS1-9493-WT053-002024	ENV	NA	NA		2.31
RS1-9493-WT068-002024	ENV	NA	NA		2.53
RS1-9493-WT071-002024	ENV	NA	NA		2.52
RS1-9493-WT072-006012	ENV	NA	NA		2.57
RS1-9493-WT073-002024	ENV	NA	NA		2.79
RS1-9493-WT078-002024	ENV	NA	NA		2.56
RS1-9493-WT080-002012	ENV	NA	NA		1.83
RS1-9493-WT086-006012	ENV	NA	NA		2.66
RS1-9493-WT144-002012	ENV	NA	NA		2.53
RS1-9493-WT146-002012	ENV	NA	NA		2.69
RS1-9493-WT159-002024	ENV	NA	NA		2.56
RS1-9493-WT165-002012	ENV	NA	NA		2.67
RS1-9493-WT172-006012	ENV	NA	NA		2.1
RS1-9493-WT176-002012	ENV	NA	NA		2.71
RS1-9493-WT179-002012	ENV	NA	NA		2.7
RS1-9493-WT186-006012	ENV	NA	NA		2.27
RS1-9493-WT187-006012	ENV	NA	NA		2.53
RS1-9493-WT189-002012	ENV	NA	NA		2.39
RS1-9493-WT195-002024	ENV	NA	NA		2.44
RS1-9493-WT205-002024	ENV	NA	NA		2.49
RS1-9493-WT206-002024	ENV	NA	NA		2.36
RS1-9493-WT207-024030	ENV	NA	NA		2.78
RS1-9493-WT234-002012	ENV	NA	NA		2.53
RS1-9493-WT241-002012	ENV	NA	NA		2.68
RS1-9493-WT250-002012	ENV	NA	NA		2.69
RS1-9493-WT702-024030	ENV	NA	NA		2.53

Table 5-4. Atterberg Limits and specific gravity in Northern Thompson Island Pool.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9493-WT718-002024	ENV	NA	NA		2.5
RS1-9493-WT725-030036	ENV	NA	NA		2.63
RS1-9493-WT726-002024	ENV	NA	NA		2.4
RS1-9493-WT726-024030	ENV	NA	NA		2.51
RS1-9493-WT727-002024	ENV	NA	NA		2.4
RS1-9493-WT728-002024	ENV	NA	NA		2.42
RS1-9594-WS145-002012	ENV	NA	NA		2.79
RS1-9594-WS169-002024	ENV	NA	NA		2.78
RS1-9594-WS175-024030	ENV	NA	NA		2.46
RS1-9594-WS601-002024	ENV	NA	NA		2.72
RS1-9594-WS605-002019	ENV	NA	NA		2.76
RS1-9594-WS702-002024	ENV	NA	NA		1.86
RS1-9594-WS703-002022	ENV	NA	NA		2.57
RS1-9594-WS707-002024	ENV	NA	NA		2.79
RS1-9594-WT121-006012	ENV	NA	NA		2.7
RS1-9594-WT129-002024	ENV	NA	NA		2.53
RS1-9594-WT136-002018	ENV	NA	NA		2.58
RS1-9594-WT143-024030	ENV	NA	NA		2.7
RS1-9594-WT149-002024	ENV	NA	NA		2.66
RS1-9594-WT156-002024	ENV	NA	NA		2.53
RS1-9594-WT171-002012	ENV	NA	NA		2.48
RS1-9594-WT701-024030	ENV	NA	NA		2.28
RS1-9493-WS066-BD0001	DUP	19	NA		2.78
RS1-9594-WT133-BD0001	DUP	23	NA		2.63
RS1-9493-WT113-BD0001	DUP	31	16	15	2.69
RS1-9493-CT182-BD0001	DUP	32	16	16	2.67
RS1-9594-WS110-BD0001	DUP	35	20	16	2.67
RS1-9493-WT201-BD0001	DUP	37	18	19	2.74
RS1-9493-WT210-BD0001	DUP	37	21	16	2.75
RS1-9392-ET172-BD0001	DUP	NA	NA		2.58
RS1-9392-WT111-BD0001	DUP	NA	NA		2.6
RS1-9392-WT177-BD0001	DUP	NA	NA		2.73
RS1-9392-WT602-BD0001	DUP	NA	NA		2.76
RS1-9493-CS112-BD0001	DUP	NA	NA		2.58
RS1-9493-WS094-BD0001	DUP	NA	NA		2.73
RS1-9493-WS604-BD0001	DUP	NA	NA		2.74

Table 5-4. Atterberg Limits and specific gravity in Northern Thompson Island Pool.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9493-WS635-BD0001	DUP	NA	NA		2.71
RS1-9493-WS715-BD0001	DUP	NA	NA		2.52
RS1-9493-WT044-BD0001	DUP	NA	NA		2.53
RS1-9493-WT195-BD0001	DUP	NA	NA		2.52
RS1-9493-WT241-BD0001	DUP	NA	NA		2.7
RS1-9594-WS169-BD0001	DUP	NA	NA		2.7

NA = Not applicable

Table 5-5. Atterberg Limits and specific gravity in Griffin Island area.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9089-WS189-030036	ENV	22	16	6	2.68
RS1-9190-WT439-002024	ENV	22	NA		2.65
RS1-9089-WT238-002024	ENV	25	NA		2.5
RS1-9190-CS444-002024	ENV	26	18	8	2.66
RS1-9190-WT251-002024	ENV	26	NA		2.19
RS1-9089-WT242-002024	ENV	27	NA		2.52
RS1-9190-ET423-006012	ENV	27	19	9	2.51
RS1-9089-WT221-002024	ENV	28	NA		2.49
RS1-9089-WT230-002024	ENV	28	NA		2.51
RS1-9089-WT138-002024	ENV	29	29	10	2.66
RS1-9089-WT148-002024	ENV	29	NA		2.58
RS1-9190-WT236-002012	ENV	29	NA		2.33
RS1-9089-ET046-011024	ENV	31	19	12	2.65
RS1-9089-WT056-002024	ENV	31	NA		2.51
RS1-9089-ET064-024030	ENV	36	17	19	2.73
RS1-9089-WT175-002024	ENV	36	NA		2.47
RS1-9190-ET427-024030	ENV	37	22	15	2.65
RS1-9089-ET006-024030	ENV	38	17	20	2.67
RS1-9190-WT455-002024	ENV	38	NA		2.4
RS1-9190-WT441-002012	ENV	43	NA		2.37
RS1-9089-WT111-002024	ENV	45	NA		2.39
RS1-9190-WT165-002024	ENV	47	NA		2.43
RS1-9190-ET331-002012	ENV	48	NA		2.4
RS1-9190-WT460-002024	ENV	49	NA		2.3
RS1-9089-WT134-002024	ENV	50	30	20	2.46
RS1-9190-WT297-002024	ENV	50	NA		2.58
RS1-9089-ET250-002012	ENV	51	NA		2.42
RS1-9089-WT208-002024	ENV	51	NA		2.29
RS1-9190-WT164-002024	ENV	54	NA		2.45
RS1-9089-WT124-002024	ENV	56	NA		2.19
RS1-9089-WT058-002024	ENV	57	NA		2.32
RS1-9190-WT188-002024	ENV	57	NA		2.16
RS1-9089-WT209-024030	ENV	61	NA		2.17
RS1-9190-WT202-002012	ENV	61	NA		2.15
RS1-9190-WT333-002024	ENV	65	49	15	2.4
RS1-9089-WT073-006012	ENV	67	48	19	2.43
RS1-9190-WT214-002024	ENV	70	NA		2.13
RS1-9089-WT066-002012	ENV	71	58	12	2.42
RS1-9089-WT082-002024	ENV	73	NA		2.08
RS1-9089-WT207-002024	ENV	76	48	28	2.23
RS1-9089-WT181-002012	ENV	78	59	19	2.24
RS1-9190-ET362-002012	ENV	79	41	39	2.06
RS1-9089-WT169-002024	ENV	80	48	32	2.1
RS1-9089-WT161-012018	ENV	83	53	30	2.06
RS1-9089-CS222-002016	ENV	NA	NA		2.71
RS1-9089-CS239-002012	ENV	NA	NA		2.61

Table 5-5. Atterberg Limits and specific gravity in Griffin Island area.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9089-CS254-002012	ENV	NA	NA		2.69
RS1-9089-CT178-002024	ENV	NA	NA		2.67
RS1-9089-CT715-024030	ENV	NA	NA		2.72
RS1-9089-ET015-002024	ENV	NA	NA		2.5
RS1-9089-ET027-002024	ENV	NA	NA		2.78
RS1-9089-ET053-002014	ENV	NA	NA		2.81
RS1-9089-ET228-002012	ENV	NA	NA		2.52
RS1-9089-WS060-024030	ENV	NA	NA		2.72
RS1-9089-WS253-002024	ENV	NA	NA		2.7
RS1-9089-WS707-002024	ENV	NA	NA		2.74
RS1-9089-WS709-002024	ENV	NA	NA		2.62
RS1-9089-WT020-002024	ENV	NA	NA		2.09
RS1-9089-WT023-002024	ENV	NA	NA		2.53
RS1-9089-WT041-002024	ENV	NA	NA		2.28
RS1-9089-WT051-002024	ENV	NA	NA		2.28
RS1-9089-WT075-002024	ENV	NA	NA		2.28
RS1-9089-WT080-002024	ENV	NA	NA		2.26
RS1-9089-WT086-002024	ENV	NA	NA		2.32
RS1-9089-WT096-030036	ENV	NA	NA		2.74
RS1-9089-WT122-024030	ENV	NA	NA		2.59
RS1-9089-WT125-002024	ENV	NA	NA		2.67
RS1-9089-WT128-002012	ENV	NA	NA		1.81
RS1-9089-WT133-002024	ENV	NA	NA		2.39
RS1-9089-WT141-002024	ENV	NA	NA		2.65
RS1-9089-WT195-030036	ENV	NA	NA		2.75
RS1-9089-WT249-002024	ENV	NA	NA		2.66
RS1-9190-CS281-002012	ENV	NA	NA		2.77
RS1-9190-CS318-002024	ENV	NA	NA		2.66
RS1-9190-CS336-006012	ENV	NA	NA		2.68
RS1-9190-CS710-024030	ENV	NA	NA		2.68
RS1-9190-CS712-002024	ENV	NA	NA		2.72
RS1-9190-CS714-006012	ENV	NA	NA		2.73
RS1-9190-CS715-024030	ENV	NA	NA		2.74
RS1-9190-ET182-002024	ENV	NA	NA		2.39
RS1-9190-ET250-002024	ENV	NA	NA		2.54
RS1-9190-ET275-002024	ENV	NA	NA		2.73
RS1-9190-ET302-002024	ENV	NA	NA		2.77
RS1-9190-ET304-002012	ENV	NA	NA		2.81
RS1-9190-ET319-002024	ENV	NA	NA		2.77
RS1-9190-ET322-002024	ENV	NA	NA		2.75
RS1-9190-ET323-002024	ENV	NA	NA		2.76
RS1-9190-ET347-024030	ENV	NA	NA		2.69
RS1-9190-ET358-002024	ENV	NA	NA		2.86
RS1-9190-ET359-002024	ENV	NA	NA		2.76
RS1-9190-ET360-002024	ENV	NA	NA		2.72
RS1-9190-ET383-002024	ENV	NA	NA		2.65
RS1-9190-ET384-030036	ENV	NA	NA		2.81

Table 5-5. Atterberg Limits and specific gravity in Griffin Island area.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS1-9190-ET390-002024	ENV	NA	NA		2.59
RS1-9190-ET393-002024	ENV	NA	NA		2.45
RS1-9190-ET402-002024	ENV	NA	NA		2.72
RS1-9190-ET403-002024	ENV	NA	NA		2.65
RS1-9190-ET405-002024	ENV	NA	NA		2.36
RS1-9190-ET424-002012	ENV	NA	NA		1.5
RS1-9190-ET426-002024	ENV	NA	NA		1.44
RS1-9190-ET434-018024	ENV	NA	NA		2.77
RS1-9190-ET436-002024	ENV	NA	NA		2.46
RS1-9190-WT177-002024	ENV	NA	NA		2.37
RS1-9190-WT220-002024	ENV	NA	NA		2.34
RS1-9190-WT225-002024	ENV	NA	NA		2.46
RS1-9190-WT239-002024	ENV	NA	NA		2.6
RS1-9190-WT244-006012	ENV	NA	NA		2.51
RS1-9190-WT261-002024	ENV	NA	NA		2.62
RS1-9190-WT263-012018	ENV	NA	NA		2.6
RS1-9190-WT274-002012	ENV	NA	NA		2.32
RS1-9190-WT298-002012	ENV	NA	NA		2.41
RS1-9190-WT315-002024	ENV	NA	NA		2.51
RS1-9190-WT343-002024	ENV	NA	NA		2.27
RS1-9190-WT353-002024	ENV	NA	NA		2.66
RS1-9190-WT365-024030	ENV	NA	NA		2.75
RS1-9190-WT374-002024	ENV	NA	NA		2.5
RS1-9190-WT387-002024	ENV	NA	NA		2.65
RS1-9190-WT388-002024	ENV	NA	NA		2.32
RS1-9190-WT397-002024	ENV	NA	NA		2.7
RS1-9190-WT399-002024	ENV	NA	NA		2.38
RS1-9190-WT408-002024	ENV	NA	NA		2.64
RS1-9190-WT419-002024	ENV	NA	NA		2.59
RS1-9190-WT420-002012	ENV	NA	NA		2.23
RS1-9190-WT431-002024	ENV	NA	NA		2.24
RS1-9190-WT432-024030	ENV	NA	NA		2.5
RS1-9190-WT452-002024	ENV	NA	NA		2.46
RS1-9190-WT702-024030	ENV	NA	NA		2.4
RS1-9089-WT230-BD0001	DUP	28	NA		2.53
RS1-9089-WT208-BD0001	DUP	52	NA		2.33
RS1-9190-WT297-BD0001	DUP	54	NA		2.47
RS1-9089-WT058-BD0002	DUP	55	NA		2.32
RS1-9089-WT023-BD0001	DUP	NA	NA		2.6
RS1-9190-ET322-BD0002	DUP	NA	NA		2.77
RS1-9190-WT225-BD0001	DUP	NA	NA		2.46
RS1-9190-WT408-BD0001	DUP	NA	NA		2.65
RS1-9190-WT419-BD0001	DUP	NA	NA		2.57

Table 5-6. Atterberg Limits and specific gravity in Northumberland Dam area.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS2-8584-ET045-002024	ENV	22	19	3	2.54
RS2-8584-ET155-002012	ENV	28	NA		2.49
RS2-8584-ET075-002012	ENV	33	NA		2.37
RS2-8483-WT169-006012	ENV	37	NA		2.42
RS2-8584-ET140-002012	ENV	43	NA		2.27
RS2-8483-ET030-002024	ENV	44	NA		2.37
RS2-8483-ET136-002012	ENV	45	NA		2.46
RS2-8584-ET130-002012	ENV	52	43	9	2.31
RS2-8483-ET025-002012	ENV	53	NA		2.29
RS2-8483-ET095-002024	ENV	59	NA		2.34
RS2-8483-ET161-002024	ENV	62	NA		2.29
RS2-8483-ET022-002012	ENV	64	NA		2.21
RS2-8483-ET151-002012	ENV	64	NA		2.47
RS2-8483-ET110-002024	ENV	66	NA		2.09
RS2-8584-ES098-002012	ENV	66	NA		2.13
RS2-8584-ET118-002024	ENV	68	NA		2.22
RS2-8483-ET160-012018	ENV	69	NA		2.14
RS2-8483-ET143-006012	ENV	71	61	10	2.2
RS2-8483-ET154-012018	ENV	72	50	22	2.19
RS2-8584-ET013-002024	ENV	75	NA		2.36
RS2-8483-ET099-030036	ENV	76	NA		2.23
RS2-8483-ET122-036042	ENV	76	NA		2.2
RS2-8483-ET096-024030	ENV	79	NA		2.23
RS2-8483-ET117-002024	ENV	79	NA		2.22
RS2-8584-ET141-006012	ENV	94	62	32	2.31
RS2-8483-ET105-002024	ENV	103	NA		2.18
RS2-8483-ET111-002024	ENV	137	71	67	1.99
RS2-8483-ET112-002024	ENV	159	83	76	2.08
RS2-8483-ET097-002024	ENV	166	75	92	2.23
RS2-8483-CT067-024030	ENV	NA	NA		2.7
RS2-8483-CT134-002024	ENV	NA	NA		2.29
RS2-8483-CT148-024030	ENV	NA	NA		2.73
RS2-8483-CT703-006012	ENV	NA	NA		2.64
RS2-8483-ET007-002024	ENV	NA	NA		2.72
RS2-8483-ET009-002012	ENV	NA	NA		2.4
RS2-8483-ET018-024030	ENV	NA	NA		
RS2-8483-ET040-002024	ENV	NA	NA		2.62
RS2-8483-ET047-002006	ENV	NA	NA		2.68
RS2-8483-ET048-024030	ENV	NA	NA		2.72
RS2-8483-ET056-002024	ENV	NA	NA		2.46
RS2-8483-ET057-002024	ENV	NA	NA		2.61
RS2-8483-ET059-030036	ENV	NA	NA		2.55
RS2-8483-ET068-002024	ENV	NA	NA		2.62
RS2-8483-ET069-030036	ENV	NA	NA		2.72
RS2-8483-ET074-002024	ENV	NA	NA		2.54
RS2-8483-ET083-030036	ENV	NA	NA		2.48
RS2-8483-ET087-002012	ENV	NA	NA		2.07

Table 5-6. Atterberg Limits and specific gravity in Northumberland Dam area.

Sample ID	Sample Type	Liquid Limit	Plastic Limit	Plasticity Index	Specific Gravity
RS2-8483-ET092-024030	ENV	NA	NA		2.61
RS2-8483-ET113-002024	ENV	NA	NA		2.34
RS2-8483-ET132-002024	ENV	NA	NA		2.38
RS2-8483-ET139-002012	ENV	NA	NA		2.14
RS2-8483-ET144-002024	ENV	NA	NA		2.47
RS2-8483-ET709-030036	ENV	NA	NA		2.36
RS2-8483-WT034-002013	ENV	NA	NA		2.73
RS2-8483-WT081-002012	ENV	NA	NA		2.7
RS2-8483-WT162-030036	ENV	NA	NA		2.33
RS2-8483-WT163-002024	ENV	NA	NA		2.3
RS2-8584-CS162-002012	ENV	NA	NA		2.71
RS2-8584-CT143-006013	ENV	NA	NA		2.6
RS2-8584-ES081-002006	ENV	NA	NA		2.72
RS2-8584-ES086-002012	ENV	NA	NA		2.63
RS2-8584-ES091-002024	ENV	NA	NA		2.72
RS2-8584-ES096-002024	ENV	NA	NA		2.57
RS2-8584-ES106-002024	ENV	NA	NA		2.67
RS2-8584-ES135-002006	ENV	NA	NA		2.68
RS2-8584-ES144-002024	ENV	NA	NA		2.68
RS2-8584-ES712-002012	ENV	NA	NA		2.59
RS2-8584-ES714-030036	ENV	NA	NA		2.7
RS2-8584-ES725-024030	ENV	NA	NA		2.71
RS2-8584-ES726-024030	ENV	NA	NA		2.7
RS2-8584-ET012-002024	ENV	NA	NA		2.64
RS2-8584-ET019-002012	ENV	NA	NA		2.46
RS2-8584-ET033-002024	ENV	NA	NA		2.37
RS2-8584-ET046-002024	ENV	NA	NA		2.63
RS2-8584-ET052-002024	ENV	NA	NA		2.54
RS2-8584-ET056-002024	ENV	NA	NA		2.57
RS2-8584-ET076-002024	ENV	NA	NA		2.62
RS2-8584-WS006-002024	ENV	NA	NA		2.48
RS2-8584-WS028-002024	ENV	NA	NA		2.55
RS2-8584-WS094-002024	ENV	NA	NA		2.66
RS2-8584-WS701-024030	ENV	NA	NA		2.41
RS2-8685-ES006-002024	ENV	NA	NA		2.37
RS2-8685-WS701-002024	ENV	NA	NA		2.49
RS2-8483-ET105-BD0001	DUP	83	NA		2.18
RS2-8483-CT134-BD0001	DUP	NA	NA		2.31
RS2-8483-ET113-BD0001	DUP	NA	NA		2.21
RS2-8584-ES086-BD0001	DUP	NA	NA		2.59
RS2-8685-ES006-BD0001	DUP	NA	NA		2.49

Table 7-1. P-values for comparison of the 2003 PE sample mean to the 2002 PE sample mean.

Description	PE1	PE2	PE3	PE4	PE5
Method GEHR8082					
A1221, A1242[1]	0.0012*	0.35	0.006*	0.62	0.2
Total PCBs[2]					
Kolmogorov-Smirnov	0.0012*	0.44	0.078	0.32	0.66
Wilcoxon	0.012**	0.79	0.034**	0.65	0.35
Student's t	0.084	0.76	0.011**	0.69	0.33
1221 [2]					
Kolmogorov-Smirnov	0.0061*	0.78	0.035**	0.32	0.49
Wilcoxon	0.0052*	0.86	0.013**	0.72	0.52
Student's t	0.041**	0.67	0.0026*	0.79	0.48
1242 [2]					
Kolmogorov-Smirnov	0.23	0.39	0.538	0.32	0.072
Wilcoxon	0.98	0.67	0.709	0.62	0.12
Student's t	0.71	0.95	0.43	0.41	0.13
Method GEHR680					
Mono, Di, Tri+ [1]	0.017**	0.18	0.58 [3]	0.076	0.019**
Total PCBs[2]					
Kolmogorov-Smirnov	0.088	0.29	1.0 [3]	0.2	0.85
Wilcoxon	0.036**	0.27	1	0.15	0.8
Student's t	0.012**	0.68		0.1	0.66
Mono [2]					
Kolmogorov-Smirnov	0.24	0.87	1.0 [3]	0.2	0.1
Wilcoxon	0.051	0.62	1	0.15	0.048**
Student's t	0.17	0.64		0.045**	0.15
Di [2]					
Kolmogorov-Smirnov	0.035**	0.4	0.93 [3]	0.6	0.78
Wilcoxon	0.025**	0.53	1	0.77	0.4
Student's t	0.017**	0.9		0.25	0.54
TriPlus [2]					
Kolmogorov-Smirnov	0.071	0.079	1.0 [3]	0.6	0.19
Wilcoxon	0.051	0.18	0.56	0.39	0.11
Student's t	0.0014*	0.55		0.19	0.23

Notes:

[1] - MULTIVARIATE, NON-PARAMETRIC TWO-SAMPLE TEST, "On a new multivariate two-sample test", Carsten Franz, Ludwig Baringhaus (2002).

[2] - UNIVARIATE TWO-SAMPLE TESTS.

[3] - Only one PE-3 was analyzed in 2003 (prior to the 2003 SSAP) for GEHR680 homolog analysis.

** - Data sets are statistically different at 99% confidence level.*

*** - Data sets are statistically different at 95% confidence level.*

Table 7-2. Candidate Phase 1 Areas summary of analytical data quality for sediment environmental samples[1].

ANALYSIS FRACTION	NUMBER OF RESULTS[2] QUALIFIED										TOTAL NUMBER OF RESULTS[4]	% COMPLETENESS[5]	% UNUSABLE DATA[6]	% USABLE DATA[7]	QUALITATIVE DATA QUALITY
	UNQUALIFIED POSITIVE RESULTS	U	U*	JN	J	J[3]	UJ	R	UR	EMPC					
PCBs as Aroclors (GEHR8082)	10,939	36,280	457	1	6,560	1,934	9,497	0	170	NA	63,904	76.2%	0.3%	99.7%	Good
PCB Homologs (GEHR680)	1,269	1,257	4	0	1,558	624	663	0	49	NA	4,800	60.5%	1.0%	99.0%	Average
Dioxins/Dibenzofurans (USEPA 1613)	22	446	31	0	62	46	39	0	0	0	600	84.5%	0.0%	100.0%	Good
Total Organic Carbon (Lloyd Kahn)	823	0	84		1,210	0	0	0	0	NA	2,117	38.9%	0.0%	100.0%	Poor
RCRA Metals [(6010B), not including Hg)]	94	44	0	0	25	17	5	0	0	NA	168	91.4%	0.0%	100.0%	Very Good
Mercury (7471A)	9	6	3	0	6	4	0	0	0	NA	24	75.0%	0.0%	100.0%	Good
ENTIRE SEDIMENT DATA SET	13,156	38,033	579	1	9,421	2,625	10,204	0	219	0	71,613	74.2%	0.3%	99.7%	Above Average

Notes:

[1] *- Summary is for sediment environmental samples and does not include results from PEs, duplicates, or blanks. Summary is based on qualification of data from verification and validation.*

[2] *- Results are the number of individual analytes in the analysis fraction. For example, there are 8 analytes in the Total PCBs as Aroclors analysis fraction.*

[3] *- Results qualified as estimates due to being below the reporting limit. For example, of the 3605 GEHR8082 results that were qualified J, 1229 results were qualified J due to being below the reporting limit.*

[4] *- Total Number of Results is the summation of all Qualified and Unqualified Results.*

[5] *- The % Completeness is the sum of results that were valid as reported [Unqualified Positive Results + U + EMPC for Dioxins/Dibenzofurans]/Total Number of Results - J3.*

[6] *- % Unusable Data is the sum of the results qualified R + UR/Total Number of Results.*

[7] *- % Usable Data is the sum of the Unqualified Positive Results + U + U* + J + J3 + JN + UJ [+ EMPC for Dioxins/Dibenzofurans]/Total Number of Results.*

Table 7-3. Candidate Phase 1 Areas summary of GEHR8082 analytical data quality for sediment environmental samples[1].

	NUMBER OF RESULTS QUALIFIED													
ANALYSIS FRACTION	UNQUALIFIED POSITIVE RESULTS	U	U*	JN	J	J[3]	UJ	R	UR	TOTAL NUMBER OF RESULTS[4]	% COMPLETENESS	% UNUSABLE DATA[6]	% USABLE DATA[7]	QUALITATIVE DATA QUALITY
Aroclor-1016	0	6,177	0	0	1	1	1,779	0	31	7,988	77.3%	0.4%	99.6%	Good
Aroclor-1221	3,600	1,931	243	1	1,915	368	293	0	5	7,988	72.6%	0.1%	99.9%	Above Average
Aroclor-1232	0	6,178	0	0	0	0	1,779	0	31	7,988	77.3%	0.4%	99.6%	Good
Aroclor-1242	3,486	2,267	45	0	1,856	420	329	0	5	7,988	76.0%	0.1%	99.9%	Good
Aroclor-1248	4	6,141	0	0	2	1	1,810	0	31	7,988	76.9%	0.4%	99.6%	Good
Aroclor-1254	496	5,541	14	0	457	102	1,449	0	31	7,988	76.6%	0.4%	99.6%	Good
Aroclor-1260	9	6,166	0	0	2	2	1,780	0	31	7,988	77.3%	0.4%	99.6%	Good
Total PCBs(GEHR8082)	3,344	1,879	155	0	2,327	1,040	278	0	5	7,988	75.2%	0.1%	99.9%	Good
PCBs as Aroclors (GEHR8082)[2]	10,939	36,280	457	1	6,560	1,934	9,497	0	170	63,904	76.2%	0.3%	99.7%	Good

Notes:

1 - Summary is for sediment environmental samples and does not include results from PEs, Duplicates, or Blanks. Summary is based on Qualification of data from verification and validation.

2 - Results are the number of individual analytes in the analysis fraction. For example, there are 8 analytes in the Total PCBs as Aroclors analysis fraction.

3 - Results qualified as estimates due to being below the reporting limit. For example, of the 3605 GEHR8082 results that were qualified J, 1229 results were qualified J due to being below the reporting limit.

4 - Total Number of Results is the summation of all qualified and unqualified results.

5 - The % Completeness is the sum of results that were valid as reported [Unqualified Positive Results + U]/Total Number of Results - J3.

6 - % Unusable Data is the sum of the results qualified R + UR/Total Number of Results.

7 - % Usable Data is the sum of the Unqualified Positive Results + U + U + J + J3 + JN + UJ/Total Number of Results.*

Table 7-4. Candidate Phase 1 Areas summary of GEHR8082 analytical data quality by lab for sediment environmental samples[1].

LABORATORY	NUMBER OF RESULTS QUALIFIED									TOTAL NUMBER OF RESULTS[4]	% COMPLETENESS	% UNUSABLE DATA[6]	% USUABLE DATA[7]	QUALITATIVE DATA QUALITY
	UNQUALIFIED POSITIVE RESULTS	U	U*	JN	J	J[3]	UJ	R	UR					
Lab 1	1,333	5,777	18	0	696	113	1,264	0	0	9,088	79.2%	0.0%	100.0%	Good
Lab 4	0	1,164	0	0	0	0	420	0	8	1,592	73.1%	0.5%	99.5%	Above Average
Lab 6	2,604	9,671	355	0	1,863	882	1,915	0	0	16,408	79.1%	0.0%	100.0%	Good
Lab 14	2,232	9,663	25	1	1,465	294	2,500	0	162	16,048	75.5%	1.0%	99.0%	Good
Lab 15	4,468	8,784	59	0	2,432	619	3,249	0	0	18,992	72.1%	0.0%	100.0%	Above Average
Lab 16	302	1,221	0	0	104	26	149	0	0	1,776	87.0%	0.0%	100.0%	Very Good
All Laboratories	10,939	36,280	457	1	6,560	1,934	9,497	0	170	63,904	76.2%	0.3%	99.7%	Good

Notes:

[1] - Summary is for sediment environmental samples and does not include results from PEs, duplicates, or blanks. Summary is based on qualification of data from verification and validation.

[2] - Results are the number of individual analytes in the analysis fraction. For example, there are 8 analytes in the Total PCBs as Aroclors analysis fraction.

[3] - Results qualified as estimates due to being below the reporting limit. For example, of the 3605 GEHR8082 results that were qualified J, 1229 results were qualified J due to being below the reporting limit.

[4] - Total Number of Results is the summation of all Qualified and Unqualified Results.

[5] - The % Completeness is the sum of results that were valid as reported [Unqualified Positive Results + U]/Total Number of Results - J[3].

[6] - % Unusable Data is the sum of the results qualified R + UR/Total Number of Results.

[7] - % Usable Data is the sum of the Unqualified Positive Results + U + U + J + J[3] + JN + UJ/Total Number of Results.*

Table 7-5. Candidate Phase 1 Areas summary of GEHR680 analytical data quality for sediment environmental samples[1].

ANALYSIS FRACTION	NUMBER OF RESULTS QUALIFIED									TOTAL NUMBER OF RESULTS[4]	% COMPLETENESS	% UNUSABLE DATA[6]	% USABLE DATA[7]	QUALITATIVE DATA QUALITY
	UNQUALIFIED POSITIVE RESULTS	U	U*	JN	J	J[3]	UJ	R	UR					
Monochlorobiphenyl	241	10	4	0	223	73	2	0	0	480	61.7%	0.0%	100.0%	Average
Dichlorobiphenyl	271	2	0	0	206	52	1	0	0	480	63.8%	0.0%	100.0%	Average
Trichlorobiphenyl	261	5	0	0	212	27	2	0	0	480	58.7%	0.0%	100.0%	Average
Tetrachlorobiphenyl	231	26	0	0	219	73	4	0	0	480	63.1%	0.0%	100.0%	Average
Pentachlorobiphenyl	78	93	0	0	269	187	37	0	3	480	58.4%	0.6%	99.4%	Average
Hexachlorobiphenyl	6	233	0	0	129	121	105	0	7	480	66.6%	1.5%	98.5%	Above Average
Heptachlorobiphenyl	0	295	0	0	3	3	169	0	13	480	61.8%	2.7%	97.3%	Average
Octachlorobiphenyl	0	295	0	0	1	1	171	0	13	480	61.6%	2.7%	97.3%	Average
Nonachlorobiphenyl	0	296	0	0	0	0	171	0	13	480	61.7%	2.7%	97.3%	Average
Total PCBs (GEHR680)	181	2	0	0	296	87	1	0	0	480	46.6%	0.0%	100.0%	Average
PCB Homologs (GEHR680)[2]	1,269	1,257	4	0	1,558	624	663	0	49	4,800	60.5%	1.0%	99.0%	Average

Notes:

[1] - Summary is for sediment environmental samples and does not include results from PEs, duplicates, or blanks. Summary is based on qualification of data from verification and validation.

[2] - Results are the number of individual analytes in the analysis fraction. For example, there are 10 analytes in the PCBs Homologs analysis fraction.

[3] - Results qualified as estimates due to being below the reporting limit. For example, of the 1220 GEHR680 results that were qualified J, 509 results were qualified J due to being below the reporting limit.

[4] - Total Number of Results is the summation of all Qualified and Unqualified Results.

[5] - The % Completeness is the sum of results that were valid as reported [Unqualified Positive Results + U]/Total Number of Results - J [3].

[6] - % Unusable Data is the sum of the results qualified R + UR/Total Number of Results.

[7] - % Usable Data is the sum of the Unqualified Positive Results + U + U + J + J [3] + JN + UJ/Total Number of Results.*

Table 7-6. Candidate Phase 1 Areas summary of field duplicate results for Aroclor PCBs by GEHR8082.

Method	Laboratory	Analyte(s)	Total No. Field Duplicate Pairs	Total No. Field Duplicate Pairs with NDs for Both Samples	Total No. Field Duplicate Pairs with Positives in Either Sample					Overall % Meet Criteria
					Total No.	No. Meet Criteria	No. Do Not Meet Criteria	% Meet Criteria	% Do Not Meet Criteria	
GEHR8082	All Laboratories	Aroclor-1016	420	420	0	0	0	NA	NA	100
		Aroclor-1221	420	64	356	251	105	71	29	75
		Aroclor-1232	420	420	0	0	0	NA	NA	100
		Aroclor-1242	420	75	345	265	80	77	23	81
		Aroclor-1248	420	420	0	0	0	NA	NA	100
		Aroclor-1254	420	322	98	82	16	84	16	96
		Aroclor-1260	420	419	1	1	0	NA	NA	100
		Total PCBs	420	59	361	282	79	78	22	81
		All Results[1]	3192	2065	1131	861	270	76	24	92
	Lab 1	Aroclor-1016	65	65	0	0	0	NA	NA	100
		Aroclor-1221	65	11	54	36	18	67	33	72
		Aroclor-1232	65	65	0	0	0	NA	NA	100
		Aroclor-1242	65	14	51	37	14	73	27	78
		Aroclor-1248	65	65	0	0	0	NA	NA	100
		Aroclor-1254	65	54	11	7	4	64	36	94
		Aroclor-1260	65	64	1	1	0	NA	NA	100
		Total PCBs	65	11	54	45	9	83	17	86
		All Results[1]	520	349	171	126	45	74	26	91

Table 7-6. Candidate Phase 1 Areas summary of field duplicate results for Aroclor PCBs by GEHR8082.

Method	Laboratory	Analyte(s)	Total No. Field Duplicate Pairs	Total No. Field Duplicate Pairs with NDs for Both Samples	Total No. Field Duplicate Pairs with Positives in Either Sample					Overall % Meet Criteria
					Total No.	No. Meet Criteria	No. Do Not Meet Criteria	% Meet Criteria	% Do Not Meet Criteria	
GEHR8082	Lab 4	Aroclor-1016	7	7	0	0	0	NA	NA	100
		Aroclor-1221	7	7	0	0	0	NA	NA	100
		Aroclor-1232	7	7	0	0	0	NA	NA	100
		Aroclor-1242	7	7	0	0	0	NA	NA	100
		Aroclor-1248	7	7	0	0	0	NA	NA	100
		Aroclor-1254	7	5	2	0	2	0	100	71
		Aroclor-1260	7	7	0	0	0	NA	NA	100
		Total PCBs	7	5	2	0	2	0	100	71
		All Results[1]	56	52	4	0	4	0	100	93
	Lab 6	Aroclor-1016	112	112	0	0	0	NA	NA	100
		Aroclor-1221	112	10	102	68	34	67	33	70
		Aroclor-1232	112	112	0	0	0	NA	NA	100
		Aroclor-1242	112	16	96	70	26	73	27	77
		Aroclor-1248	112	112	0	0	0	NA	NA	100
		Aroclor-1254	112	53	59	54	5	92	8	96
		Aroclor-1260	112	112	0	0	0	NA	NA	100
		Total PCBs	112	10	102	73	29	72	28	74
		All Results[1]	896	537	359	265	94	74	26	90
	Lab 14	Aroclor-1016	111	111	0	0	0	NA	NA	100
		Aroclor-1221	111	30	81	50	31	62	38	72
		Aroclor-1232	111	111	0	0	0	NA	NA	100
		Aroclor-1242	111	31	80	58	22	73	28	80
		Aroclor-1248	111	111	0	0	0	NA	NA	100
		Aroclor-1254	111	105	6	3	3	50	50	97
		Aroclor-1260	111	111	0	0	0	NA	NA	100
		Total PCBs	111	27	84	63	21	75	25	81
		All Results[1]	888	637	251	174	77	69	31	91

Table 7-6. Candidate Phase 1 Areas summary of field duplicate results for Aroclor PCBs by GEHR8082.

Method	Laboratory	Analyte(s)	Total No. Field Duplicate Pairs	Total No. Field Duplicate Pairs with NDs for Both Samples	Total No. Field Duplicate Pairs with Positives in Either Sample					Overall % Meet Criteria
					Total No.	No. Meet Criteria	No. Do Not Meet Criteria	% Meet Criteria	% Do Not Meet Criteria	
GEHR8082	Lab 15	Aroclor-1016	111	111	0	0	0	NA	NA	100
		Aroclor-1221	111	1	110	91	19	83	17	83
		Aroclor-1232	111	111	0	0	0	NA	NA	100
		Aroclor-1242	111	2	109	94	15	86	14	86
		Aroclor-1248	111	111	0	0	0	NA	NA	100
		Aroclor-1254	111	94	17	15	2	88	12	98
		Aroclor-1260	111	111	0	0	0	NA	NA	100
		Total PCBs	111	1	110	96	14	87	13	87
		All Results[1]	888	542	346	296	50	86	14	94
	Lab 16	Aroclor-1016	14	14	0	0	0	NA	NA	100
		Aroclor-1221	14	5	9	6	3	67	33	79
		Aroclor-1232	14	14	0	0	0	NA	NA	100
		Aroclor-1242	14	5	9	6	3	67	33	79
		Aroclor-1248	14	14	0	0	0	NA	NA	100
		Aroclor-1254	14	11	3	3	0	100	0	100
		Aroclor-1260	14	14	0	0	0	NA	NA	100
		Total PCBs	14	5	9	5	4	56	44	71
		All Results[1]	112	82	30	20	10	67	33	91

Notes:

1 - All Results = Total number Field Duplicate Pairs multiplied by the number of analytes determined by the method.

Table 7-7. Candidate Phase 1 Areas summary of field duplicate results for PCB homologs by GEHR680.

Method	Laboratory	Analyte(s)	Total No. Field Duplicate Pairs	Total No. Field Duplicate Pairs with NDs for Both Samples	Total No. Field Duplicate Pairs with Positives in Either Sample					Overall% Meet Criteria
					Total No.	No. Meet Criteria	No. Do Not Meet Criteria	% Meet Criteria	% Do Not Meet Criteria	
GEHR680	Lab 15	Monochlorobiphenyl	26	0	26	19	7	73	27	73
		Dichlorobiphenyl	26	0	26	22	4	85	15	85
		Trichlorobiphenyl	26	0	26	21	5	81	19	81
		Tetrachlorobiphenyl	26	0	26	20	6	77	23	77
		Pentachlorobiphenyl	26	1	25	24	1	96	4	96
		Hexachlorobiphenyl	26	12	14	14	0	100	0	100
		Heptachlorobiphenyl	26	26	0	0	0	NA	NA	100
		Octachlorobiphenyl	26	26	0	0	0	NA	NA	100
		Nonachlorobiphenyl	26	26	0	0	0	NA	NA	100
		Total PCBs	26	0	26	22	4	85	15	85
		All Results[1]	260	91	169	142	27	84	16	90

Notes:

Lab 4 data are excluded from analysis.

1 - All Results = Total number Field Duplicate Pairs multiplied by the number of analytes determined by the method.

Table 7-8. Candidate Phase 1 Areas summary of field duplicate results for other analytes.

Method	Laboratory	Analyte(s)	Total No. Field Duplicate Pairs	Total No. Field Duplicate Pairs with NDs for Both Samples	Total No. Field Duplicate Pairs with Positives in Either Sample					Overall % Meet Criteria
					Total No.	No. Meet Criteria	No. Do Not Meet Criteria	% Meet Criteria	% Do Not Meet Criteria	
Lloyd Kahn	Lab 15	TOC	132	0	132	76	56	58	42	58
6010B/7471A	Lab 6	Arsenic	1	0	1	1	0	100	0	100
		Barium	1	0	1	1	0	100	0	100
		Cadmium	1	0	1	1	0	100	0	100
		Chromium	1	0	1	1	0	100	0	100
		Lead	1	0	1	1	0	100	0	100
		Mercury	1	0	1	1	0	NA	NA	100
		Selenium	1	1	0	0	0	NA	NA	100
		Silver	1	1	0	0	0	NA	NA	100
		All Results[1]	8	2	6	6	0	100	0	100
1613	Lab 18	2378-TCDD	1	1	0	0	0	NA	NA	100
		Total-TCDD	1	1	0	0	0	NA	NA	100
		2378-TCDF	1	0	1	1	0	NA	NA	100
		Total-TCDF	1	0	1	0	1	0	100	0
		12378-PeCDD	1	1	0	0	0	NA	NA	100
		Total-PeCDD	1	1	0	0	0	NA	NA	100
		23478-PeCDF	1	0	1	1	0	100	0	100
		12378-PeCDF	1	0	1	1	0	100	0	100
		Total-PeCDF	1	0	1	1	0	100	0	100
		123789-HxCDD	1	1	0	0	0	NA	NA	100
		123478-HxCDD	1	1	0	0	0	NA	NA	100
		123678-HxCDD	1	1	0	0	0	NA	NA	100
		Total-HxCDD	1	0	1	1	0	100	0	100
		123678-HxCDF	1	0	1	1	0	100	0	100
		234678-HxCDF	1	1	0	0	0	NA	NA	100
		123478-HxCDF	1	0	1	1	0	100	0	100
		123789-HxCDF	1	1	0	0	0	NA	NA	100
		Total-HxCDF	1	0	1	1	0	100	0	100
		1234678-HpCDD	1	0	1	1	0	100	0	100
		Total-HpCDD	1	0	1	1	0	100	0	100
	Lab 18	1234789-HpCDF	1	1	0	0	0	NA	NA	100
		1234678-HpCDF	1	0	1	1	0	100	0	100
		Total-HpCDF	1	0	1	1	0	NA	NA	100
		OCDD	1	0	1	1	0	NA	NA	100
		OCDF	1	0	1	1	0	NA	NA	100
		All Results[1]	25	10	15	14	1	NA	NA	96
Gamma Spectroscopy	Lab 19	137 Cesium	97	52	45	44	1	98	2	99
ASTM D4531-86	Lab 15	Bulk Density	98	0	98	98	0	100	0	100
Calculated	NA	Bulk Density	322	0	322	321	1	100	0	100

Notes:

[1] *- All Results = Total number Field Duplicate Pairs multiplied by the number of analytes determined by the method.*

Table 7-9. Candidate Phase 1 Areas summary of field duplicate results for percent moisture by Method 160.3.

Method	Laboratory	Analyte(s)	Total No. Field Duplicate Pairs	Total No. Field Duplicate Pairs with NDs for Both Samples	Total No. Field Duplicate Pairs with Positives in Either Sample					Overall % Meet Criteria
					Total No.	No. Meet Criteria	No. Do Not Meet Criteria	% Meet Criteria	% Do Not Meet Criteria	
160.3	All Labs	Percent Moisture	425	0	425	415	10	98	2	98
	Lab 1	Percent Moisture	64	0	64	64	0	100	0	100
	Lab 4	Percent Moisture	7	0	7	7	0	100	0	100
	Lab 6	Percent Moisture	112	0	112	107	5	96	4	96
	Lab 14	Percent Moisture	111	0	111	109	2	98	2	98
	Lab 15	Percent Moisture	117	0	117	115	2	98	2	98
	Lab 16	Percent Moisture	14	0	14	13	1	93	7	93

Notes:

[1] *- All Results = Total number Field Duplicate Pairs multiplied by the number of analytes determined by the method.*

Table 7-10. Candidate Phase 1 Areas percentage of field blanks contaminated with Total PCBs.

Lab	Total Number of Field Blanks Analyzed in Association with Candidate Phase 1 Areas	2002 Number of Field Blanks Analyzed in Association with Candidate Phase 1 Areas	2003 Number of Field Blanks Analyzed in Association with Candidate Phase 1 Areas	Total Number of Field Blanks with Positive PCB Results > MDL Analyzed in Association with Candidate Phase 1 Areas	2002 Number of Field Blanks with Positive PCB Results > MDL Analyzed in Association with Candidate Phase 1 Areas	2002 Average (Median) Total PCB Concentration for Field Blanks with Results > MDL (ppm)	2003 Number of Field Blanks with Positive PCB Results > MDL Analyzed in Association with Candidate Phase 1 Areas	2003 Average (Median) Total PCB Concentration for Field Blanks with Results > MDL (ppm)	2002 Percent of Field Blanks Contaminated	2003 Percent of Field Blanks Contaminated
Lab 1	84	27	57	4	4	0.261 (0.226)	0	NA	15%	0%
Lab 4	31	31	0	0	0	NA	0	NA	0%	NA
Lab 6	138	66	72	32	29	0.063 (0.035)	3	6.4 (3.2)	44%	4%
Lab 14	140	71	69	8	6	0.626 (0.303)	2	0.092 (0.092)	8%	3%
Lab 15	176	64	112	39	9	0.098 (0.030)	30	0.047 (0.040)	14%	27%
Lab 16	14	14	0	0	0	NA	0	NA	0%	NA
TOTAL	583	273	310	83	48	0.157 (0.041)	35	0.595 (0.042)	18%	11%

Notes:
NA - not applicable.

Table 7-11. Comparison of split samples analyzed by GEHR680 and a comparable USEPA method.

River Section	GE Lab	Sample ID	Total PCB Concentration (mg/kg)					Tri+ PCB Concentration (mg/kg)				
			USEPA	GE	RPD	RPD>75%	Combined RPD>25%	USEPA	GE	RPD	RPD>75%	Combined RPD>25%
RS2	6	RS2-8685-WS275-002024	5.3	2	90.4	*		2.594	1.02	87.1	*	
RS2	6	RS2-8685-CT073-002024	154	86	56.7			55.63	23.23	82.2	*	
RS2	15	RS2-8685-CT062-002024	430	530	20.8			109.99	111.6	1.5		
RS2	15	RS2-8685-ET139-002024	241	360	39.6			78.31	78	0.4		
RS2	15	RS2-8382-ES019-002024	14	3	129.4	*		5.416	1.31	122.1	*	
RS2		**River Section Median**			**56.7**		*			**82.2**		*
RS3	1	RS3-6766-CS266-002024	3.35	3.2	4.6			1.767	1.61	9.3		
RS3	1	RS3-7877-ES050-012018	1.63	2.4	38.2			0.824	1.17	34.7		
RS3	1	RS3-7776-WS031-002024	3.71	4.1	10.0			1.675	1.66	0.9		
RS3	1	RS3-8180-ES009-002024	1.16	0.61	62.1			0.725	0.221	106.6	*	
RS3	1	RS3-7877-ES034-002024	128	200	43.9			30.774	38.6	22.6		
RS3	1	RS3-7675-ES016-002024	104	140	29.5			49.58	50	0.8		
RS3	1	RS3-7170-ES070-002024	12	8.1	38.8			6.131	3.4	57.3		
RS3	6	RS3-6766-CS275-002012	1.63	0.9	57.7			0.606	0.54	11.5		
RS3	6	RS3-7069-ET292-002024	35.9	47	26.8			15.38	15.06	2.1		
RS3	6	RS3-7675-WS047-002024	6.8	9.8	36.1			2.812	3.5	21.8		
RS3	6	RS3-7069-ET127-002024	0.36	0.092	118.6	*		0.222	0.048	128.9	*	
RS3	6	RS3-7574-WS029-002024	2.8	6.8	83.3	*		1.38	3.02	74.5		
RS3	6	RS3-7473-ES037-002024	85.6	95	10.4			24.547	22.22	10.0		
RS3	6	RS3-7675-ES001-002024	32.4	25	25.8			13.753	9.3	38.6		
RS3	6	RS3-7675-WS062-002024	12	12	0.0			6.511	5.57	15.6		
RS3	6	RS3-7069-ET020-002024	0.71	0.18	119.1	*		0.346	0.14	84.8	*	
RS3	6	RS3-5958-ES067-002024	2.6	2.3	12.2			1.656	1.5	9.9		
RS3	6	RS3-6160-ES021-002024	9.7	8.4	14.4			7.169	6.195	14.6		
RS3	6	RS3-7372-WS022-002024[1]	0.55	0.14	118.8	*						
RS3	6	RS3-7069-ES405-002024	3.45	7.8	77.3	*		1.892	3.962	70.7		
RS3	6	RS3-7271-WS067-002006	4.96	3.9	23.9			3.414	2.586	27.6		
RS3	6	RS3-7069-WS369-002024	4.36	4.3	1.4			2.752	2.793	1.5		
RS3	6	RS3-7170-ES036-002024	11	14	24.0			4.115	4.14	0.6		

Table 7-11. Comparison of split samples analyzed by GEHR680 and a comparable USEPA method.

River Section	GE Lab	Sample ID	Total PCB Concentration (mg/kg)					Tri+ PCB Concentration (mg/kg)				
			USEPA	GE	RPD	RPD>75%	Combined RPD>25%	USEPA	GE	RPD	RPD>75%	Combined RPD>25%
RS3	6	RS3-7675-ES015-002012	53	67	23.3			16.32	18.79	14.1		
RS3	6	RS3-7170-ES072-002024	3.1	1.2	88.4	*		1.979	0.78	86.9	*	
RS3	14	RS3-6766-ET131-002024	36.9	38	2.9			15.1	14.517	3.9		
RS3	14	RS3-7675-WS031-002012	1.68	2.2	26.8			1.015	1.42	33.3		
RS3	14	RS3-7574-WS014-002012	7.35	9.2	22.4			2.85	3.74	27.0		
RS3	14	RS3-6160-ES006-002024	51	31	48.8			46.727	29.77	44.3		
RS3	14	RS3-7271-CT007-002012[1]	0.29	0.03	162.5	*						
RS3	14	RS3-7372-WS024-002012	0.374	0.6	46.4			0.157	0.18	13.7		
RS3	14	RS3-6968-WS007-002024	126	160	23.8			41.38	44.41	7.1		
RS3	14	RS3-6968-WS017-002024	12.4	12	3.3			6.042	5.12	16.5		
RS3	14	RS3-6766-WT251-002024	123	110	11.2			46.045	29.6	43.5		
RS3	14	RS3-5958-ES051-002024	37	15	84.6	*		16.161	7.094	78.0	*	
RS3	14	RS3-6463-WT132-002024	30	23	26.4			19.198	14.13	30.4		
RS3	14	RS3-6463-WT130-002024	6.4	2.1	101.2	*		5.2	1.58	106.8	*	
RS3	14	RS3-7069-ET160-002024	67.7	35	63.7			23.702	7.57	103.2	*	
RS3	15	RS3-7069-ET294-000006	3.38	3.4	0.6			1.957	1.66	16.4		
RS3	15	RS3-7069-ET159-000006	2.8	3.5	22.2			1.6	1.82	12.9		
RS3	15	RS3-5958-ES049-002012	0.52	0.57	9.2			0.316	0.3	5.2		
RS3	15	RS3-7372-WS026-002024	1.7	2.1	21.1			0.904	1.01	11.1		
RS3	15	RS3-6059-CS030-002024	1.82	1.6	12.9			1.315	1.11	16.9		
RS3	15	RS3-7069-ET204-000006	4.65	6.5	33.2			2.447	2.9	16.9		
RS3	15	RS3-6766-WT205-000006	7.9	6.8	15.0			4.186	3.25	25.2		
RS3	15	RS3-7170-ET102-000006	1.9	2.3	19.0			1.155	1.22	5.5		
RS3	15	RS3-7170-ET132-000006	12	16	28.6			4.669	5.48	16.0		
RS3	15	RS3-7170-ET147-000006	3.2	2.2	37.0			1.59	1.01	44.6		
RS3	15	RS3-7069-ET249-000006	0.1	0.22	75.0	*		0.026	0.087	108.0	*	
RS3	15	RS3-6766-WT235-000006[1]	2.5	2.7	7.7							
RS3	15	RS3-7069-ET039-000006	7.9	1.8	125.8	*		6.286	1.12	139.5	*	
RS3	15	RS3-7069-ET099-000006	10	7.7	26.0			5.624	3.8	38.7		

Table 7-11. Comparison of split samples analyzed by GEHR680 and a comparable USEPA method.

River Section	GE Lab	Sample ID	Total PCB Concentration (mg/kg)					Tri+ PCB Concentration (mg/kg)				
			USEPA	GE	RPD	RPD>75%	Combined RPD>25%	USEPA	GE	RPD	RPD>75%	Combined RPD>25%
RS3	15	RS3-6463-WT146-000006	8.6	5	52.9			7.088	3.5	67.8		
RS3	15	RS3-6463-WT161-000006	13.4	7.2	60.2			10.036	5.31	61.6		
RS3	15	RS3-6463-WT131-000006	31	31	0.0			20.214	20.09	0.6		
RS3	15	RS3-7069-ET189-000006	3.4	2.1	47.3			2.2	1.22	57.3		
RS3		**River Section Median**			**26.8**	*				**22.6**		

Note:

[1] *- Tri+ PCB Total was less than or equal to zero, so no analysis conducted on these samples.*

Outlier RS2-8685-CT089-002024 removed from analysis.

APPENDICES

Quantitative Environmental Analysis, LLC

Appendix 1

Sediment Coring SOPs and Associated Corrective Action Memoranda

Quantitative Environmental Analysis, LLC

STANDARD OPERATING PROCEDURES FOR SEDIMENT CORE COLLECTION

1. All data from sediment core collection will be recorded in the field database (Microsoft Access®) provided by QEA using a laptop computer on the sampling vessel. Upon completion of sampling at one location, all data from the core will be entered into the database and the field log for that location, printed, and the hard copy stored in the field notebook. This will limit the risk of losing core information due to computer failure. Blank field log sheets that can be used to record information manually also will be provided in case of loss of computer power.

2. Using the on-board GPS system, maneuver the sampling vessel to within 5 ft of the pre-programmed target coordinates for each sample location. Secure the vessel in place using spuds and/or anchors.

3. Use a calibrated steel rod to probe the sediment surface 3 to 5ft away from the target location to determine the sediment thickness and type in accordance with the Sediment Probing SOP. Each boat will be provided with an identical probing rod prior to initiation of field activities. The sediment will be probed a minimum of three times at each location, with the deepest penetration recorded in the field database. Each probing attempt will be a minimum of one foot away from any previous attempts.

    - If the estimated sediment thickness at the probing area is greater than 6 inches record probing information in the field log and attempt to collect a core using a Rossfelder P3 vibracorer.

    - If the estimated sediment thickness at the probing area is less than 6 in., additional probing of the sediment surface will be conducted within 10 ft of the target location for deeper sediments. If deeper sediments are found, relocate the boat to the new coordinates and attempt to collect a core. If sediment depth appears to be systematically less than 6 in., make one attempt at collection with the vibracorer. If 60% recovery is not achieved after one attempt, collect a sample with a ponar dredge.

4. Once the targeted area is deemed suitable for core collection select a 3 in. (o.d.) aluminum core tube of appropriate length based on the probing information. (maximum length of 8 ft)

5. Mount a clean coring tube approximately 2 ft longer than the probing depth (maximum 8 ft tube) onto the vibracoring device.

6. Lower the coring apparatus with the core tube attached vertically through the water column tube end first, until the river bottom is reached.

7. Allow the core tube to advance into the sediment under its own weight a maximum of approximately 6 in. and then activate the vibracorer.

8. Vibrate the core into the sediment to refusal or until a maximum penetration of approximately 7.5 ft is reached (goal is to prevent vibracorer head from coming into contact with surface sediments). Measure and record the depth of core tube penetration into the sediments in the field database.

9. Pull the apparatus upward out of the river bottom (using a winch as needed), and raise it to the surface, while maintaining the core in a vertical position.

10. If it appears that the vibracorer head has come into contact with the surface sediments, or if penetration is limited to prevent this when a tube shorter than 8 ft. is used, the core will not be counted as a core collection attempt (i.e., up to three additional attempts will be made using the longer tubing). The only exception will be when the core tube appears to contain 12 or more inches of clay at the bottom, as determined by visual evidence of smearing on the outside of the core tube. Cores that appear to contain clay at the bottom and have a recovery of at least 60% will be retained and additional attempts will not be required. If the core does not appear to contain clay, it will be temporarily retained until additional attempts are made with a longer core tube. In the event that a better core (i.e., greater % recovery) cannot be collected using longer tubing, the original core will be retained and submitted for analysis. Prior to attaching a longer core tube, inspect the check valve and clean as necessary to remove any sediment. Attach a longer core tube (at least 2 ft longer, up to a maximum of 8 ft.) to the vibracorer and repeat the process.

11. Before the bottom of the tube breaks the water surface, place a cap over the bottom to prevent the loss of material from the corer. Secure the cap in place with duct tape when brought on board the vessel.

12. Estimate the recovered length of the sediment core and note it in the electronic field database.

    - The length of the cores will be determined by measuring to the top of sediment with a pre-fabricated measurement tool. This tool is a 4 ft long measuring stick with an aluminum foot attached to one end, specially designed for this program. The tool will be decontaminated

prior to reuse at a new location; a full day's supply will be provided to the coring crews each day. Place a line on the core tube using a permanent marker to indicate the length of field recovery and write the recovery in inches on the tube adjacent to this line. If the top of sediment in the core tube is lower than the measuring tool can reach in long core tubes, the recovery in aluminum tubing can be estimated by tapping the outside of the tube with a metal object. When the core tube has been cut, verify recovery using the measuring tool. (See Step 20).

- The distance between the top of the sediment in the core tube and the bottom of the coring tube corresponds to the estimated length of the recovered core.

13. Compare the length of the recovered core with the core penetration depth.

- If the recovered length of the sediment core is more than 60% of the penetration depth, keep the core.
- If recovery approaches 60% (e.g., approximately 50% or greater), temporarily retain the core. If an insufficient amount of material is recovered, discard the sediment contained in the core tube into a re-sealable 5-gallon pail and store for subsequent disposal at the field processing facility. Rinse the core tube with river water and prepare to make an additional attempt, or select another core tube for an additional attempt if the first core is retained.
    - An additional attempt will be made at a minimum distance of 1ft from previously attempted locations.
    - A maximum of three attempts to collect a core will be made for a given location ID.
    - Rinse the core tubes with river water between consecutive attempts.
    - If it appears that sediment was not retained in the core tube due to a leaking check valve in the vibracorer, the valve will be cleaned and collection of a core will be reattempted. Cores lost due to leaking check valves will not be counted as core collection attempts (i.e., three full attempts must be made with a properly operating check valve).
    - If all three attempts to collect a core are unsuccessful based on recovery alone (i.e., less than 60% recovery), retain the core with the highest recovery for analysis and put flag in the database that indicates that the targeted recovery was not achieved.
    - If an acceptable core cannot be collected within 10 ft of the node location, abandon the location and note conditions preventing core collection in the field database.
    - Discard the unusable cores by first decanting the water off the top back into the river and placing the sediment in a 5-gal bucket for disposal.

14. After a successful core recovery enter additional information into the field database:
    - Date
    - Time of recovery
    - Actual coordinates of the sample location
    - Water depth (ft)
    - Core tube material (aluminum)
    - Core penetration depth (in.)
    - Observations, including probing results

15. Remove the core tube from the vibracorer and place a second cap on the top of the core tube. Secure the cap in place with duct tape. Rinse the outside of the core tube with a small amount of river water to remove any residual sediment. Long core tubes with a recovery of less than approximately 6 ft. may be cut to facilitate handling as follows:

    - Cut the core tube at least 2 in. above the sediment-water interface using a tubing cutter (aluminum tubing)
    - Allow the water to decant.
    - Cap the top of the core tube.
    - If the cutting tool came into contact with sediment, it will require decontamination. If cutting tool only contacted the overlying water, no decontamination is necessary.

16. Draw an arrow on the core tube with permanent marker to mark the top of the core. Label the core with permanent marker indicating station ID, date, and time.

17. Store the core vertically in an insulated core tube storage rack (provided) on ice. Use the provided insulating blankets to keep the cores cool and out of direct sunlight until they are processed at the field processing facility.

18. At locations where grab samples will be collected, obtain a sediment sample by lowering a decontaminated ponar dredge until it comes in contact with the sediment and the release mechanism trips. Retrieve the ponar dredge and estimate the amount of sediment recovered. Enough sediment must be obtained to fill two 4 oz. containers (approximately ½ pint of sediment). If a sufficient amount of sediment is recovered, empty the contents into a new aluminum pan. Seal container with lid and duct tape. Label the container with permanent marker indicating station ID, date, and location. Place aluminum pan on ice in a cooler. If the amount of sediment recovered is insufficient, make up to two additional attempts with the ponar dredge and combine the sediment from each attempt in the aluminum pan. If sufficient sample cannot be collected after 3 attempts, abandon the location. Place the ponar dredge in a plastic bag for subsequent transport to the core processing facility for decontamination.

19. Decontaminate the ponar dredge (performed at the end of the day by QEA) according to the following decontamination procedure:

    - Wash with laboratory grade detergent
    - Rinse with distilled water
    - Rinse with acetone and allow to air dry
    - Rinse with hexane and allow to air dry
    - Rinse with distilled water and air dry
    - Contain rinsate for disposal at the field processing laboratory

20. For long cores that are difficult to transport (recovery > 6ft), cut into two sections.
    - Remove all visible sediment from the outside of the core tube using paper towels and water.
    - Measure the estimated recovery, then mark the core tube 48 in. below the surface of the sediment.
    - Cut the core tube at this mark using a tube cutter (aluminum tubing)
    - Slide a stainless steel taping knife through the cut to separate the upper and lower portions of the core.
    - Lift the upper section off the bottom section and place a cap on the bottom end of the upper section by sliding the taping knife out as the cap is slid into place. Tape the cap in place.
    - Place a cap on the top of the lower section, and tape in place.
    - Label both sections with the date, time, core ID, and an arrow indicating the top of each section. Also label the upper section as "top" and the lower section as "bottom".
    - Place both sections in a core storage rack, store, and transport in accordance with the SOP.

21. At the end of each sampling day, field blanks will be prepared on each sampling vessel in accordance with the following procedure:
    - Put on a new pair of disposable gloves
    - Place an end cap on the lower end of an unused 36 in. core tube and secure with duct tape. Core tube should have been in the clean container of tubes for the entire day.
    - Pour approximately 6 in. of distilled water into the bottom of the tube.
    - Add play sand until there is insufficient water left in the tube to saturate the sand.
    - Add additional water and sand until there is a minimum of 30 in. of saturated sand in the tube. Standing water above the sand is acceptable.
    - Cap the top of the tube and secure with duct tape.
    - Label the tube with the proper field blank sample ID, date, and time.

22. At the end of each day, an electronic copy (disk or data stick) of the field log that includes the information recorded for each core sample collected that day will be provided to the processing laboratory coordinator. Additionally, a hard copy of the field log will be printed out. The hard copy will serve as a back-up to the electronic copy, as well as the chain of custody form from the field to the processing laboratory. This form will be signed by sample collection personnel and core processing personnel at the time that the core processing personnel take custody of the cores. A copy of the signed field log form will be maintained in the processing laboratory.

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: October 24, 2002

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Mark D. LaRue, Field Sampling Manager

Problem Description: Transportation of long cores (> than ~6 ft. long) from the staging area to the processing lab is difficult as it is not possible to fit these cores inside the transport vehicle (14 ft. box truck w/power lift gate). Therefore, the cores must be transported by placing the storage racks on the tailgate, and strapping them in place. While the cores appear to be secure when being transported using this method, they would be most secure if they were inside the truck and strapped to the walls, reducing the potential for accidental loss of the cores during transport. Also, if all cores are transported inside the truck, they will not be in full view to the public. The possibility of the use of another system for transport (e.g., larger truck with more head room, or use of an open stake rack truck or trailer has been researched; however, the vehicle currently in use appears to be the best option available. Additionally, the long cores are difficult to store and handle in the processing lab, requiring ladders to cut the upper sections. Therefore, we recommend cutting over length cores on the sampling vessels into two sections to allow transportation of the cores inside the truck and simplify processing. These conditions and the corrective action specified below have been developed with input from Brian Miner, USACE.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

1. Collect the cores following the SOP, including placing a cap on the top of the core and taping into place.

2. Rinse the outside of the core tube with river water and wipe with paper towels to remove all visible sediment.

3. Measure the estimated recovery length, then mark the core tube at approximately 50% of this length.

4. Cut the core tube at this mark using a tubing cutter (aluminum tubing) or a hack saw (lexan tubing)

5. Slide a stainless steel taping knife through the cut to separate the upper and lower portions of the core.

6. Lift the upper section off the bottom section and place a cap on the bottom end of the upper section by sliding the taping knife out as the cap is slid into place. Tape the cap in place.

7. Place a cap on the top of the lower section, and tape in place.

8. Label both sections with the date, time, core ID and an arrow indicating the top of each section. Also label the upper section as "top" and the lower section as "bottom".

9. Place both sections in a core storage rack, store and transport in accordance with the SOP.

10. Processing lab personnel will be required to combine the lowest segment of the upper core section with the appropriate portion of the top segment of the lower core section to maintain the core segmenting scheme defined in the processing SOP (e.g., if the lowest segment of the upper core section is 3.5 in., the upper 2.5 in of the lower core section will be added to the above material for sample preparation.

Reviewed and Implemented By: Reviewed and implemented by Mark D. LaRue (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: October 25, 2002

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Mark D. LaRue, Field Sampling Manager

Problem Description:

1. Collection of cores in accordance with the SOP requires discarding of cores with less than a 60% recovery unless it is the third attempt, in which case the core is retained for analysis. This practice occasionally results in cores being collected on the first or second attempt that have a recovery that is less than 60%, but is greater than the recovery measured on the third attempt. Therefore, it is possible that the core retained for analysis is a core that did not have the best recovery of the three attempts.
2. The qualitative nature of the sediment probing that is performed to help estimate the type (aluminum or lexan) and length of core tubing that should be used at each sampling location has resulted in core tube penetration exceeding the probing depth at some locations. This situation may result in the collection of cores that do not penetrate the sediment far enough to reach clean sediment. Also, if core tubing is too short, the vibracore head may come in contact with the surface of the sediment, preventing further penetration. Therefore, a false refusal depth may be obtained.
3. Disposal of cores with insufficient recovery (trial 1 or 2 with less than 60% recovery) may result in a significant amount of water above the sediment in the core tube. This water significantly increases the amount of material that has to be contained on board the sampling vessel, and complicates handling of this material for proper disposal at the GE Fort Edward Facility. Reduction in the volume of this water is desirable.
4. The SOP does not specify a procedure for the preparation of field blanks; therefore, field personnel have been following verbal guidelines, but inconsistencies between field personnel exist.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

The following procedures have been developed and implemented in the field following discussion and input from USACE and MPI field oversight personnel (Bryan Miner and Mike Johnson).

1. Cores collected on the first or second attempt that have recoveries that are less than 60% but approach it (e.g., approximately 50% or greater) are kept on the sampling vessels until the third attempt is completed. The core with the greatest recovery is retained for analysis. The other cores with less recovery will be disposed of in accordance with the SOP.

2. The probing SOP has been reviewed again with all field personnel to make this activity more consistent between crews. Additionally, when cores are collected and there is evidence that the vibracore head came into contact with the surface of the sediment (thereby limiting penetration and indicating that the length of the core tubing is too short), the core is retaken using a core tube that is a minimum of two feet longer. The core will be retaken regardless of whether it was collected on the first, second, or third core collection attempt; however, the core tube with the greatest recovery (regardless of core tubing length) will be retained for analysis. An exception to this is when lexan core tubes are used and the presence of Lake Albany clay can be visually confirmed in the lower portion of the core.
3. To reduce the amount of water that has to managed for disposal, sampling crews decant water that is present in the core tubes above the sediment/water interface back into the river prior to placing the sediment in the PCB waste containers provided.
4. Field blanks will be prepared in accordance with the following procedure:
    - Put on a new pair of disposable gloves
    - Place an end cap on the lower end of an unused 36 in. core tube and secure with duct tape
    - Pour approximately 6 inches of distilled water into the bottom of the tube
    - Add play sand until there is insufficient water left in the tube to saturate the sand
    - Add additional water and sand until there is a minimum of 30 inches of saturated sand in the tube. Standing water above the sand is acceptable.
    - Cap the top of the tube and secure with duct tape
    - Label the tube with the proper field blank sample ID, date, and time.
    - Sampling crews should alternate core tube materials used for field blanks each day (i.e., aluminum one day, lexan the next)

Reviewed and Implemented By: Reviewed and implemented by Margaret Murphy (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: May 9, 2003

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Mark D. LaRue, Field Sampling Manager

Problem Description:

Approximately twenty percent of the cores collected in the 2002 sampling season had a penetration depth greater than 6 ft. resulting in the use of core tubes exceeding 6.5 ft in length. These cores were difficult to handle in the field and in the laboratory. In the field, long cores had to be split into two portions for easier handling and transportation. This required additional processing in the laboratory to maintain the appropriate core segmentation scheme. Limiting penetration depth to 6 ft would allow the use of core tubing a maximum of 6.5 ft. long, which in turn would permit transportation of the cores in one piece and simplify processing. Additionally, analysis of numerous clean segments typically found towards the bottom of long cores could be prevented. Evaluation of the 2002 data indicates that limiting penetration depth to 6 ft would have resulted in an approximate 2% increase in the number of incomplete cores. Of these incomplete cores, only a subset would require resampling to fill significant data gaps. Therefore, based on the results of the 2002 program, the benefits realized from limiting core penetration (increased productivity rates and reduced analytical costs) would outweigh the potential need for the re-sampling of a relatively small number of locations where incomplete cores were collected, and significant data gaps were identified.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

Limit penetration depth to 6 ft. and overall core tube length to 6.5 ft. Incomplete core locations will be re-sampled if data analysis suggests that more information is needed for accurate dredge area delineation.

Reviewed and Implemented By: Reviewed and implemented by Mark LaRue (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: May 9, 2003

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Mark D. LaRue, Field Sampling Manager

Problem Description:

The method used during 2002 field season for estimating field recovery in cores collected in aluminum tubing was adequate to assess the acceptability of a core in the field. However, direct measurement of recovery in the field will reduce the variability in core length determination, and improve its accuracy. A measurement tool fabricated from a 4 ft long aluminum measuring stick with an aluminum foot attached to one end was designed and used successfully in the core processing facility in 2002. Therefore, direct measurement will be obtained using the same type of measuring tool used in the processing laboratory to determine recovery. The tool will be decontaminated after each use, in a manner that is consistent with other equipment used in the processing laboratory. Precise core length measurements will improve our ability to accurately measure field recoveries and will yield additional information about processes, such as settling, that occur between core collection and processing.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

Direct measurement of recovery will be performed on the sampling vessels. The method for this measurement will be consistent with that used in the processing laboratory. The measurement tools will be decontaminated between cores consistent with the SOP for core processing (Appendix 18) of the QAPP.

Reviewed and Implemented By: Reviewed and implemented by Mark LaRue (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson

QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: May 9, 2003

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Mark D. LaRue, Field Sampling Manager

Problem Description:

Lexan® tubing did not perform as well as aluminum tubing for core collection during 2002. Aluminum tubing achieved greater average penetration than Lexan® (49 in. Aluminum vs. 46 in. Lexan) and achieved comparable average core recovery (66% Aluminum vs. 69% Lexan) despite Aluminum tubing being used in more difficult coring conditions. Additionally, the aluminum tubing was easier to cut and segment accurately in the processing lab, and was preferred in the field due to its superior strength and ability to be used in all sediment types. The stratigraphic information obtained during core processing of aluminum cores provided sufficient information to support dredge area delineation. Therefore, the benefit of a modest increase in stratigraphic resolution provided by the use of Lexan® is outweighed by aluminum's superior performance.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

The use of Lexan® tubing will be discontinued. Aluminum tubing will be used exclusively for the core collection work to be conducted during the 2003 field season.

Reviewed and Implemented By: Reviewed and implemented by Mark LaRue (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

Appendix 2

Sediment Core Processing SOPs and Associated Corrective Action Memoranda

Quantitative Environmental Analysis, LLC

STANDARD OPERATING PROCEDURES FOR CORE PROCESSING

1. Decontaminate all equipment prior to contact with core segments in a designated decontamination area. The decontamination steps are:
   (1) remove visible sediment from equipment using paper towels. Dispose of the towels in appropriate containers labeled as PCB waste;
   (2) wash thoroughly using laboratory grade detergent and a scrub brush in the laboratory sink (wash water can go down the sink drain);
   (3) rinse with distilled water;
   (4) rinse thoroughly with acetone under the hood in the laboratory, then allow to air dry;
   (5) rinse thoroughly with hexane under the hood in the laboratory, then allow to air dry; and
   (6) rinse with distilled water.

   Acetone and hexane rinsate will be collected and placed in appropriate disposal containers.

2. Transport the cores from the field staging area to the field processing facility at the end of each day for core sectioning and sample preparation. The cores must be kept on ice and maintained in a vertical position during transport and handling.

3. Upon the delivery of the cores to the processing laboratory, a hard copy of the corresponding field data will be presented to the processing lab coordinator. The field data sheet will be signed by both the sample collection/delivery personnel and the processing lab coordinator, and will serve as the chain of custody form from the field to the processing facility. Transcribe either electronically (diskette or data stick) or manually the field data for each core into the field processing database.

4. The processing laboratory coordinator will disperse the cores to each sample processing custodian for processing.

5. Fasten the core tube in a clamping system (Figure 1) and place a container below or next to the clamping system to collect water removed from the core and any spills that occur. Measure the total length of the core and record in the database.
   - use the measuring device (4 ft aluminum measuring stick with aluminum foot attached to bottom) to measure to the top of the sediment inside the tubing. Subtract the distance from the top of sediment to the top of the core tube from the total core tube length to obtain core recovery and record in the database. If lab recovery differs from field recovery by more than 2 in. in the first 2 ft and 1 in. every 1 ft thereafter, discard the core and indicate as unusable in the database. It will be assumed for these cores that there was a void in the core that settled following collection and the sediment may be disturbed or displaced due to this. See step 15 of this SOP for details on voids encountered during core sectioning.
   - drain the core by drilling a small hole about 1 in. above the estimated surface of the sediment and allow the water overlying the sediment core to drain, taking care not to disturb the surface of the sediment.
   - cut the core tube off approximately 1 in. above the estimated surface of the sediment with

a pipe cutter so the sediment/water interface can be seen
- mark the position of the top of the sediment on the outside of the core tube

6. Before sectioning, the mass of the sediment contained within the core will be determined. Place the upright core on the scale and weigh to the nearest gram. Measure and record the total length of the core tube. The mass of the core tubing can be determined from the volume and the density. Be sure to note the length of sediment, the length of water-filled tube above the sediment, and the length of air-filled tube above the water, if appropriate. The density of sediment in the core can be determined from the volume and the mass, after accounting for the mass of the tube itself.

7. Based on the core length, mark the locations of where the core tube will be cut into segments (there are four different schemes according to which cores can be sectioned; Figure 2). The sample processing custodian will print labels for each jar necessary for each segment of the core. If the total length of the core is greater than 36 in., segment the entire core and enter all required data in the database; however, archive samples greater than 36 in. following the same segmentation scheme (Figure 2).

8. The sample custodian will determine what analyses need to be performed on each core segment. The types of analyses selected for individual core segments depend on their position within the core, their physical characteristics or will be assigned on a random basis.

9. Verify the analyses for each core segment listed in the database (automatically assigned for Aroclor PCBs, TOC, moisture content, radionuclides, and archive samples). If necessary select additional analyses based on the field database tracking system (PCBs by USEPA Method 680, RCRA Metals, Dioxins and Furans, disposal characterization) or a combination of the tracking system and visual evaluation (Geotechnical characterization). Enter additional analyses in the database, print container labels and place on appropriate containers. Container specifications are provided in the QAPP. Update the field processing database, and generate hard copies of chain of custody forms.

10. Prepare a set of clean, disposable aluminum pans (approximately 10 in. x 12 in. x 3 in.) for all sectioned core segments (use larger aluminum pan for 2-24 in. segment). Mark bowls with core segment location (i.e., 0-2”). When using a new shipment of aluminum pans get an average tare weight for 50 pans. Weigh each core segment, except 0-2 in on a calibrated scale. Create new entries in the field processing database by entering the top and bottom depth of each core segment.

11. Adjust the position of the core tube in the clamping system to provide adequate support and clearance for cutting the core into segments. For Lexan core tubes place a clean plastic cap on the top of the tube prior to each cut to minimize the loss of soft sediment during cutting.

12. To reduce sediment loss from the top of the core, spoon out the top 2 in. and place into an aluminum pan prior to cutting the core tube. Measure the amount of sediment removed by placing the spoon into the core and measuring 2 in. to the top of the next segment. The base of the handle on the teaspoon being used is equivalent to the 2 in. mark.

13. Use a tubing cutter to cut the core tube at the bottom of the top core segment. Use a decontaminated tubing cutter to cut each segment (i.e., do not make two cuts with the same blade). Avoid disturbing the sediment. Use a clean stainless steel broad knife to separate the segment from the rest of the core after the core tube is cut, and place the segment into an aluminum pan (tare weight already established). Place the aluminum pan with the core segment on the balance and obtain a weight.

14. Extrude the sediment from the core tube, and dispose of the tube in appropriate containers labeled for PCB waste. When extruding sediments, attempt to keep the sediment intact to record stratigraphic changes within the section. For difficult to remove sediments, spoon out the sediment, trying to keep it intact to record stratigraphic changes.

15. Cores may occasionally contain voids; processing these cores will follow the protocol listed below. The protocol may be modified on a core-specific basis if field judgment indicates that alternative procedures are appropriate. Any such modifications will be made with the concurrence of USEPA oversight personnel.

    - Cores containing voids with a length of 2 in. or less per the first 2 ft and 1 in. per 1 ft thereafter will be sectioned as though they were intact (e.g., push core together). The void length will be recorded in the database for future modification of the lab recovery value. If void appears to have disturbed the core (e.g., stratigraphic layers are mixed), the core will be discarded.
    - If the void length is greater than the above values, the core will be discarded, unless the void is below 36 in. (see next bullet).
    - For cores greater than 36 in. in length that contain voids below 36 in., segment the top 36 in of sediment and discard the core below 36 in. If the void is much deeper in a longer core, use field judgment to determine whether or not to archive samples below 36 in and above the void.

16. Give a physical description of each core segment to the sample custodian to record in the database. Characteristics include the general soil type based on the Unified Soil Classification System, approximate grain size, presence of observable biota, odor, and color. Classification of grain size will be a qualitative observation with the following types denoted: silt, fine sand, medium sand, coarse sand, clay, organic matter, and gravel. The approximate proportion of each soil type within each sample will be estimated (i.e., primary, some, little, trace).

17. Identify any changes in sediment character within each segment. If changes in stratigraphy are observed within a core segment, then the nature and approximate length of the various layers will be verbally relayed to the sample custodian for inclusion in the database. Evidence of changes in stratigraphy include an abrupt change in grain size (e.g., from silt to wood chip layer) or change in soil color which may indicate oxidized or reduced sediments. If objects of cultural significance are observed during the core processing, note them in the database and set them aside for inspection by a qualified geomorphologist or archaeologist.

18. The core sectioning scheme will be modified when glacial lake clay is encountered in a core. Split the appropriate section into two separate samples at the clay/sediment interface. Place into two separate aluminum pans and record the length of each section. Scrape off any coarse material from the clay segment to reduce cross contamination potential. Homogenize each as separate sample and reprint jar labels. Obtain a weight from each section with the appropriate length of tubing material to allow bulk density to be calculated. Collect the clay sample immediately below the section with the clay/sediment interface for submittal for PCB and moisture content analysis. Subsample this section by splitting the entire section longitudinally into quarters. Note any varves that are observed and homogenize one quarter for laboratory analysis. The remaining clay in the core tube can be properly disposed.

19. Homogenize the sediment in the aluminum pans using a stainless steel spoon. A 6 inch core segment will result in approximately 0.7 liters of sediment, a 24-inch segment will result in approximately 2.7 liters of sediment. Use the spoon to bring the sediment near the bottom of the bowl up to the top using a circular motion, similar to preparing food that requires mixing (e.g., cake batter). Repeat this procedure until all of the sediment near the bottom of the bowl has been brought to the surface at least twice. Continue mixing the contents of the bowl until an even texture and color is observed throughout the entire sample. Using the stainless steel spoon, manually break up large wood pieces that are too large to fit into the sample jar and are not required to be retained for cultural resources. Homogenize these smaller fragments with the rest of the sample to allow a representative portion to be placed in the sample jar. For the longer segments (e.g., 2-12 in. and 2-24 in.) thorough homogenization will require more effort and time compared to the smaller segments. The amount of effort expended by processing personnel to homogenize core segments should be proportional to the length of the segment (i.e., personnel should expend approximately 4 times as much effort to mix a 2-24 in. segment as expended to homogenize a 6 in. segment). Be sure to thoroughly homogenize each segment.

20. Fill the appropriately labeled containers with sample and package them in a cooler for shipment to the laboratories. The samples will be shipped out in batches of 20 environmental samples accompanied by appropriate QA/QC samples. Chill samples to 4°C with ice packed in Ziploc® bags or equivalent.

21. Process the next core segment as described in steps 13-17 until the whole core is sectioned and all sample jars are filled.

22. Field blank processing will be conducted by sectioning the field blank in 4 in segments for each field blank needed. Using a vibratory saw or pipe cutters, depending on the core tube material, cut the 4 in section and place in the aluminum pan. Thoroughly homogenize the sample and place into an appropriately labeled 4 oz jar. Collect additional field blanks from the core in the same manner.

23. Prior to shipping the samples, confirm which project laboratory has capacity to receive samples the next day, and ship samples (with corresponding COC forms) accordingly *via* overnight delivery service or courier. All samples will be delivered to the analytical laboratories within 24 hours of processing, except for the samples for geotechnical characterization, which will be delivered to the laboratory on a less frequent basis.

24. Place all used spoons, vibratory saw blades, pipe cutters, and the measuring tool at the decontamination station for proper decontamination prior to reuse.

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GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANLAYSIS PROGRAM

Date: October 4, 2002

Organization Name: Environmental Standards, Inc.

Initiator's Name and Title: David Blye, QA Program Manager

Problem Description: The Standard Operating Procedure (SOP) for Core Processing (QAPP, Rev. 4, Appendix 18) indicates the use of stainless steel bowls for containing, weighing and homogenizing the sediment samples. The production rate for 60 cores per day equating to approximately 300 samples per day results in decontamination of the stainless steel bowls as a production rate-limiting step. The time necessary to decontaminate the stainless steel bowls will hinder an efficient sample production rate.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action: The stainless steel bowls will be replaced with clean (virgin) aluminum pans (approximately 10" × 12" × 3") for containing, weighing and homogenizing the sediment samples. The aluminum pans will be disposed of after each use and therefore, will not need to be decontaminated. This change is expected to increase sample processing efficiency since the aluminum pans are disposable. The SOP for Core Processing (QAPP, Rev 4., Appendix 18) will be updated to reflect this change once approved by EPA.

Reviewed and Implemented By: Reviewed and implemented by Margaret Murphy (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: October 10, 2002

Organization Name: Environmental Standards, Inc.

Initiator's Name and Title: David Blye, QA Program Manager

Problem Description: Some of the cores collected during the first few days of the program contain several feet (2' – 5') of glacial lake clay in the bottom depths of the core. The core sectioning scheme presented in the Quality Assurance Project Plan (QAPP, Rev. 4, October 2002) and Field Sampling Plan (FSP, QEA July 2002) would have numerous samples of this clay being submitted for analysis. The clay is from a geologic strata deposited in the last glacial period and, unlike the unconsolidated sediments deposited since PCB usage commenced in the late-1940s, is not expected to contain PCBs. Therefore, sampling the entire depth of sampled clay, as defined in the core sectioning scheme, is not warranted.

Additionally, Erin Shutak from Malcolm Pirnie, an EPA oversight contractor, has requested that steps 5 (determine weight of core) and 6 (drain water from core tube above the sediment) of the Standard Operating Procedure (SOP) for Core Processing (QAPPP, Rev. 4, Appendix 18) be reversed to reflect the actual order of work being performed.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action: The core sectioning scheme will be modified when glacial lake clay is encountered in a core. The appropriate section will be split into two separate samples at the clay/sediment interface. These samples will be placed in separate aluminum pans. Any coarse material will be scraped off the outside of the clay section and this section will be sampled from the interior of the core to reduce cross contamination potential. The sediment and clay samples from this section will be submitted for PCB analysis (GEHR8082) and moisture content. The weight of the clay sample portion and the sediment sample portion of the segment will be individually measured (with appropriate section of tubing material) and recorded to allow bulk density to be calculated. The clay sample section immediately below the section with the clay/sediment interface will also be collected and submitted for PCB analysis (GEHR8082) and moisture content. The weight of this section will be obtained in accordance with the SOP for Core Processing (QAPP, Rev 4., Appendix 18). This clay section will be subsampled by splitting the entire section longitudinally into quarters. The sections will be visibly inspected to note any varves and one quarter will be homogenized and submitted for PCB analysis (GEHR 8082) and moisture content. The remaining clay contained in the core tube will be discarded and properly disposed. The core processing procedure modification described above was approved verbally by the USEPA RPM, Mr. Doug Tomchuk on October 9, 2002.

The SOP will also reorder item 5 and 6 to reflect the actual order of the work being performed. The SOP for Core Processing (QAPP, Rev 4., Appendix 18) will be updated to reflect this change once approved by EPA.

Reviewed and Implemented By: Reviewed and implemented by Margaret Murphy (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: October 21, 2002

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Margaret H. Murphy, Field Sampling Manager

Problem Description: When the top 2" section is cut, it is difficult to collect the entire section due to the higher water content. When using the vibratory saw, the majority of the 2" section is splattered against the upper sides of the core tube. When using the aluminum pipe cutters, the sediment oozes out through the cut prior to the broad knife being placed to contain the segment. The core sectioning scheme presented in the Quality Assurance Project Plan (QAPP, Rev. 4, October 2002) and Field Sampling Plan (FSP, QEA July 2002) do not differentiate cutting of this segment from the other segments. Cutting this segment in the same manner as the other segments will result in loss of sediment from the top 2".

The core sectioning scheme presented in the Quality Assurance Project Plan (QAPP, Rev. 4, October 2002) and Field Sampling Plan (FSP, QEA July 2002) did not establish a methodology for sectioning the field blanks in the SOP.

Additionally, Erin Shutak from Malcolm Pirnie, an EPA oversight contractor, has noted that large pieces of wood or rock that do not fit into the 4 oz jars are being removed. The protocol for this removal is described below.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action: The core sectioning scheme will be modified for collecting the top 2" of sediment. The top 2" of sediment will be measured and appropriately marked on the outside of the core tube. This sediment will be spooned out into the aluminum pan prior to any cutting. The amount of sediment removed will be measured by placing the spoon into the core and measuring 2" to the top of the next segment. The base of the handle on the teaspoon being used is equivalent to the 2" mark. The 2" core tube section will be cut off following the removal of the sediment so that the top of the next segment is visible. Sectioning of the rest of the core will follow the SOP.

Field blanks will be sectioned in the processing lab by cutting 4"segments for each sample needed. The section will be cut using a vibratory saw or pipe cutters, depending on the core tube material, and the 4" section placed in the aluminum pan. The segment will be thoroughly homogenized and placed into an appropriately labeled 4 oz jar. Additional field blanks needed from the same core will be collected in the same manner.

When possible, wood fragments will be homogenized with the sample by breaking into pieces with the spoon. When large pieces of wood or rock are encountered that cannot be homogenized to fit into the 4oz jar, they will be removed from the sample. It will be noted in the database for that segment that a rock or piece of wood was removed.

Reviewed and Implemented By: Reviewed and implemented by Margaret Murphy (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: May 9, 2003

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Margaret H. Murphy, Field Sampling Manager

Problem Description:

The current core processing procedure calls for discarding the bottom two inches of each core. Discarding the bottom two inches of each core leads to a significant loss of information especially in incomplete cores which are typically short and account for approximately one third of all cores collected during 2002. More cores with a complete PCB profile could be collected if the bottom two inches of each core were archived. Archiving with possible subsequent analysis of the bottom two inches of each core would be less costly and yield information faster than the collection and analysis of additional cores. The potential for contamination in the bottom core segments due to smearing could be eliminated if samples were spooned out of the center of each core tube. Adding this step to core processing procedures would not significantly affect the time to process a core.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

Alter the core processing procedure by archiving the bottom two inches of each core. Samples will be collected by spooning out the center of the bottom two-inch segment; they will be processed in a manner consistent with all other core segments, and archived. GE will consult with USEPA prior to any needed analyses of the archived 2 in. segments to fill in data gaps. Revisions to the QAPP will include specific protocols and an explanation of what type of conditions would justify analysis of these archived segments.

Reviewed and Implemented By: Reviewed and implemented by Margaret Murphy (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: May 9, 2003

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Margaret H. Murphy, Field Sampling Manager

Problem Description:

The 2002 sediment sampling data suggest that PCB contamination (Total PCB concentration greater than 1 mg/kg) below 36 in. in depth only occurred in about 3% of all collected cores. The analysis of segments greater than 36 in. in depth resulted in the unnecessary analysis of more than 700 clean core segments in 2002, resulting in additional burden on the analytical laboratories and unnecessary expense.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

Analyze the segments from the top 36 in. of each core, and archive the remaining core segments. Samples will be preserved by an EPA-approved method (eg. freezing) by placing in a freezer at the GE Hudson Falls Plant and kept at temperatures $\leq 10^{o}$C. The archived core segments will be analyzed if data analysis suggests that additional information is necessary for accurate dredge area delineation.

Reviewed and Implemented By: Reviewed and implemented by Mark LaRue (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: May 9, 2003

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Margaret H. Murphy, Field Sampling Manager

Problem Description:

The sediment classification in the laboratory database did not include the "medium sand" classification in the visual texture description field. This option should be added to the database so that the sample texture description from field laboratory would better match the results of quantitative grain size analysis provided by geotechnical laboratory.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

Incorporate the "medium sand" classification in the processing laboratory database for the visual description of core segments.

Reviewed and Implemented By: Reviewed and implemented by Margaret Murphy (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)

GENERAL ELECTRIC COMPANY
HUDSON RIVER DESIGN SUPPORT SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Date: May 9, 2003

Organization Name: Quantitative Environmental Analysis, LLC

Initiator's Name and Title: Margaret H. Murphy, Field Sampling Manager

Problem Description:

During the 2002 field season, numerous samples contained wood fragments that were removed from the sample if they did not fit into the 4 oz sample jar. Larger wood fragments typically were set aside for appraisal as a cultural resource. Incorporating this homogenization to the procedures would not add additional time to processing.

Reported To: Bob Gibson, GE; John Haggard, GE; John Connolly, QEA

Corrective Action:

Large wood pieces recovered in the core samples that are too large to fit into sample jars and not required to be retained for cultural resource purposes will be manually broken up using the mixing spoon during homogenization. These smaller pieces will be homogenized with the rest of the sample to allow a representative portion to be placed in the container.

Reviewed and Implemented By: Reviewed and implemented by Margaret Murphy (QEA).

cc: GE Program Manager: John Haggard; Bob Gibson
QA Program Manager: David Blye, EnvStd
Other Distribution: John Connolly (QEA), Mark LaRue (QEA), Margaret Murphy (QEA)