Hudson River PCBs Site

Design Support
Sediment Sampling and Analysis Program
Field Sampling Plan

Prepared for:

General Electric Company
Corporate Environmental Programs
Albany, NY

July 2002

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SECTION 1 - INTRODUCTION

1.1 INTRODUCTION

This Field Sampling Plan (FSP) has been prepared on behalf of General Electric Company (GE) as part of the remedial design to implement the February 2002 Record of Decision (ROD) for the Hudson River PCBs Site issued by the U.S. Environmental Protection Agency (USEPA) (USEPA, 2002). This FSP describes the scope of the Sediment Sampling and Analysis Program (SSAP) that will be performed. This FSP will be accompanied by a Quality Assurance Project Plan (QAPP), a Health and Safety Plan (HASP) and a Community Health and Safety Plan (CHASP). The QAPP and CHASP will be subject to USEPA approval. Procedures and approaches specified in the QAPP will be consistent with those presented in this FSP. This FSP includes the following six USEPA-approved exhibits. These exhibits also will be incorporated into the QAPP for the sediment sampling and analysis.

Exhibit A – Project-specific PCB Aroclor Analytical Method (GEHR8082)

Exhibit B – Project-specific PCB Homolog Analytical Method (USEPA Method 680)

Exhibit C - Sediment Extraction Procedures for PCB Analysis (USEPA SW-846 Method 3545)

Exhibit D - Sediment Extraction Procedures for PCB Analysis (USEPA SW-846 Method 3540C)

Exhibit E - Data Verification and Validation Strategy

Exhibit F - Project Schedule

1.2 OBJECTIVES

The objective of the SSAP is to provide sediment data for the design of the remedy set forth in the ROD (USEPA, 2002). 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 sediments and related data will be reviewed to elicit information useful for determining the possible presence of cultural resources.

The results of the SSAP work will be documented in two reports (see Section 5), one for each year of field activities.

1.3 BACKGROUND

In the ROD (USEPA, 2002), USEPA divided the Upper Hudson into 3 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 3 g/m^2 Tri+PCBs 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 (NYSDEC *Hot Spots* 36, 37, and the southern portion of 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).

Areas of sediment targeted for remediation were selected based on the potential for those areas to contribute PCBs to the water column and fish through the food chain. The delineation of the target areas considered a number of factors, primarily the inventory of PCBs in the sediment, but also surface sediment concentrations, sediment texture, bathymetry and depth at which the PCB contamination is found. Areas where 12 inches of greater of relatively clean sediment exist were eliminated from consideration. Target areas were defined as approximately 50,000 square feet (a little over an acre) or greater, due to practical limitations on the number of separate remediation zones that could be accommodated for a project of this size (ROD at pp. 54-55). EPA identified certain select areas in River Section 3 for remediation, specifically NYSDEC *Hot Spots* 36, 37, and the southern portion of *Hot Spot* 39, based on PCB inventory and signs of potential loss of PCB inventory to the water column or uptake by biota (ROD at pp. 55-56).

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

1.4 APPROACH

The SSAP is focused on sediments having some likelihood of qualifying for removal. These sediments have been divided into two categories. These categories are:

- 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 River Section 1, the Target Areas and Areas to be Screened will be those identified in the FS (USEPA 2000) based on historical data. For River Sections 2 and 3, the Target Areas will be those identified in the FS. The remaining portions of River Sections 2 and 3 will be addressed as follows. Side scan sonar data will be collected throughout River Sections 2 and 3 and used to map river bed sediment types. Fine grained deposits identified by the geophysical survey in River Sections 2 and 3 that are not already Target Areas and are 50,000 ft^2 or more will be identified as Areas to be Screened by sediment coring. In addition, sediment cores will be taken from other sediment types if information obtained from work conducted in River Section 1 demonstrates in conjunction with the existing sediment data that these sediment types may exceed the respective MPA thresholds. The number of additional sediment cores in these sediment types in River Sections 2 and 3 will not exceed a total of five hundred (500) within the scope of this FSP.

Sediment cores will be collected at predetermined locations along a grid system. These cores will be cut into segments and analyzed for PCBs and other parameters (Section 2.2).

SECTION 2 – METHODS

2.1 GEOPHYSICAL SURVEYS

Geophysical surveys will be conducted to identify additional Areas to be Screened and to determine the physical characteristics of sediment. These surveys will include a side scan sonar survey to map sediment type and the presence/absence of submerged archaeological artifacts, and a bathymetric survey to map sediment bed elevation. Additionally, a sub-bottom profiling survey may be conducted to attempt to determine sediment stratigraphy. Performing the sub-bottom profiling survey is contingent on the success of a test of the efficacy and utility of sub-bottom acoustic and electromagnetic imagery that is described in Section 2.1.3. As described below, the side scan sonar survey will be performed prior to the bathymetric survey as side scan sonar data will be used to select the spacing of bathymetric transects in some areas.

2.1.1 Side Scan Sonar Survey

Side scan sonar surveys will be conducted throughout all three River Sections in accordance with the Standard Operating Procedure (SOP) to be presented in the QAPP. The goal is to develop a map of sediment types that may be correlated with PCB concentrations and inventory. Previous studies have shown a correlation between the grain size distribution and PCB concentration (USEPA, 1997). Acoustic imagery will be obtained along longitudinal survey lines parallel to the course of the river. Bank-to-bank side scan survey coverage will be obtained by running multiple survey lines with overlapping coverage. The surveys will be conducted using a high resolution, dual frequency, side scan sonar system. Manual probing, visual characterization of sediments during the survey, and confirmatory sampling of grain size will be conducted to ground-truth the remote sensing data. Sediment samples will be collected and analyzed for grain size in 2002 to confirm side scan sonar data. Sample locations will be

selected from areas which, based on input from the geophysical contractor and USEPA, need further definition/confirmation of grain size. In each River Section, approximately 150 shallow core samples will be collected using push-core techniques, for a total of 450 samples. The top one (1) inch of each core will be submitted for grain size analysis (sieve method) in accordance with the method to be specified in the QAPP. The details of the side scan survey program will be included in the side scan sonar SOP to be submitted as part of the QAPP.

The acoustic imagery will be processed and interpreted to represent graphically the physical characteristics of the riverbed (*i.e.*, sediment type or rock). These data will be used to assist in identifying the areas to be sampled, as discussed in Section 2.2.2.

2.1.2 Bathymetric Survey

Bathymetric data exist for River Section 1 from a survey conducted for GE in the Fall of 2001. Bathymetric surveys will be performed in River Sections 2 and 3 after the side scan sonar data have been collected and interpreted. The surveys will be performed in accordance with a SOP that will be developed and incorporated in the QAPP upon selection of a geophysical surveying contractor. The transect spacing is based on professional judgment and previous experience at other sites. If data gaps are identified during subsequent design activities, additional data will be obtained.

2.1.2.1 River Section 1

As noted above, bathymetric data exist for River Section 1 from a survey conducted for GE in the fall of 2001. These data will be used for the remedial design, subject to confirmation of the data from the side scan sonar survey, which also provides bathymetric data. The 2001 bathymetric data are currently being processed for inclusion into the project database. The surveys were conducted for GE by Ocean Surveys, Inc. (OSI) along 361 bank-to-bank transects

spaced at approximately 100-ft. intervals throughout the Thompson Island Pool (River Section 1). Approximately 277 data points were obtained along each transect, resulting in a typical spacing of 2 feet between soundings. To maintain horizontal and vertical control for this work, OSI used an on-board GPS that received signal corrections from a shore-based unit. The reported accuracy for this system was +/-1 cm for horizontal positioning, and +/-3 cm for vertical positioning.

The horizontal positioning data were transmitted in real-time to an on-board vessel tracking system that was capable of displaying significant features such as the river shoreline, navigational aids, target transects for data collection, and the position of the vessel in relation to these features. This enabled the helmsman to maneuver the vessel to follow each transect laterally across the river, and collect water depth data using an Innerspace Model 448 digital depth sounder. The water depth data were used to calculate an elevation of the riverbed. These elevations were in reference to the elevation of a shore-based benchmark. This system accounted for variability in water elevation that occurred as a result of upstream hydroelectric and canal operations.

2.1.2.2 River Section 2

Bathymetric data will be collected in River Section 2 using procedures specified in the SOP on bathymetry to be presented in the QAPP. Data will be obtained along bank-to-bank transects spaced at 300-ft. intervals throughout River Section 2. The transect frequency will be increased to every 100 feet in the areas identified for sediment sampling by side scan sonar (if 50,000 ft^2 or more) and areas identified for navigational dredging. This increased transect density will extend approximately 500 feet upstream and downstream of these areas. The approximate location of the data collection transects in River Section 2 are presented in Figure 2-1; however, additional transects will be included in any areas identified for sediment sampling during the side scan sonar survey.

2.1.2.3 River Section 3

Bathymetric data will be collected in River Section 3 using procedures specified in the SOP on bathymetry to be presented in the QAPP. Bank-to-bank sampling transects generally will be spaced 1000 feet apart. The transect frequency will be increased to every 100 feet in areas identified for sediment sampling by side scan sonar (if 50,000 ft^2 or more) and areas identified for navigational dredging. This increased transect density will extend approximately 500 feet upstream and 500 feet downstream of these areas. The approximate locations of the data collection transects in River Section 3 are presented in Figure 2-1; however, additional transects will be included in any areas identified for sediment sampling during the side scan sonar survey.

2.1.3 Sub-Bottom Profiling Test

In portions of the site, the interfaces between geologic strata may provide information useful in delineating sediment to be dredged. The side scan sonar survey (Section 2.1.2) will provide one means to estimate the boundaries between sediment types. Other geophysical techniques, specifically sub-bottom profiling, can image the subsurface geology using acoustic and/or electromagnetic signals. The utility of these techniques is not assured and depends on various properties of the sediment. These techniques are currently being applied in the Lower Hudson River.

Sub-bottom profiling will be tested during the 2002 field season in selected portions of River Section 1 (i.e., the Thompson Island Pool) and River Section 2 (in the vicinity of NYSDEC Hotspots 33, 34, or 35). Both River Sections will be used for testing because of potential differences in stratigraphy attributable to differences in the origin of the sediments (i.e., both catastrophic and long-term deposition in River Section 1 versus primarily long-term deposition in River Section 2). The areas in which sub-bottom profiling will be tested are

scheduled for sediment coring during the 2002 field season (Section 2-2). Coring in the areas subject to the sub-bottom profiling tests will be performed as soon as practicable after the testing is completed.

Testing will be conducted in 5 to 10 acre plots in which stratification is expected based on historical data. Sonar and ground penetrating radar will be applied along 3-4 transects that overlay lines of sediment cores planned for or previously collected in the 2002 field season. The transects will be sampled multiple times using different acoustic and electromagnetic frequencies. The choice of frequencies will be determined based on real-time assessment of the reflected signal.

Sub-bottom acoustic and electromagnetic data will be interpreted using the stratigraphy observed in sediment cores as confirmatory data. The ability of the techniques to identify interfaces between strata accurately will be assessed and recommendations for potential use in Year 2 (i.e., the 2003 field season) will be presented in the Supplemental FSP for USEPA review and approval. The specific equipment and procedures to be used in the sub-bottom profiling test will be chosen after consultation with firms expert in sub-bottom profiling of shallow soft-bottom riverine sediments. A separate Sub-Bottom Profiling Test Work Plan and associated QAPP will be developed and submitted to USEPA for review and approval in accordance with the schedule in Exhibit F.

2.2 SEDIMENT PCB CHARACTERIZATION

A summary of the estimated number of cores, resulting samples, and analytical program is presented for River Sections 1, 2, and 3 in Tables 2-1, 2-2, and 2-3, respectively.

2.2.1 Schedule

The project schedule is presented in Exhibit F. The sampling program is currently planned for two field seasons (approximately August to November of 2002 and May to November of 2003). Sampling in the first field season will focus on River Section 1 and *Hot Spots* 33, 34 and 35 in River Section 2. River Section 3 and the remainder of River Sections 1 and 2 will be sampled during the second field season at locations selected based on the results of the geophysical surveys performed during the first field season.

A production rate of approximately 60 sediment cores per day (5 days/week) will be required to complete this program in two field seasons. This production rate assumes that significant delays in the program are not encountered. Sampling will begin simultaneously at the upstream end of both River Section 1 and River Section 2 (Hotspots 33, 34, and 35). Sampling will not be initiated in any other areas of River Section 2 or in River Section 3 until completion of the side scan sonar survey.

2.2.2 Designation of Areas to be Sampled

Essentially all of River Section 1 is designated either as Target Areas or as Areas to be Screened (USEPA 2000). Target Areas in River Sections 2 and 3 were also designated; however, Areas to be Screened were not identified in the FS (USEPA 2000). In River Section 2, samples will be collected from Hot Spots 33, 34, and 35 and adjacent fine-grained sediment areas during the first part of the 2002 field season. For the remaining areas of River Section 2, the historical PCB data and the USEPA 1992 side scan survey will supplement the new geophysical survey results and the results of 2002 sampling to delineate the areas to be sampled in 2003. For River Section 3, the results of the work in River Sections 1 and 2 and the 2002 side scan survey will be supplemented by the historical data to designate areas to be sampled (River Section 3 was not surveyed previously).

The side scan sonar surveys and the results for River Section 1 will provide data to facilitate the identification of the Areas to be Screened in River Sections 2 and 3. The side scan sonar data will be interpreted to identify and differentiate among sediment types. Areas of fine-grained sediment generally coincide with areas of elevated PCB concentrations and, therefore, may be appropriate for designation as Areas to be Screened. In River Sections 2 and 3, areas of fine-grained sediment not already designated as Target Areas will be designated as Areas to the Screened if they abut Target Areas or have an areal extent of 50,000 ft^2or more. Up to 500 cores may be placed in other areas in River Sections 2 and 3 (see Section 1.4). The specific areas to be sampled in River Sections 2 and 3 will be specified in the Supplemental FSP.

2.2.3 Sediment Core Locations

The SSAP requires sufficient core samples to accurately define the boundaries of sediment removal in accordance with the ROD (USEPA, 2002). Interpolation between sample core locations will require that the sample spacing not exceed the distance over which the sediment samples are correlated. GE conducted a variogram analysis of closely spaced samples (i.e., about 10-foot separation) taken in 1990 from four areas of River Section 1 (i.e., the Thompson Island Pool) and found that correlation extended about 300 feet along channel and 50 feet cross-channel. USEPA took an alternative approach in the FS (USEPA, 2000) and used the statistical properties of the 1984 data set to calculate that 40 samples are needed to provide a log mean (median) MPA that has an upper 95% confidence limit no greater than 1.5 times the log mean. USEPA applied this performance requirement to a 5-acre plot, producing a sampling density of 40 cores per 5-acre plot (8 cores per acre), which is satisfied by sampling on a triangular grid with 80-foot spacing. This spacing is designed to provide sufficient precision for purposes of defining the dredge boundaries in conjunction with the geophysical survey results. Additional sampling may be needed to refine boundaries between 80-foot grid nodes. If needed, this would occur as part of the dredge delineation activities undertaken during remedial design.

In Targeted Areas, an 80-foot triangular grid will be used to identify sample core locations. In Areas to be Screened and in Targeted Areas of the navigational channel, a coarser 160-foot triangular grid (i.e., every other node of the 80-foot triangular grid) will be used to select the initial sample core locations. The intent is not to reduce the number of samples obtained, but rather to utilize the initial data to see if changes in the program are appropriate. The resulting data will be analyzed statistically to determine whether sediment cores should be collected from any of the remaining node locations to fill in the 80-foot grid.

Cores advanced from on-board a sampling boat will be collected as close to the shoreline as possible, as long as the water depth is sufficient for navigation by sampling vessels (minimum depth approximately 2 ft. of water). Other methods may be necessary to collect cores in water less than 2 feet in depth (e.g., manual coring or a small hand-operated unit).

2.2.3.1 River Section 1

Nearly all of River Section 1 (i.e., Thompson Island Pool) is navigable by sampling vessels. Sediment cores will be collected in two phases in River Section 1 during 2002. The first phase of sampling will involve collecting sediment cores at every grid node (80-ft. spacing) in the defined Target Areas (except in those portions of the Target Areas that fall into the navigational channel, which will be sampled at a grid node spacing of 160 ft.) and at a grid node spacing of 160 feet in the Areas to be Screened (remainder of River Section 1). Sediment cores will be collected in the Lock 6 land cut (upstream of the Thompson Island Dam Guard Gate) at a 160-foot grid spacing. As described in Section 3.2, data obtained from the Areas to be Screened will be evaluated on an as-received basis to identify areas where the data are insufficient to meet the project objectives.

The second phase of sampling will be performed to address data gaps, and will involve collection of sediment cores within selected areas at the grid nodes located between the nodes

already sampled. This will result in samples being collected at a grid node spacing of 80 feet in these selected areas. Sediment core locations for River Section 1 are presented in Figures 2-2a through 2-2e, and example horizontal coordinates for each core location are presented in Table 2-4. During field activities, latitude and longitudinal coordinates for each sediment core location will be downloaded electronically into the field GPS system on each sampling vessel and used to guide the vessels into position. It is unlikely that it will be possible to collect sediment cores in the areas of River Section 1 that were identified as being rocky during previous geophysical surveys; however, these conditions will be confirmed by probing at the grid nodes during the field sampling activities. Cores will be collected at all targeted grid nodes where conditions permit.

2.2.3.2 Lock 6 Land Cut

The portion of the Lock 6 land cut between the Thompson Island Dam Guard Gate and Lock 6 will be investigated during the off-season (winter 2002) when this portion of the channel is drained. The channel will be inspected visually for sediment types and surveyed using conventional surveying techniques to identify areas where water depths may be less than required for navigation to support completion of the project. Geophysical investigations may supplement or replace the visual inspection described above. If areas of fine-grained sediment with an areal extent of 50,000 ft^2 or more are identified or areas where navigation may be impeded due to insufficient water depth are identified, these areas will be sampled using push core techniques on a 160-foot grid spacing. The supplemental FSP that will be provided upon completion of the 2002 field activities (and related evaluation activities) will identify additional sediment core locations in the land cut, if necessary.

2.2.3.3 River Section 2

With the exception of Hot Spots 33, 34, and 35 and adjacent areas of fine-grained sediment, the sediment core locations in River Section 2 will be determined after the side scan sonar survey is completed and the data are interpreted to delineate sediment types. Both the 1992 and the 2002 side scan surveys will be considered in identifying areas for sampling. Sediment core locations for Hot Spots 33, 34, and 35 and areas of adjacent fine-grained sediment have been selected based on existing side scan sonar data. Sediment core locations in these areas are presented in Figure 2-f.

In River Section 2, areas that are not designated as Target Areas will be designated as Areas to the Screened if they are fine-grained sediments that abut Target Areas or have an areal extent of 50,000 ft^2 or more. In addition, if information obtained from work conducted in River Sections 1 and 2 demonstrate in conjunction with the existing sediment data that other sediment types may exceed the River Section 2 MPA threshold, sampling of those sediment types will be conducted. The number of sediment cores to be taken from these other sediment types in River Sections 2 and 3 will not exceed five hundred (500) (see Section 1.4).

Core samples will be collected at grid nodes in Target Areas (80-ft. spacing), and Areas to be Screened (160-ft. spacing). Sampling will also be conducted within areas selected in River Section 2 in the FS (USEPA 2000a) for navigational dredging, where sediment core samples will be collected at every other grid node (160-ft. node spacing). The Supplemental FSP that will be prepared upon completion of the 2002 field activities (and related data evaluation activities) will specify the sediment core locations in River Section 2 that will be sampled in 2003.

2.2.3.4 River Section 3

The side scan sonar survey data to be collected in River Section 3 will be used to distinguish among sediment types. The Supplemental FSP that will be prepared upon

completion of the 2002 field activities (and related data evaluation activities) will specify the sampling locations within River Section 3. In River Section 3, areas that are not designated as Target Areas will be designated as Areas to the Screened if they are fine-grained sediments and either abut Target Areas or have an areal extent of 50,000 ft^2 or more. In addition, if information obtained from work conducted in River Sections 1 and 2 demonstrates in conjunction with the existing sediment data that other sediment types may exceed the respective MPA thresholds, sampling of those sediment types will be conducted. The number of sediment cores to be taken from these other sediment types in River Sections 2 and 3 will not exceed five hundred (500) (see Section 1.4).

Core samples will be collected at grid nodes in Target Areas (80-ft. spacing) and Areas to be Screened (160-ft. spacing). Sampling will also be conducted within areas selected in River Section 3 in the FS (USEPA 2000a) for navigational dredging, where sediment core samples will be collected at every other grid node (160-ft. node spacing).

River Section 3 sampling will occur before River Section 2 sampling in 2003. A portion of the cores for River Section 3 will be sectioned more finely than those in River Sections 1 and 2 to address the "select" criteria identified in the ROD. For Target Areas, two thirds of the cores will be segmented in the same manner applied in River Sections 1 and 2. The remaining cores will be segmented in six-inch segments as shown in Figure 2-3. In Areas to be Screened, the segmentation approach will be the same as proposed for River Sections 1 and 2. If the results of these samples indicate that a MPA threshold of 10 g/m^2 has been exceeded, the finer segmentation approach will be implemented on half of the remaining 80-ft. grid nodes (i.e. six inch segments as shown in Figure 2-3). The Supplemental FSP will specify the sediment core locations for River Section 3.

2.2.4 Sample Collection Procedures

The procedures for collecting the sediment cores will follow the standard operating procedures (SOPs) to be provided in the QAPP. Vessels utilized for sample collection will be equipped with real-time kinematic differential GPS receivers capable of sub-meter accuracy. Adequate shore-based control points to operate this system will be established. This positioning system will provide data to onboard GPS receivers that will guide vessels to pre-programmed coordinates for each sediment core location. Once in position, vessels will be held in position with spuds and/or anchors.

Prior to attempting to collect a core, probing will be conducted in an area adjacent to the target sample location (i.e., 3 – 5 ft. away) to avoid disturbing the sediment in the vicinity where the core will be taken. The probing will identify the general characteristics of the sediment (i.e., approximate depth and texture). This information will be used to evaluate whether a core can be obtained, and what type of core tube material should be used. Cores will be collected by manually advancing a sample collection tube into the sediment until significant resistance is encountered. At each location, the core tubes will be advanced further into the sediment with the aid of vibra-coring equipment, which will allow for a greater depth of penetration. In cohesive sediments, the cores will be collected in 3-in. outside diameter transparent polycarbonate (Lexan®) tubes. In non-cohesive sediments, the cores will be collected using aluminum tubes. Once the vibra-coring equipment is no longer able to penetrate the sediment, cores will be pulled from the sediments, and the length of the recovered core sample estimated.

Core recovery in the polycarbonate tubes will be measured directly. In the aluminum tubes, the core recovery will be estimated by tapping the outside of the core tube with a small hammer and correlating the location of the change in sound with the sediment water interface. The recovery will be defined as the distance from the bottom of the core tube to the top of the sediment retained in the core tube.

If the recovery is less than 60% of the depth of penetration, the sediment in the core tube will be discarded (contained on the vessel for proper disposal). Up to three attempts at vibra-core collection will be made to obtain an acceptable core. Between attempts, the core tube will be rinsed with river water until all sediment is visibly removed. If the third vibra-coring attempt is unacceptable based on recovery alone, it will be flagged but still used as a sample for that location. If sediment probing indicates a sediment depth of less than 6 inches over a hard substrate, only one vibracore attempt will be made. If a minimum of 60 percent recovery is not achieved, a ponar grab sample will be collected. A minimum distance of 1 ft. will be maintained between the locations of attempted core samples. If an acceptable core cannot be collected within 10 feet of the node location, the attempts at collecting the core and the conditions preventing the collection will be recorded on the field log, and the location will be abandoned.

Upon collection of an acceptable core, the core will be capped, sealed, and labeled. Core tubes will be labeled by writing directly on the core tube using a permanent marker. The labeling will include the core identification number, date, and time. In addition, an arrow will be drawn on the core to indicate the core top. All other field data will be recorded in the field log, as described in Section 2-6. The capped cores will be maintained in a vertical position and stored on ice in a storage rack kept in the dark until they are submitted to the field processing facility at the end of each day and cut into segments the following day.

2.2.5 Core Processing

Processing of the sediment cores into analytical samples will follow the SOPs presented in the QAPP. The field processing facility will be equipped to process approximately 60 sediment cores per day. This will require multiple "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. Additionally, decontamination facilities that include adequate ventilation, new and spent solvent storage facilities, and liquid and solid PCB waste storage facilities will be required.

When a sediment core arrives at the field processing facility, field notes prepared by the sampling personnel will accompany it. This information will be entered into a database by a sample custodian. This database will be used to compile information as the sample processing proceeds, and will be capable of producing chain of custody forms that will accompany processed samples to off-site analytical laboratories. Additionally, this database will be formatted in a manner that will facilitate entry of analytical data electronically as it is received from the laboratories.

The initial step will be to weigh the core tube. This weight will be used as an initial estimate of the sediment bulk density. Cores will be transported with the water head space to minimize disturbance with the top core layer. The next step will be removal of the cap on the top of the core. Any standing water above the sediment will be siphoned off once the fines have settled. The length of the recovered core will then be measured, and the outside of the core tube will be marked to identify where the core tube will be cut into segments. The marking procedure will include placing arrows on each segment to indicate the upper end. The segmentation scheme has been designed to provide, among other things, information required to define the boundary between the PCB-containing sediments and any underlying clean sediments. Additionally, the top 2 inches of sediment in each core will be analyzed.

The length of the core segments will vary from core to core, depending on the total length of the recovered core. The core segmentation approach is presented in Figure 2-3. For cores with a sample recovery of 2 ft. or less, the upper segment will be 2 in., with the remainder of the

core cut into 6-in. segments. For cores with a sample recovery greater than 2 ft., but less than 3 ft., the upper segment will be 2-in. long; the next segment will extend from 2–12 in., with the remainder of the core cut into 6-in. segments. For cores with a sample recovery exceeding 3 ft., the upper segment will be 2-in. long; the next segment will extend from 2–24 in., with the remainder of the core cut into 6-in. segments. Material at the very bottom of the core, typically the last 2 inches, will be discarded and not used as sample to avoid sediments entrained during the coring process. The last (bottom) sample segment of each core will typically be less than 6-in. long. These segments will be submitted for analysis if they are at least 1 in. in length. If less than 1 in., this material will be combined with the segment above it, and the total length of the bottom segment will be recorded.

Prior to extruding the sediment from the core tubing, the core tube will be cut into segments (vibratory saw for polycarbonate tubing, pipe cutter for aluminum tubing). Therefore, the sediment will only be extruded from the section of the core tubing that corresponds to the sample that will be mixed and analyzed. As the core tube is cut, the portion of the tube above and below the cut will be supported. When the core tube is cut through, the core segment will be separated from the rest of the core with a stainless steel broad knife. The sediment will then be removed from the core tube segment with a stainless steel spatula, and placed in a stainless steel bowl, and thoroughly homogenized prior to placing the sample into an appropriate sample container. Equipment that is reused (cutting tools, broad knife, spatula, bowls) will be decontaminated prior to reuse in accordance with the procedures specified in Section 2-7.

A brief description of the physical characteristics of each core segment will be recorded in the field database. These characteristics will include the general soil type (sand, silt, clay, and organic/other matter such as wood chips, as determined using the Unified Soil Classification System (USCS)), approximate grain size (fine, medium, coarse), presence of observable biota, odor, and color. Each core segment will be examined visually to identify changes in sediment

characteristics as it is extruded from the core tubing. If changes in stratigraphy are observed within a core segment, then the nature and approximate length of the various layers will be noted in the field database. If any objects of cultural significance are observed during the core processing, they will be noted in the field database and separated from the sediment and stored at the field processing facility for subsequent inspection by a qualified geomorphologist or archaeologist (see Section 2.3).

Sample volumes and corresponding container specifications are to be provided in the QAPP. Samples will be chilled to 4°C and kept in the dark until they are relinquished to the analytical laboratory. All reusable materials that come into contact with the sediment will be decontaminated in accordance with the procedures specified in Section 2.7. Disposable equipment and residual materials will be properly contained for proper disposal.

GE will archive the remaining portion of each sediment sample collected and analyzed by GE pursuant to the Consent Order in one 4-ounce storage jar. The purpose of such archiving is to ensure that the data needs to be served by the sediment samples for the design and implementation of EPA's remedy have been satisfied. Subsequent analysis of the archived samples may be necessary if, for example, there are problems with the quality of the data obtained from the initial analysis, or if data gaps relating to the above goal are identified by GE or USEPA, or if additional data are needed to characterize sediments for disposal. However, GE's obligation to archive samples shall not obligate GE under this Consent Order to conduct any analyses beyond those required by the Consent Order and the Sediment Field Sampling Plan.

GE will continue to archive the samples from each year of field investigations until such time as USEPA has approved the delineation of areas to be dredged. Thereafter, USEPA will have the option of obtaining some or all of the archived samples pursuant to Paragraph 58 of the Consent Order. All parties reserve whatever rights they have under applicable law with respect

to such samples, including (but not limited to) GE's right to challenge any analysis of such samples conducted by EPA (subject to Paragraph 62 of the Consent Order) or by any third party. These archiving obligations will not abrogate or otherwise affect any rights or obligations of either GE or the Trustees for Natural Resources with respect to such samples.

2.2.5.1 Core Processing for Engineering Data

Samples for engineering parameters will be obtained from a subset of the sediment core segments in accordance with SOPs to be presented in the QAPP. The engineering data samples will be prepared by placing a portion of the homogenized sediment from the core segments into appropriate containers, as will be specified in the QAPP. The containers for PCB analysis will be filled before the containers for engineering parameters are filled. If the sample volume is insufficient to perform the engineering data analyses, additional sample volume will be obtained by forming a composite sample using a portion of an adjacent homogenized core segment. As a last resort, sample collection for engineering data may be abandoned for that segment, although this will be minimized to reduce any potential for bias. The core segments used to form the composite and proportions thereof will be described in the project database.

2.2.5.2 Core Processing for Preliminary Disposal Characterization

Samples for preliminary disposal characterization will be obtained from a subset of the sediment cores in accordance with Section 2.4.3 below and SOPs will be presented in the QAPP. The samples will be prepared by homogenizing the sediment from each core segment in a single core separately, and then forming a composite sample containing homogenized sediment from each of the segments in the core. The composite sample will be placed in containers, stored and analyzed appropriately, as will be specified in the QAPP.

2.3 CULTURAL RESOURCES

As part of the ROD Responsiveness Summary, EPA prepared a Stage IA Cultural Resource Survey to comply with Section 106 of the National Historic Preservation Act (USEPA 2001). The survey concluded that the selected dredging remedy may potentially affect fourteen previously identified archaeological sites and seven National Register-listed and one National Register-eligible historic properties. The Stage IA report noted that all of these resources are terrestrial and it is not known if any of the resources extend into the river. The SSAP provides an opportunity to collect some information early in the remedial design to begin evaluating whether cultural resources are present within the river. The evaluation to be conducted as part of this FSP will be as follows:

Side Scan Sonar: Side-scan sonar will be used to identify sediment types (Section 2.1.1). These data also will be utilized to study the river bottom and sides in an attempt to locate submerged cultural resources (e.g., river barges, wharfs). Details on the methods to be employed in the side scan sonar survey will be provided in the QAPP. A review of the side scan sonar and background cultural resources data will be performed jointly by a geophysicist and archaeologist to interpret the results of the studies and identify areas that may contain submerged archaeological sites.

Sediment Cores: Sediment cores will be collected in River Sections 1, 2, and 3 for various environmental and geotechnical analyses (Section 2.2). The sediment core segments also will be used to assess the potential for archaeological sites to be present, as follows. Based on review of the Stage IA study and other available data, an overlay map will be generated to identify all areas that have some potential to contain archaeological sites (e.g., excluding areas that have been disturbed by previous dredging). All cores collected from those areas will examined for artifacts and for evidence of a submerged land surface that was at one time terrestrial and over 50 years old (i.e., a buried A horizon). For the latter purpose, project staff

responsible for sediment core processing will be trained by an experienced geomorphologist to gather the appropriate soil data (for example, color, grain size, mottling, and other characteristics) using standard ASTM methods. Periodic visits by the geomorphologist will be performed when sampling is conducted in such areas. In this way every sediment core can be examined and those samples containing artifacts or other dateable anomalies will be noted and the artifacts stored for later evaluation.

These data, as well as the side scan sonar data and other available information, will be used in later efforts to identify areas that contain or are likely to contain archaeological sites. Such follow up efforts will be conducted as part of the cultural resource evaluation performed during the remedial design.

Data Reporting: The cultural resource information gathered from the sediment cores and side-scan sonar will be included in the yearly Data Summary Reports.

2.4 ENGINEERING DATA COLLECTION

Preliminary engineering data will be collected concurrently with the chemical characterization data. These data will be used during the design of the remedy selected in the ROD. Engineering data will be obtained by performing the following tasks:

- geotechnical analyses on sediment;
- preliminary sub-bottom characterization; and
- disposal characterization.

2.4.1 Geotechnical Analysis

All samples analyzed for PCBs also will be analyzed for the geotechnical properties of bulk density, water content, and USCS classification. A subset of the sediment samples (approximately 5%) will be selected for additional geotechnical testing by a qualified geotechnical field technician. The additional geotechnical tests will include grain size distribution, Atterberg limits, Total Organic Carbon and specific gravity. The selection of samples for additional geotechnical testing will be based on visual characterization using the USCS during sediment sample processing (Section 2.2.5). The samples will be selected from representative locations in each of the three River Sections in a manner that will result in the evaluation of a range of sediment properties, including fine/coarse particle content, solids concentration, organic content, and specific gravity. Depending on the results of the USCS visual characterization, additional samples may be required.

In accordance with the DQOs to be presented in the QAPP, the geotechnical data will be evaluated for variability and correlation of geotechnical properties relative to material types. Given the relatively limited number of sediment types expected to be encountered (on order of 5 to 10), this effort should generate a sufficient number of data points to assess the variability. Variability also may be evaluated relative to river location, sediment depth or specific sediment areas. The scope of the SSAP includes this further variability analysis but does not include the collection of additional samples for geotechnical analysis.

2.4.2 Sub-bottom Characterization

Sub-bottom characterization will be performed on a limited basis as part of the SSAP to help define the geotechnical conditions below soft sediment. The sub-bottom characterization will include probing of the river bottom and will be performed in conjunction with the sample collection procedures presented in Section 2.2.4. During the collection of sediment cores, the sediment at each sampling location will be probed by manually advancing a probing rod into the

sediment to assess sediment thickness, degree of compaction, presence of subgrade cobbles, gravel, sand, and/or rock, to the extent practicable. The probing will generally be done 3 to 5 ft. away from the target sample location to avoid disturbing the sediment prior to core sample collection. Physical information and observations obtained by the initial manual advancement and subsequent vibra-coring of each of the sediment core tubes described in Section 2.2.4 for collection of sediments will also be valuable in assessing sub-bottom characteristics. A profile of subgrade conditions will be developed by combining field data, probing results, and the geotechnical characterization of sediment samples.

2.4.3 Preliminary Disposal Characterization

The SSAP also will provide preliminary information regarding sediment characteristics that may affect acceptance for disposal in licensed, off-site landfill facilities. This portion of the program is not intended to fully characterize sediment for disposal; however, these data will be obtained on a preliminary basis to identify what types of sampling and treatment may be required when final characterization is made for disposal purposes. Samples prepared for disposal characterization will be full core composites rather than core segments to better reflect the effects of the dredging process, because the dredging operations will tend to mix sediments as they are removed from the river.

Twenty cores will be selected for disposal characterization at random from each of the three River Sections. A length-weighted composite sample will be prepared for each core by mixing aliquots obtained from each core segment. Core sample processing is described in Section 2.2.5. This will result in the generation of 60 samples for disposal characterization. Each disposal characterization sample will be analyzed for RCRA hazardous waste characteristics and concentrations (*i.e.*, TCLP metals and organics, reactivity, ignitability) and high-resolution dioxins/furans. Corrosivity has not been included because this test applies to

liquid materials which will be land disposed; such disposal is not anticipated for sediment during remediation.

2.5 ANALYTICAL TESTING PROGRAM

The analytical testing program for this FSP includes analysis of some or all sediment samples for the following parameters:

- PCBs
  - Aroclors
  - homologs
- RCRA metals
  - arsenic
  - barium
  - cadmium
  - chromium
  - lead
  - mercury
  - silver
  - selenium
- high resolution dioxins/furans
- radionuclides (^{137}Cs, ^{7}Be)
- geotechnical parameters
    - bulk density
    - water content
    - USCS classification
    - grain size distribution

    - Atterberg limit
    - specific gravity
- total organic carbon
- preliminary disposal characterization
    - TCLP metals and organics
    - reactivity, and
    - ignitability.

This section specifies the methods that will be used for each of these analyses. Tables 2-1, 2-2 and 2-3 summarize the analytical methods in River Sections 1, 2 and 3.

2.5.1 Chemical Analysis of Sediments

A homogenized sediment sample from each core segment will be analyzed for PCBs using the project-specific PCB Aroclor method presented in Exhibit A. The PCB extraction procedures are defined in Exhibits C and D. Additional analyses will be performed in accordance with the methods summarized in Tables 2-1, 2-2, and 2-3 and will be presented in detail in the QAPP. These analyses include moisture content and bulk density in each core segment. The top 2-inch segment also will be analyzed for radionuclides (^{137}Cs, ^{7}Be) and Total Organic Carbon. In the first two weeks, an estimated 3000 environmental sediment samples will be analyzed for Aroclor PCBs and these other parameters (60 cores per day x 10 days = 600 cores x 5 samples per core = 3000 samples).

A project-specific method for homolog PCB analysis (USEPA Method 680 – Exhibit B) will be performed on 400 positive (i.e., not non-detect) sediment sample extracts in the first two weeks[1] (apportioned among the labs performing the Aroclor analyses based on their rate of

[1] As used herein, the "first two weeks" shall refer to the first two weeks of the sampling program or the first 3000 samples (150 SDGs with a SDG containing approximately 20 field sediment samples), whichever is greater.

analysis); this amounts to about 13% of the Aroclor samples. Thereafter, homolog analysis will be reduced to 4% of the Aroclor samples per lab (not less than 350 positive Aroclor analyses, apportioned among the labs based on their rate of analysis). The subset of sample extracts being analyzed for homologs will span the same range of PCB concentrations as the subset being analyzed for Aroclors. The homolog sample extracts will be selected from sample delivery groups (SDGs) that have satisfied the performance evaluation (PE) criteria for Aroclors (as described in Exhibit E).

Additionally, approximately 2% of the total number of cores (selected randomly from core segments immediately below the deepest segment in which PCBs were measured at greater than 1 ppm) will be analyzed for RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, silver, and selenium) and high resolution dioxins/furans. The 1 ppm criterion has been 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.

2.5.2 Engineering Data

Samples for geotechnical characterization (Section 2.4.1) will be submitted for the following parameters:

Test Description	*Method*
Grain Size Distribution (sieve and hydrometer as appropriate)	ASTM D422 and D1140
Atterberg Limit	ASTM D4318-00
Specific Gravity	ASTM D854-001
Total Organic Carbon	Lloyd Kahn Method
USCS Classification	ASTM D2487

Samples for disposal characterization (Section 2.4.3) will be submitted for RCRA hazardous waste characteristics (TCLP metals and organics, reactivity, ignitability), and high resolution dioxins/furans.

2.6 APPLICATION OF AROCLOR PCB DATA TO TRI+ PCB

The selected remedy specifies the removal of sediments defined in terms of PCBs with three or more chlorine atoms (Tri+ PCBs). The Aroclor method to be used in this SSAP will measure total PCBs. It is important that the Aroclor data can be translated to Tri+ PCBs. An analysis of 20 paired Aroclor and congener PCB measurements found the following relationship:

$$\text{Tri+ PCB} = 0.13 \text{ Aroclor } 1221 + 0.7 \text{ Aroclor } 1242 \ (r^2 = 0.991)$$

GE is currently reanalyzing those extracts for PCB homologs using EPA Method 680. These data, along with data collected during the SSAP, will be used to determine the comparability of the Aroclor and homolog analytical methods and relationships between total and Tri+ PCB data. Separate relationships may have to be developed for each Aroclor lab.

2.7 FIELD DATA MANAGEMENT

Field notes will be taken by field personnel to provide a detailed description of the sampling event. Information for each sediment core will be recorded on a field log form, and will include the following:

- Date
- Time
- Initials of sampler
- Weather conditions

- Core identification number
- GPS coordinates (northing/easting)
- Water depth
- Probing depth
- Sediment type (based on probing)
- Sediment description
- Sample type (core or ponar grab)
- Tube material (Lexan or aluminum)
- Depth of penetration of the core tube into the sediment
- Approximate length of sediment core recovered
- Signature lines for transfer of cores to processing laboratory

This information will accompany the sediment cores to the field processing facility where it will be entered into the project database. As described in Section 2.2.5, other observations regarding the sediment (e.g., color, texture, etc.) will be recorded in the project database during core processing. Example sample identification numbers are presented in Table 2-4. An example field log form is presented in Figure 2-4.

2.8 DECONTAMINATION PROCEDURES

All non-disposable equipment that comes in contact with sediment will be decontaminated prior to reuse. These procedures will be specified in the QAPP and include:

- wash with laboratory grade detergent;
- rinse with distilled water;
- rinse with acetone and allow to dry (contain rinsate for appropriate disposal);
- rinse with hexane and allow to dry (contain rinsate for appropriate disposal); and

- rinse with distilled water.

Residual sediment core segments and decontamination fluids (generated in the field processing facility and on the sampling vessels) will be stored in an appropriately designed storage facility at the field processing facility prior to shipment for off-site disposal in accordance with applicable regulations.

Disposable materials that come into contact with sediment, such as personal protective equipment, will also be stored at the field processing facility prior to appropriate off-site disposal as PCB-containing waste. Used core tube sections will be cleaned with detergent and water, and disposed of as municipal solid waste or recycled.

2.9 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality Control (QA/QC) will be assessed for all aspects of the project, including field, laboratory, and data management activities. This section of the FSP provides a general description of the QA/QC program. Details of the QA/QC program will be presented in the QAPP, which will be consistent with this FSP.

2.9.1 Field QA/QC Assessment

QA/QC for field procedures will be addressed through implementation of a thorough inspection and audit process. This process will include routine observation and critique of the sample collection process by the field sampling coordinator. These inspections will include reviewing core collection techniques, preparation and transcription of field notes, accuracy of the GPS used to navigate to core sample locations, and ability of the selected equipment to obtain adequate samples. Additionally, the field processing facility and core sample processing procedures will be reviewed to assure that the facilities and protocols are appropriate. Activities

reviewed will include sample login, field data entry, core segmenting and sample homogenization procedures, container labeling, and sample packaging for shipment. The Field QA/QC Manager will be informed of any deficiencies in the data, including field QA/QC sample data (Section 2.8.3), and will investigate potential sources of these deficiencies within the field processes.

2.9.2 Laboratory and Data Management QA/QC Assessment

QA/QC assessment of the laboratory analytical procedures and data management activities will be performed by the Project Data QA/QC Manager. This assessment will include review of laboratory electronic data deliverables to assure that they are in a format that is appropriate for inclusion in the project database, on-site laboratory audits, evaluation of field QA/QC sample data (Section 2.8.3), verification and validation of data upon receipt from the laboratory, and routine review of the project database as it develops.

2.9.2.1 Data Verification and Validation

Verification and validation of the data will be performed to determine the usability of the data and to ensure results are generated in accordance with the procedures defined in the FSP. The overall strategy to be employed for the data verification and validation is described in Exhibit E. Specifically, electronic data verification will be performed on 100% of the samples (as described in Exhibit E). In addition, for PCB samples performance evaluation (PE) samples will be analyzed by the laboratories at specified frequencies, as set forth in Section 2.9.3.1 below and Exhibit E. Where a given laboratory fails a PE analysis (as described in Exhibit E), the PCB samples associated with that PE sample (i.e., all samples analyzed by the laboratory between acceptable PE samples) will be subject to full manual data validation. For other analytes, full data validation will be performed on a subset of the analytical results as specified in Exhibit E.

Where data validation is necessary, the specific data validation procedures that will be used are described in the QAPP.

To facilitate data verification and validation, sample analysis and batch quality control results will be delivered in an Electronic Data Deliverable (EDD) for batch loading into the project database. Analytical results for all samples will also be provided in a full USEPA Contract Laboratory Program (CLP) equivalent (CLP-like) data package in a scanned electronic media (Adobe® Acrobat® .pdf). The EDD and CLP-like data package deliverables will be defined in the QAPP. If either verification or validation identifies deficiencies in data quality, the source of the deficiencies will be investigated and corrective action will be taken. Qualification of data resulting from the electronic verification or validation processes will be reflected by assigning the appropriate qualifier code to the sample result in the project database.

2.9.2.2 Pre-Program Inter-Laboratory Comparison Study

Since more than one laboratory facility may be involved in the PCB analytical program to support the SSAP, an inter-laboratory comparison study will be completed prior to the commencement of the analysis of sediment core samples. This evaluation will include a comparison of the data and data packaging produced by various laboratories, and is described in additional detail in Exhibit E. Sediment samples from the Upper Hudson River at 4 different locations and one matrix matched performance evaluation (PE) sample in the 30-40 ppm range will be used to provide a range of PCB concentrations. Sufficient sample volumes have been collected to allow homogenization and splitting of the samples to supply an adequate number of samples to each prospective laboratory. The laboratories will be instructed to analyze the samples for PCBs by the Aroclor method (Exhibit A), and to provide electronic data packages in accordance with specifications in this FSP. The resulting data and data packages will be compared among laboratories for consistency and adherence to the packaging requirements. The data assessment will include comparing both total PCB concentration and PCB composition (to

the extent possible using the Aroclor PCB methodology). These samples will also be analyzed by an independent laboratory for homologs by the GC/MS SIM (EPA Method 680) to determine the comparability of the Aroclor and homolog results by the two different methods. Acceptance criteria will be established for each analytical method using the results of the interlab comparison study. Additional details on the PE program are described in Exhibit E.

2.9.3 QA/QC Samples

Additional sampling and laboratory analyses will be performed to provide data to allow the assessment of the quality of field and laboratory procedures. These additional samples (QA/QC samples) will include sample duplicates, field blanks, and equipment blanks. MS/MSD sample analysis is not required by USEPA for the PCB analysis performed for this SSAP program, but is required for other analytes (e.g., metals). Field duplicate samples will be collected at the rate of 5% of the total number of environmental samples. Sample duplicates will be prepared in the field processing facility and submitted to the analytical laboratory "blind" without any indication of the actual sample location. Equipment blank samples will be prepared by processing a sample of laboratory grade sand (sodium sulfate may be substituted depending on laboratory preference) in the same manner that the environmental samples are subjected to, including placement in new core sample tubing, removal, mixing, and placing in containers. Rinsate blanks will also be collected to document that decontamination methods are effective. Additional details regarding frequency of QA/QC samples to be provided in the QAPP.

2.9.3.1 *Performance Evaluation*

For the labs running Aroclor analysis, the frequency of PE samples shall be one per day for the first two weeks (e.g., 5 labs x 10 days = 50 PE samples). Thereafter, the frequency shall be one PE sample per lab per day for each lab performing satisfactorily.

The lab(s) running homolog analysis shall analyze the extracts of 12 PE samples in the first two weeks (i.e., 3 at each of the 4 PCB concentration levels). Thereafter, the frequency shall be one per every two SDGs or one PE per day, whichever is more frequent, for each lab performing satisfactorily.

2.9.3.2 Split Sample Analysis

During the SSAP, EPA intends to split sediment samples with GE and analyze them for PCBs. GE will analyze its portion of split samples (up to 100 analyses) for both Aroclor (Exhibit A) and homologs by USEPA Method 680 (Exhibit B). For the split samples in which GE performs analysis by USEPA Method 680 (Exhibit B), EPA will analyze its portion of the split sample utilizing an analytical method that is consistent with the method given in Exhibit B. The precision goal for these split sample results is 25% (median) within each River Section and within 75% on an individual basis. If the median RPD within any River Section is greater than 25%, GE will take appropriate corrective action in accordance with the approach to be outlined in the QAPP.

2.10 HEALTH AND SAFETY

Appropriate health and safety procedures will be followed during the field activities, including sample collection and sample processing. Specific health and safety procedures will be defined in the Health and Safety Plan (HASP) and Community Health and Safety Plan (CHASP) for this project.

SECTION 3 – DATA MANAGEMENT AND EVALUATION

3.1 DATA MANAGEMENT

The field and laboratory data will be incorporated into an electronic database for the project designed to facilitate searching, segregating, and summarizing the data according to the needs of the users. At the field processing facility, information such as sample ID, date and time of collection, and other field data will be entered into the project database. This step will create a record in the database for each sample prior to receipt of the analytical data from the laboratory, and will be the initial step of setting up the sample tracking system. The sample tracking system will allow database users to identify the status of each sample during the data generation process. The field data entry process will be reviewed once per day to identify transcription errors. As will be described in the QAPP, the project database will be available to all appropriate data users in a format that allows users to conduct their own analyses to verify interpretations of the data performed by GE and its consultants. The database will be transmitted or made available on the web to USEPA on a monthly basis. The PE sample results will be reported to USEPA on a weekly basis.

As described in Section 2.8.2.1, a customized electronic format for laboratory data packages will be developed in a manner that will facilitate incorporation of the data into the database and the use of an electronic data verification and validation program. Additionally, full laboratory data packages that are consistent with the requirements of the USEPA CLP deliverables will be supplied for the PCBs, dioxins/furans, metals and other analyses in electronic format.

3.2 DATA EVALUATION

The Aroclor sediment data may be adjusted according to any correction factors approved by USEPA among the Aroclor and homolog results and the correction factors developed to convert values for total PCBs to Tri+ PCBs, as necessary. A geographical information system (GIS) will be used to develop maps of the PCB contamination in the sediment based on the data and consistent with the criteria for identifying target areas to be dredged set forth in the ROD (USEPA 2002) and FS (USEPA, 2000). These data will be evaluated on an as-received basis to identify areas that may require additional characterization. This evaluation will involve a statistical assessment of the data on an area basis (e.g., 5-acre parcels) and a determination of the extent of spatial correlation (i.e., variogram analysis). In River Section 1, the data evaluation process will include two phases. The first phase will be performed to identify data gaps within the Areas to be Screened (areas sampled at 160-ft. grid node spacing). Additional samples will be collected as part of a second phase sampling program in areas where data gaps are identified. These additional samples will be collected at the grid nodes spaced at 80-ft. intervals between the originally sampled nodes (160-ft. spacing) or at other locations between the 160 ft grid nodes, depending on the data needs. Sampling may be phased in River Sections 2 and 3 as well.

SECTION 4 – REPORTS

In addition to this FSP, this program will include the following work plans and reports:

- Health and Safety Plan for the workers
- Community Health and Safety Plan
- Interlab Comparison Study
- QAPP
- Subbottom Profiling Test Work Plan and associated QAPP
- Data Summary Report for 2002 Sampling
- Supplemental Field Plan and any updates to QAPP
- Data Summary Report for 2003 Sampling
- Weekly reports of PE sample results
- Monthly progress reports.

The monthly reports will include a summary of the activities completed during the preceding month, including:

- actions that have been taken toward achieving compliance with the Consent Order during the previous month;
- number and location of cores collected;
- number of cores processed;
- number of samples generated;
- status of laboratory analysis;
- all results of sampling, tests, and all other verified or validated data received or generated by or on behalf of GE during the previous month in the implementation of

the work required by the Consent Order, including the results of PT analyses and a summary of whether the PT results meet the acceptance criteria established for that PT sample;

- all actions, data and plans that are scheduled for the next two months and other information relating to the progress of work as is customary in the industry;
- assessment of the status of the project schedule, including percentage of completion, all delays encountered or anticipated that may affect the future schedule for completion of the work, and a description of all efforts made to mitigate those delays or anticipated delays
- description of any outstanding issues and how they are being resolved; and
- an electronic deliverable of the project database.

The monthly reports will also provide information that will be useful for informing the public regarding the progress of the project and the approximate location and type of field activities that are anticipated to be performed during the upcoming month.

The Data Summary Report prepared after the end of each field season will fully document the season's work and will include a summary of the work performed, a tabulation of results, field notes, processing data, chain-of-custody forms, copies of laboratory audits, data validation results, copies of the laboratory reports, reports documenting the geophysical work, and a CD version of the final database.

SECTION 5 – PROJECT SCHEDULE AND LOGISTICS

The project schedule is presented in Exhibit F. The schedule is triggered by the effective date of the AOC. Specific calendar dates will depend on time frames for USEPA review and approval of submitted documents and the total number of cores to be collected. The side scan sonar survey will be timed during the field season in a manner that minimizes any difficulties posed by the presence of submerged aquatic vegetation. In areas where submerged aquatic vegetation is present, the side scan sonar survey and the associated confirmatory sediment sampling for grain size analysis and will be completed in 2002 if practical. The program is currently planned to be completed in two field seasons as follows:

1. 2002 Field Season. The target core collection rate is 60 cores per working day (Monday through Friday). The total number of cores planned to be taken during the 2002 season assumes that significant delays are not encountered, e.g., as a result of delays associated with unsafe river work conditions. As specified in Exhibit F, work will terminate on November 1 or such later date as is agreed to by GE and USEPA (with the exception of the work in the Lock 6 land cut, which will be conducted in the winter of 2002 [see Section 2.2.3.2]). If the sediment cores targeted for collection in 2002 cannot be collected by the end of the field season, these locations will be added to the 2003 field season.

2. 2003 Field Season. The number of cores that will need to be collected in 2003 will be defined after the side scan sonar data are collected and interpreted and the results from River Section 1 are evaluated. Again, the target production rate will be 60 cores per working day. The 2003 field season may include cores targeted for collection in 2002 that could not be collected by the end of the 2002 field season due to time constraints.

Collection will continue until the end of the field season -- i.e., October 31or such later date as is agreed to by GE and USEPA.

A conceptual organizational chart depicting how GE plans to manage the SSAP is presented in Figure 5-1.

SECTION 6 - REFERENCES

USEPA, 1997. Further Site Characterization and Analysis, Volume 2C – Data Evaluation and Interpretation Report. Hudson River PCBs Reassessment RI/FS. Prepared for the USEPA by TAMS Consultants, Inc. and The CADMUS Group Inc. February, 1997.

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USEPA, 2001. Methods for Collection, Storage, and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. EPA 823-B-01-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA, 2002. Record of Decision, Hudson River PCBs Site, New York. United States Environmental Protection Agency, February 2002.

TABLES

Quantitative Environmental Analysis, LLC

TABLE 2-1
SEDIMENT SAMPLING PROGRAM SUMMARY
RIVER SECTION 1

NOTE: NUMBERS OF CORES AND CORRESPONDING SAMPLES ARE ESTIMATES BASED ON HISTORICAL DATA. ACTUAL NUMBERS WILL VARY.

Areas to be Investigated	Number of Cores to be Collected		Analytical Program	Analysis *(Analytical Method)*	Sample Type	Environmental Samples *(2)*		Field Duplicates		Total Samples
	Phase 1	*Phase 2 (1)*				*Phase 1*	*Phase 2*	*Phase 1*	*Phase 2*	*Phase 1 + Phase 2*
Target Areas	**1865**	**0**	**Sediment Characterization For Area Delineation**	**Total PCBs as Aroclors** *(SOP GEHR8082)* **Moisture Content** *(ASTM D2216-98)* **Bulk Density** *(USACE EM-1110-2-1906)*	Each Core Segment	11445	2120	572	106	14243
Areas to be Screened	**424**	**424**		**Total Organic Carbon** (Lloyd Kahn Method) **137Cs and 7Be** *(Gamma Ray Spectroscopy)*	Top 2 Inch Core Segments Only	2289	424	114	21	2849
				Homolog PCBs (USEPA 680*)*	13% of Aroclor Samples (3)	400	0	20	0	
					4% of Aroclor Samples *(4)*	458	85	23	4	990
				Total RCRA Metals *(SW-846 6010B/7471A)* **Dioxins/Furans** *(EPA Method 1613B)*	2% of Cores, Bottom Core Segments Only *(5)*	46	8	2	0	57
			Geotechnical Characterization	**Grain Size Distribution** *(ASTM D422)* **Atterberg Limit** *(ASTM D4318-00)* **Specific Gravity** *ASTM D854-001)* **USCS Classification** *(ASTM D2487)* **Total Organic Carbon** *(Lloyd Kahn Method)*	5% of Core Segments	572	106	29	5	712
			Disposal Characterization	**TCLP Metals** *(SW-846 1311/6010B/7470A)* **TCLP Volatiles** *(SW-846 1311/8260B)* **TCLP Semivolatiles** *(SW-846 1311/8270C)* **TCLP Pesticides** *(SW-846 1311/8081A)* **TCLP Herbicides** *(SW-846 1311/8151A)* **Reactivity** *(SW-846)* **Ignitability** *(SW-846)* **Dioxins/Furans** *(EPA Method 1613B)*	Core Composites	20	0	1	0	21
			Side-Scan Sonar Survey Confirmation Sampling *(6)*	**Grain Size Distribution** *(ASTM D422)*	Top 1 Inch of Cores	150	0	8	0	158

(1) - Assumes all locations sampled in Phase 2.
(2) - Assumes 5 samples generated per core.
(3) - Selected randomly from positive sediment sample extracts in the first 2 weeks.
(4) - Selected randomly from positive sediment sample extracts after the first 2 weeks.
- Minimum of 350 sample extracts analyzed from all river sections.
(5) - First core segment below peak PCB concentration containing <1 ppm PCB.
(6) - Cores will be collected as part of a separate program conducted in 2003.

TABLE 2-2
SEDIMENT SAMPLING PROGRAM SUMMARY
RIVER SECTION 2

NOTE: NUMBERS OF CORES AND CORRESPONDING SAMPLES ARE ESTIMATES BASED ON HISTORICAL DATA. ACTUAL NUMBERS WILL VARY.

Areas to be Investigated	Number of Cores to be Collected	Analytical Program	Analysis *(Analytical Method)*	Sample Type	Environmental Samples *(1)*	Field Duplicates	Total Samples
Target Areas	**534**	**Sediment Characterization For Area Delineation**	**Total PCBs as Aroclors** (*SOP GEHR8082)* **Moisture Content** *(ASTM D2216-98)* **Bulk Density** *(USACE EM-1110-2-1906)*	Each Core Segment	5310	266	5576
Areas to be Screened	**528**		**Total Organic Carbon** (*Lloyd Kahn Method)* **^{137}Cs and ^{7}Be** *(Gamma Ray Spectroscopy)*	Top 2 Inch Core Segments Only	1062	53	1115
			Homolog PCBs (USEPA 680*)*	4% of Aroclor Samples *(2)*	212	11	223
			Total RCRA Metals *(SW-846 6010B/7471A)* **Dioxins/Furans** *(EPA Method 1613B)*	2% of Cores, Bottom Core Segments Only *(3)*	21	1	22
		Geotechnical Characterization	**Grain Size Distribution** *(ASTM D422)* **Atterberg Limit** *(ASTM D4318-00)* **Specific Gravity** *ASTM D854-001)* **USCS Classification** *(ASTM D2487)* **Total** **Organic Carbon** *(Lloyd Kahn Method)*	5% of Core Segments	266	13	279
		Disposal Characterization	**TCLP Metals** *(SW-846 1311/6010B/7470A)* **TCLP Volatiles** *(SW-846 1311/8260B)* **TCLP Semivolatiles** *(SW-846 1311/8270C)* **TCLP Pesticides** *(SW-846 1311/8081A)* **TCLP Herbicides** *(SW-846 1311/8151A)* **Reactivity** *(SW-846)* **Ignitability** *(SW-846)* **Dioxins/Furans** *(EPA Method 1613B)*	Core Composites	20	1	21
		Side-Scan Sonar Survey Confirmation Sampling *(4)*	**Grain Size Distribution** *(ASTM D422)*	Top 1 Inch of Cores	150	8	158

(1) - Assumes 5 samples generated per core.
(2) - Minimum of 350 positive sample extracts will be analyzed from all river sections.
(3) - First core segment below peak PCB concentration containing <1 ppm PCB.
(4) - Cores will be collected as part of a separate program conducted in 2003.

TABLE 2-3
SEDIMENT SAMPLING PROGRAM SUMMARY
RIVER SECTION 3

NOTE: NUMBERS OF CORES AND CORRESPONDING SAMPLES ARE ESTIMATES BASED ON HISTORICAL DATA. ACTUAL NUMBERS WILL VARY.

Areas to be Investigated	Number of Cores to be Collected	Analytical Program	Analysis *(Analytical Method)*	Sample Type	Environmental Samples *(1)*	Field Duplicates	Total Samples
Target Areas	**944**	**Sediment Characterization For Area Delineation**	**Total PCBs as Aroclors** (*SOP GEHR8082)* **Moisture Content** *(ASTM D2216-98)* **Bulk Density** *(USACE EM-1110-2-1906)*	Each Core Segment	10480	524	11004
Areas to be Screened	**1152**		**Total Organic Carbon** (*Lloyd Kahn Method)* **^{137}Cs and ^{7}Be** *(Gamma Ray Spectroscopy)*	Top 2 Inch Core Segments Only	2096	105	2201
			Homolog PCBs (*USEPA 680)*	4% of Core Segments *(2)*	419	21	440
			Total RCRA Metals *(SW-846 6010B/7471A)* **Dioxins/Furans** *(EPA Method 1613B)*	2% of Cores, Bottom Core Segments Only *(3)*	42	2	44
		Geotechnical Characterization	**Grain Size Distribution** *(ASTM D422)* **Atterberg Limit** *(ASTM D4318-00)* **Specific Gravity** *ASTM D854-001)* **USCS Classification** *(ASTM D2487)* **Total Organic Carbon** *(Lloyd Kahn Method)*	5% of Core Segments	524	26	550
		Disposal Characterization	**TCLP Metals** *(SW-846 1311/6010B/7470A)* **TCLP Volatiles** *(SW-846 1311/8260B)* **TCLP Semivolatiles** *(SW-846 1311/8270C)* **TCLP Pesticides** *(SW-846 1311/8081A)* **TCLP Herbicides** *(SW-846 1311/8151A)* **Reactivity** *(SW-846)* **Ignitability** *(SW-846)* **Dioxins/Furans** *(EPA Method 1613B)*	Core Composites	20	1	21
		Side-Scan Sonar Survey Confirmation Sampling *(4)*	**Grain Size Distribution** *(ASTM D422)*	Top 1 Inch of Cores	150	8	158

(1) - Assumes 5 samples generated per core.
(2) - Minimum of 350 positive sample extracts will be analyzed from all river sections.
(3) - First core segment below peak PCB concentration containing <1 ppm PCB.
(4) - Cores will be collected as part of separate program conducted in 2003

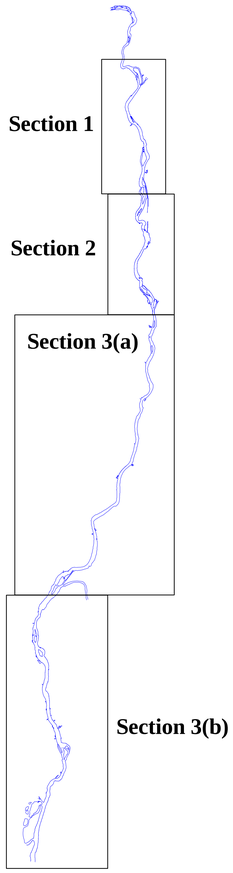
Table 2-4.
Example Sample ID and Horizontal Coordinates for 80 ft Nodal Spacing for Cores in River Section 1.

Sample ID[1]	Easting	Northing
195194_WS001	698440.00000	1188806.75000
195194_WS002	698400.00000	1188876.00000
195194_WS003	698480.00000	1188876.00000
195194_WS004	698560.00000	1188876.00000
195194_WS005	698440.00000	1188945.25000
195194_WS006	698520.00000	1188945.25000
195194_WS007	698600.00000	1188945.25000
195194_WS008	698680.00000	1188945.25000
195194_WS009	698400.00000	1189014.50000
195194_WS010	698480.00000	1189014.50000
195194_WS011	698560.00000	1189014.50000
195194_WS012	698640.00000	1189014.50000
195194_WS013	698720.00000	1189014.50000
195194_WS014	698800.00000	1189014.50000
195194_WS015	698360.00000	1189083.75000
195194_WS016	698440.00000	1189083.75000
195194_WS017	698520.00000	1189083.75000
195194_WS018	698600.00000	1189083.75000
195194_WS019	698680.00000	1189083.75000
195194_WS020	698760.00000	1189083.75000
195194_WS021	698320.00000	1189153.00000
195194_WS022	698400.00000	1189153.00000
195194_WS023	698480.00000	1189153.00000
195194_WS024	698640.00000	1189153.00000
195194_WS025	698720.00000	1189153.00000
195194_WS026	698800.00000	1189153.00000
195194_WS027	698280.00000	1189222.25000
195194_WS028	698360.00000	1189222.25000
195194_WS029	698440.00000	1189222.25000
195194_WS030	698600.00000	1189222.25000
195194_WS031	698680.00000	1189222.25000
195194_WS032	698760.00000	1189222.25000
195194_WS033	698240.00000	1189291.50000
195194_WS034	698320.00000	1189291.50000
195194_WS035	698400.00000	1189291.50000
195194_WS036	698560.00000	1189291.50000
195194_WS037	698640.00000	1189291.50000
195194_WS038	698720.00000	1189291.50000
195194_WT039	699440.00000	1189291.50000
195194_WS040	698200.00000	1189360.75000
195194_WS041	698280.00000	1189360.75000

[1]First 6 characters indicate river miles cores fall between
First character after the underscore indicates location relative to navigational channel:
W=west of channel
C=in channel
E=east of channel
Second character after the underscore indicates Target Area or Screening Area (T or S)
Last three numbers sequential between each river mile

FIGURES

Quantitative Environmental Analysis, LLC



LEGEND

- Dams / Locks

USEPA Dredge Depths (ft)

- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- >8
- Shoreline

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Figure 1-1.
Site Map.

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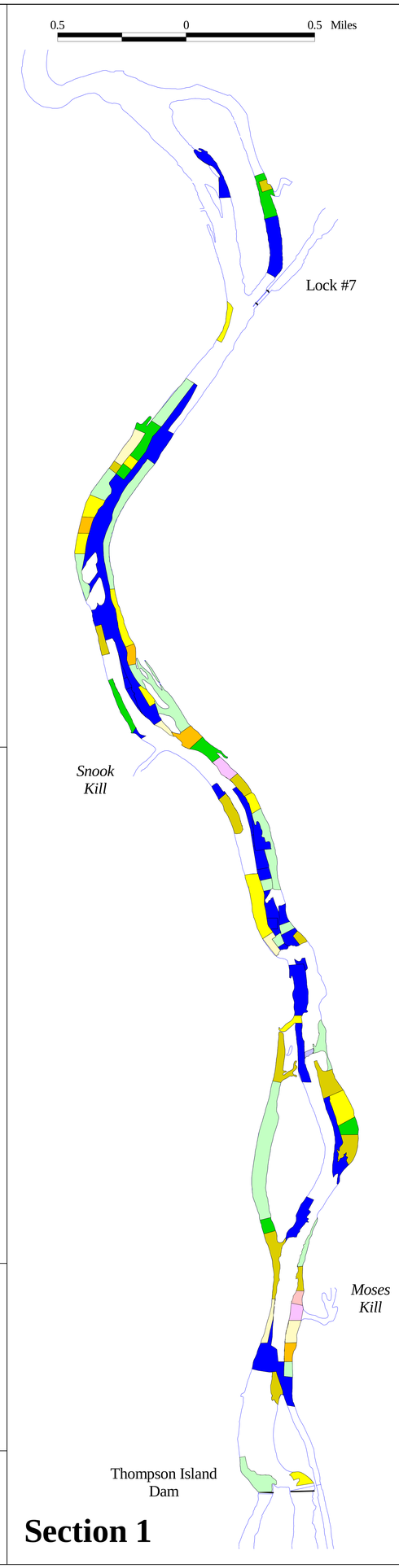
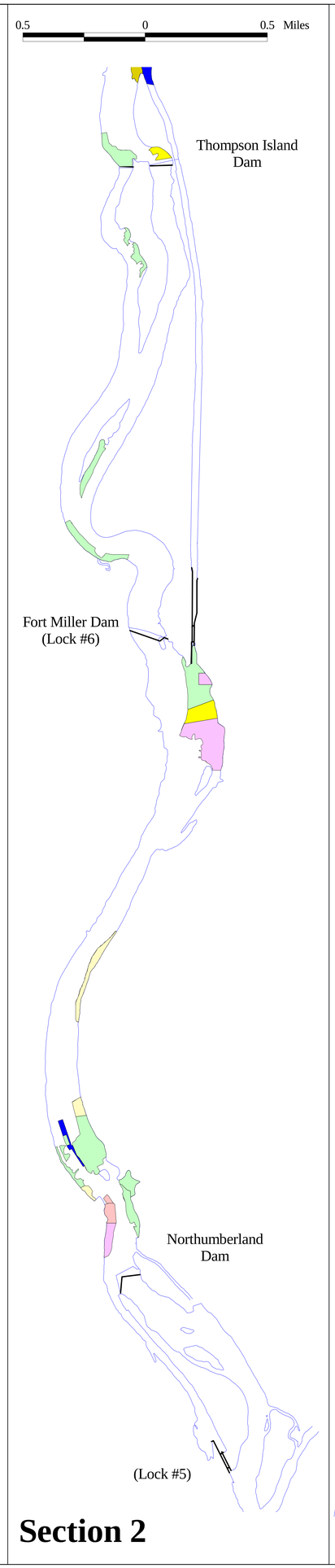
QEA Quantitative Environmental Analysis, LLC

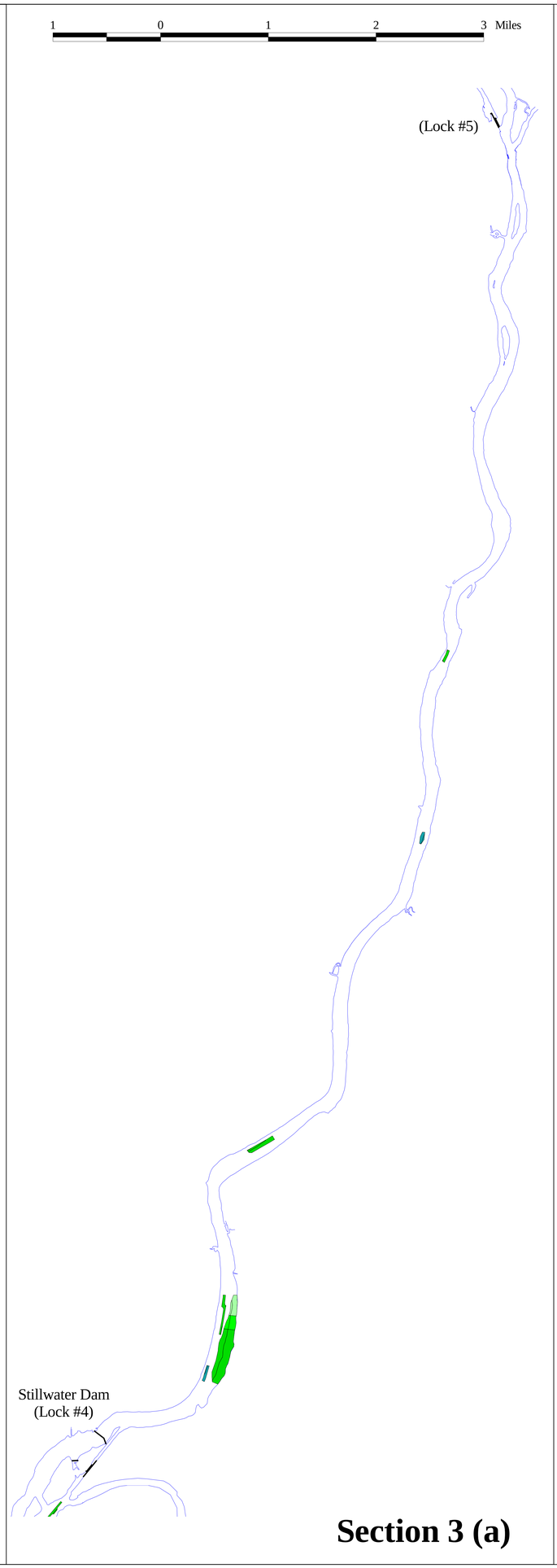
GENrem 113 July 2002



Section 1



Section 2



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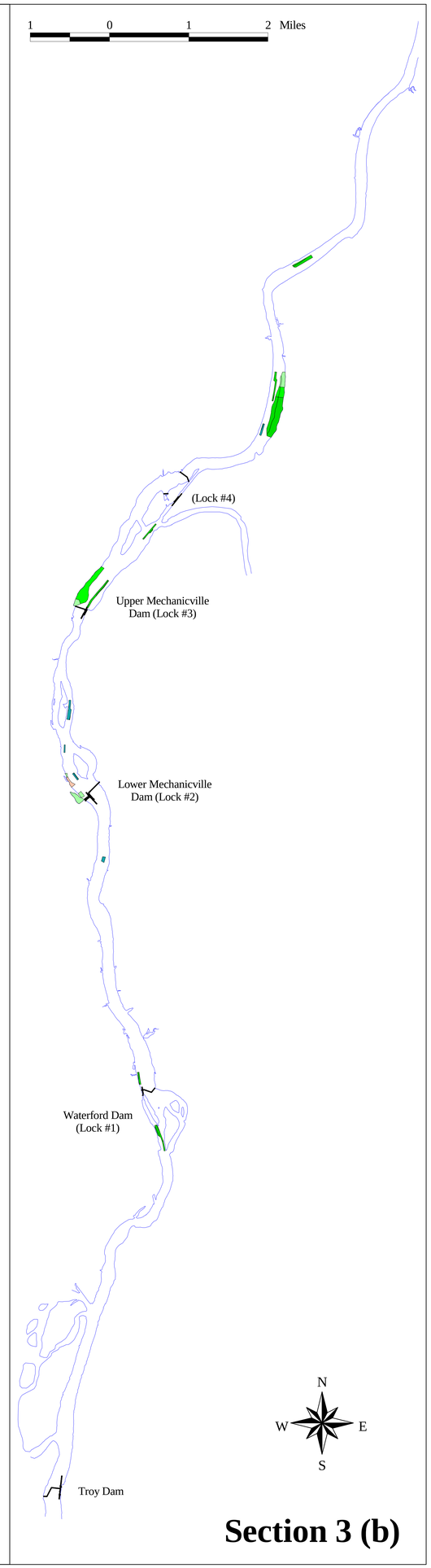
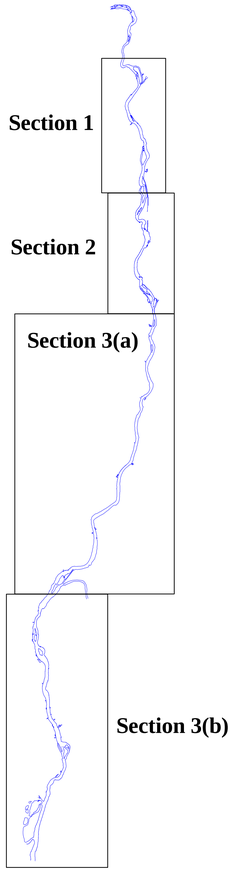


Section 3 (b)



LEGEND

2001 GE Bathymetry Survey
Dams / Locks
Shoreline
Proposed Bathymetry Transects

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Figure 2-1.
Bathymetric survey transects.

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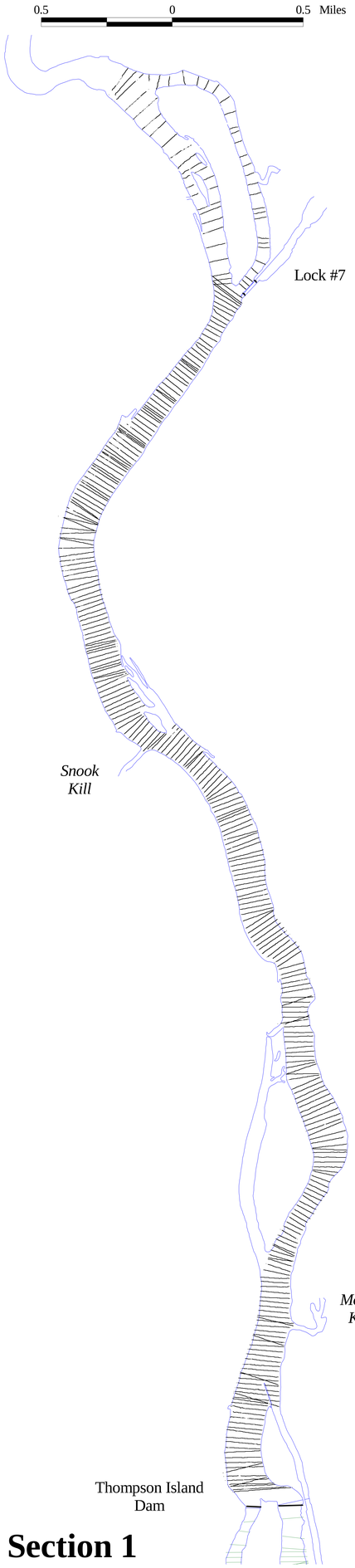
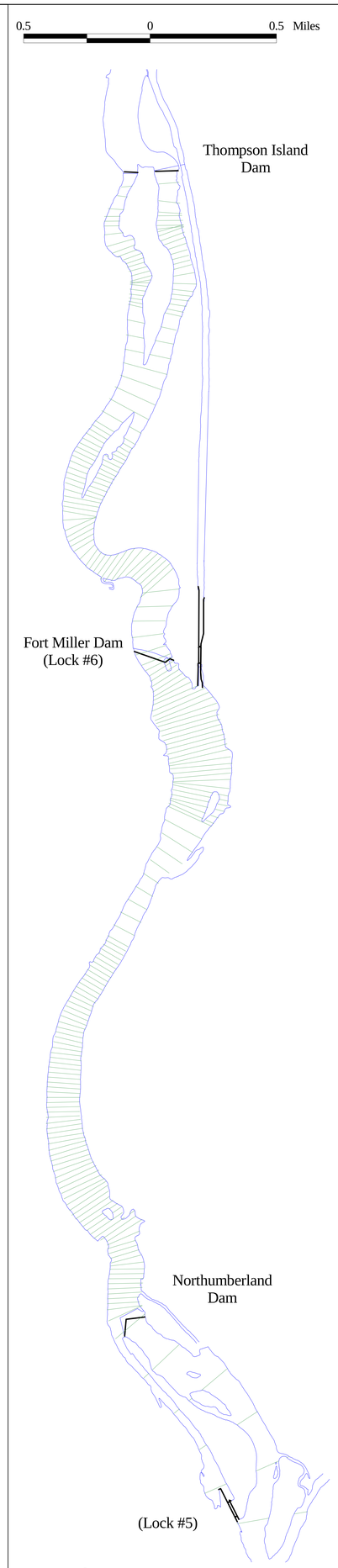
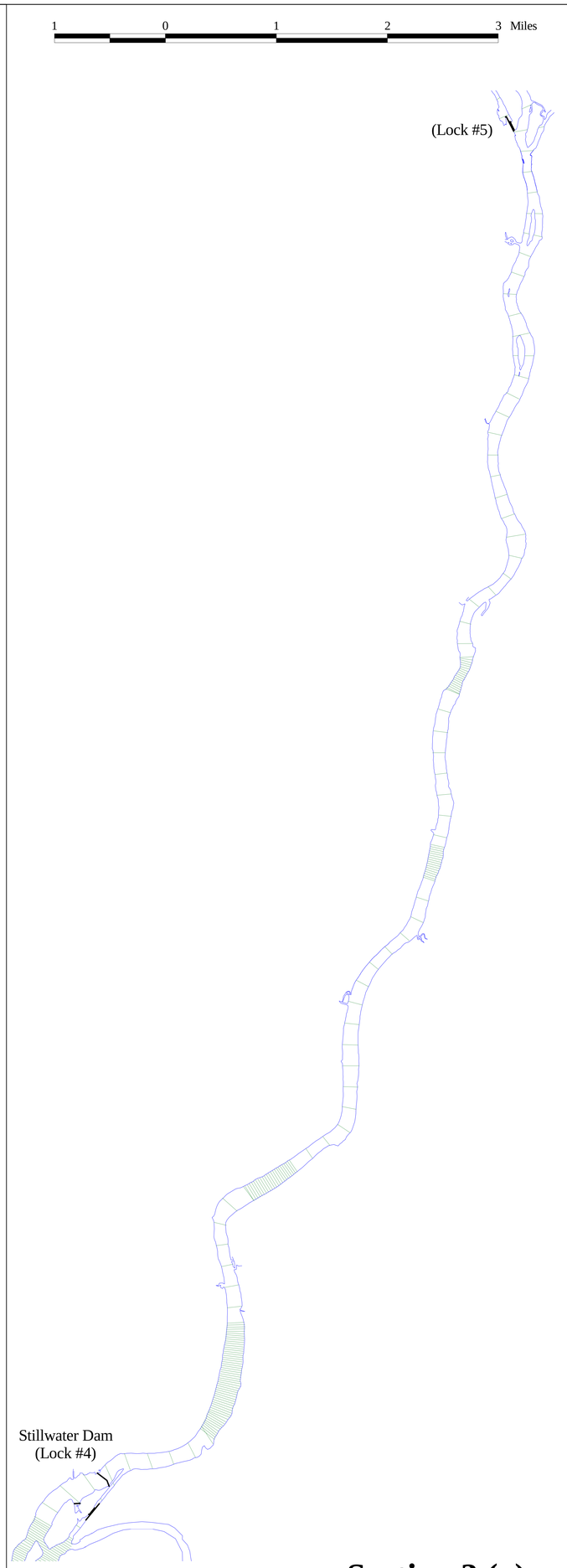
GENrem 113 April 2002



Section 1



Section 2



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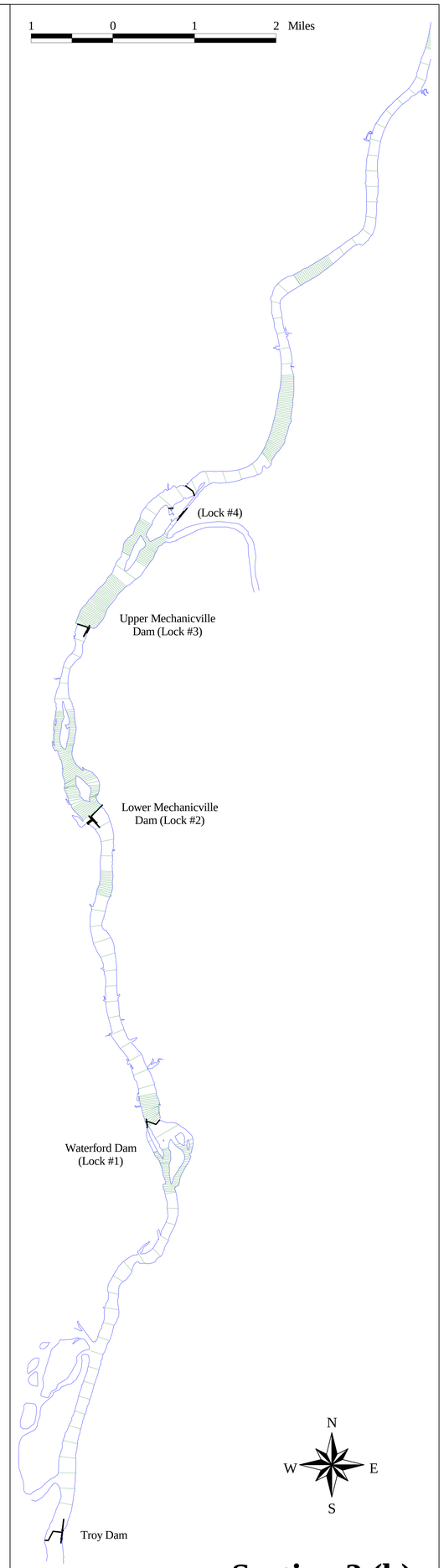
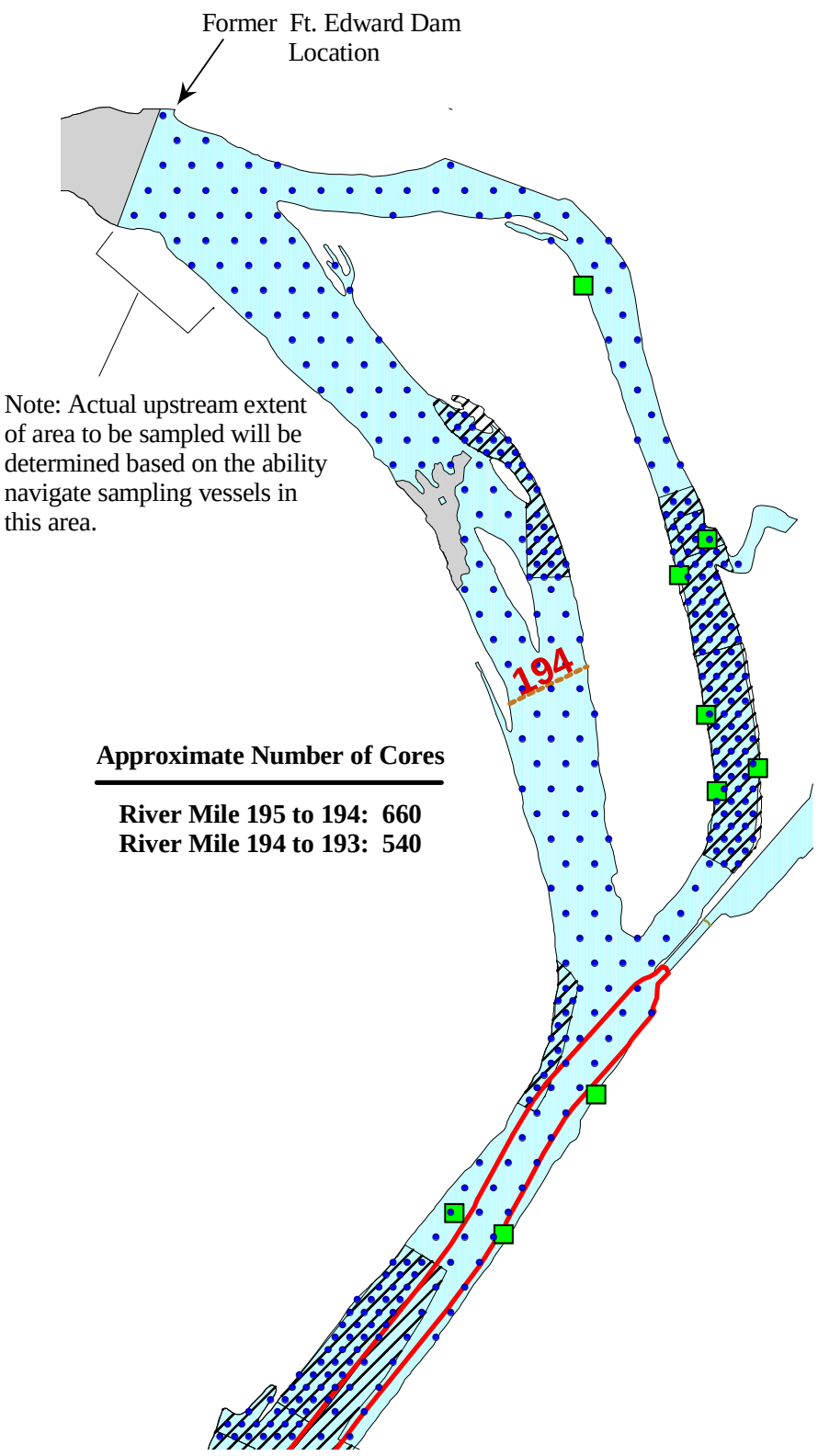


Section 3 (b)



Approximate Number of Cores

River Mile 195 to 194: 660
River Mile 194 to 193: 540

Location Map

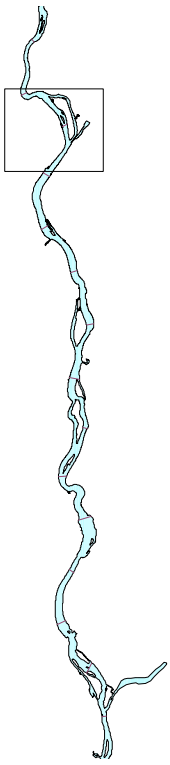


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Figure 2-2a. River Miles 195-193, core sample locations in River Section 1

GENrem:133 **July 2002**

Legend

- **Proposed Sediment Sample Locations**
- **NOAA Buoys**
- **Navigational Channel - Approximate Location**

REM-3/10/Select

- **Navigational Dredging**
- **Target Dredging**
- **Rocky Areas**
- **Hudson River**

N

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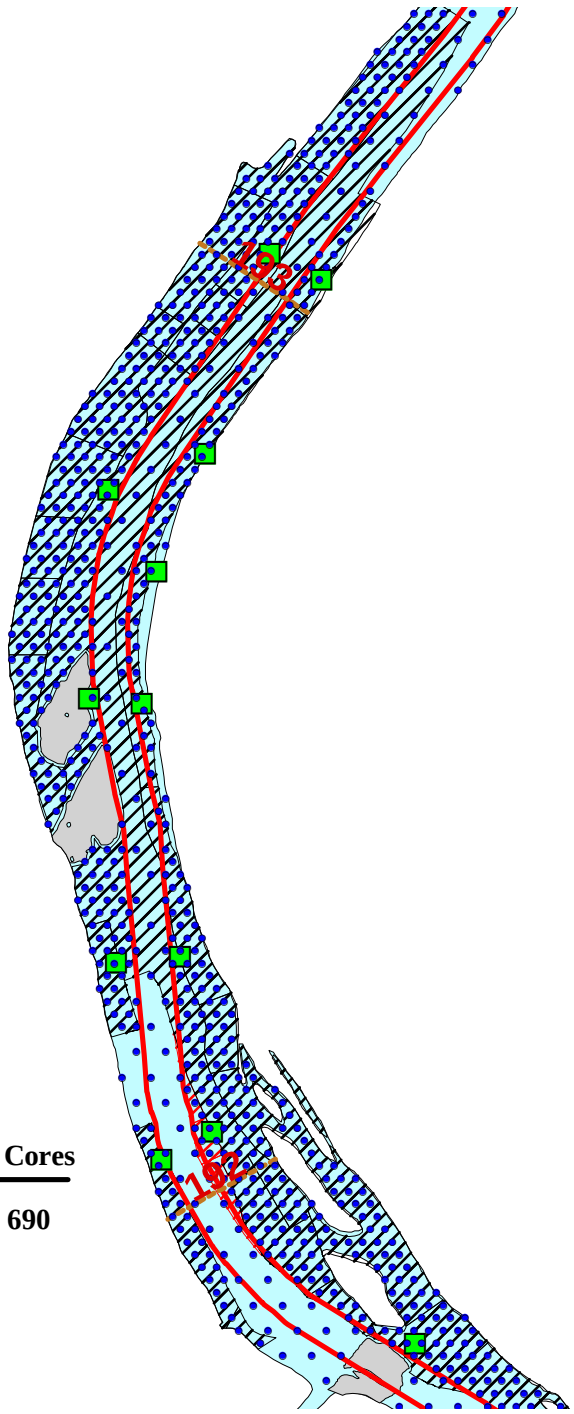
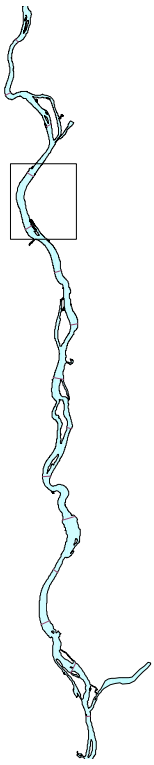


Location Map



Approximate Number of Cores

River Mile 193 to 192: 690

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Figure 2-2b. River Miles 193-192, core sample locations in River Section 1

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GENrem:133 **July 2002**

Legend

- **Proposed Sediment Sample Locations**
- **NOAA Buoys**
- **Navigational Channel - Approximate Location**

REM-3/10/Select

- **Navigational Dredging**
- **Target Dredging**
- **Rocky Areas**
- **Hudson River**

N

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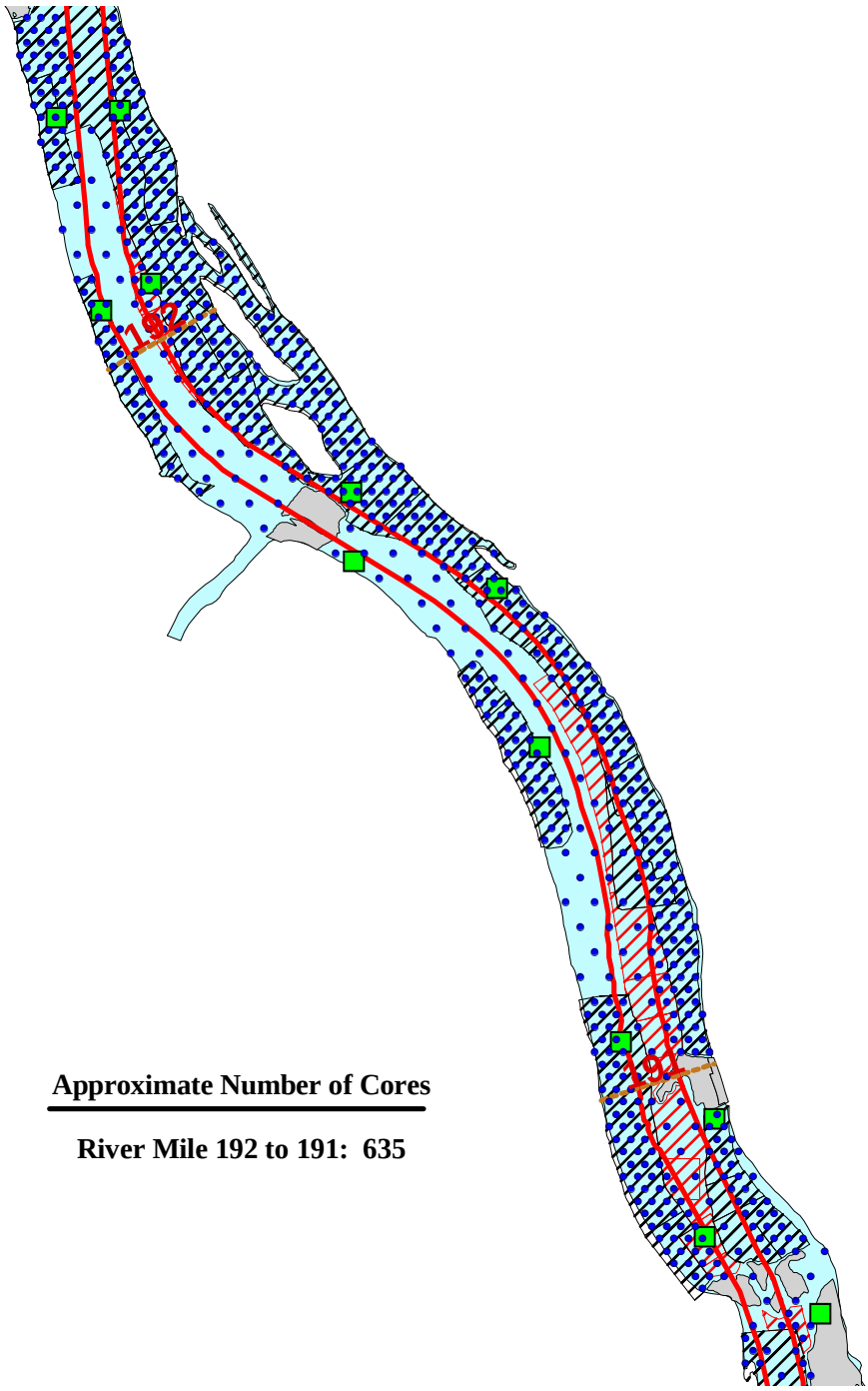

Approximate Number of Cores

River Mile 192 to 191: 635

Location Map

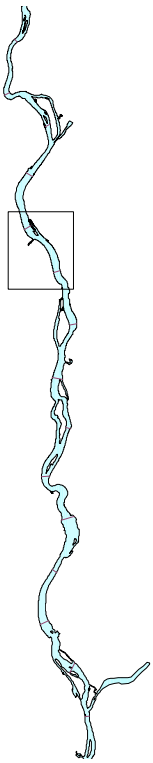

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Figure 2-2c. River Miles 192-191, core sample locations in River Section 1

GENrem:133 **July 2002**

Legend

- **Proposed Sediment Sample Locations**
- **NOAA Buoys**
- **Navigational Channel - Approximate Location**

REM-3/10/Select

- **Navigational Dredging**
- **Target Dredging**
- **Rocky Areas**
- **Hudson River**

N

1000 0 1000 Feet

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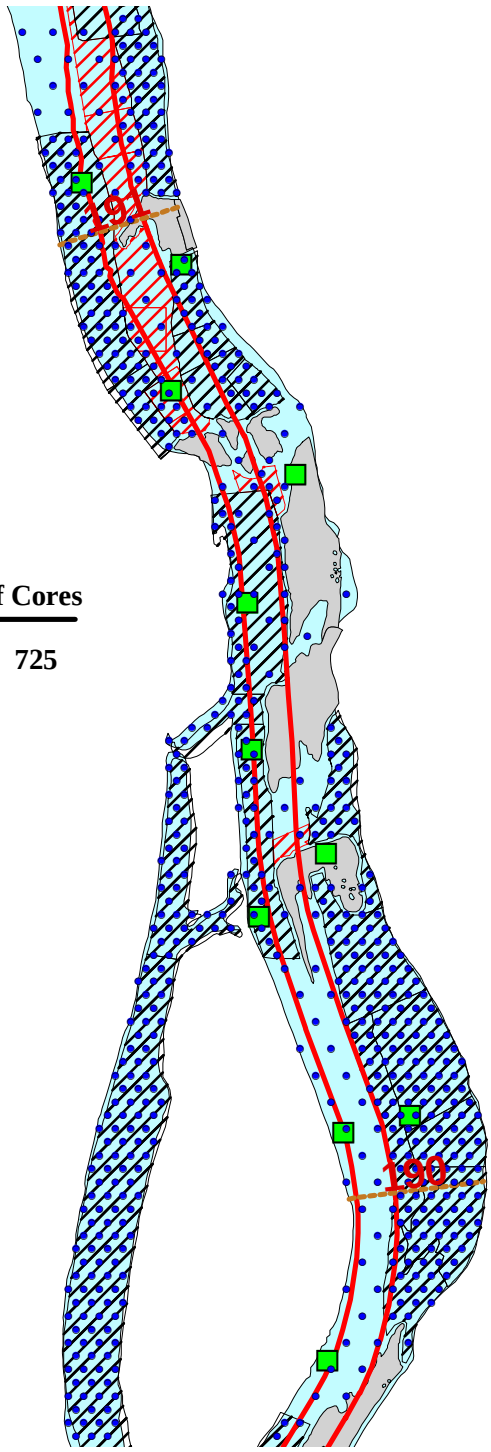

Approximate Number of Cores

River Mile 191 to 190: 725

Location Map

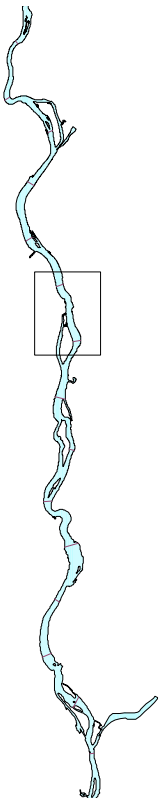

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Figure 2-2d. River Miles 191-190, core sample locations in River Section 1

GENrem:133 **July 2002**

Legend

- **Proposed Sediment Sample Locations**
- **NOAA Buoys**
- **Navigational Channel - Approximate Location**

REM-3/10/Select

- **Navigational Dredging**
- **Target Dredging**
- **Rocky Areas**
- **Hudson River**

N

1000 0 1000 Feet

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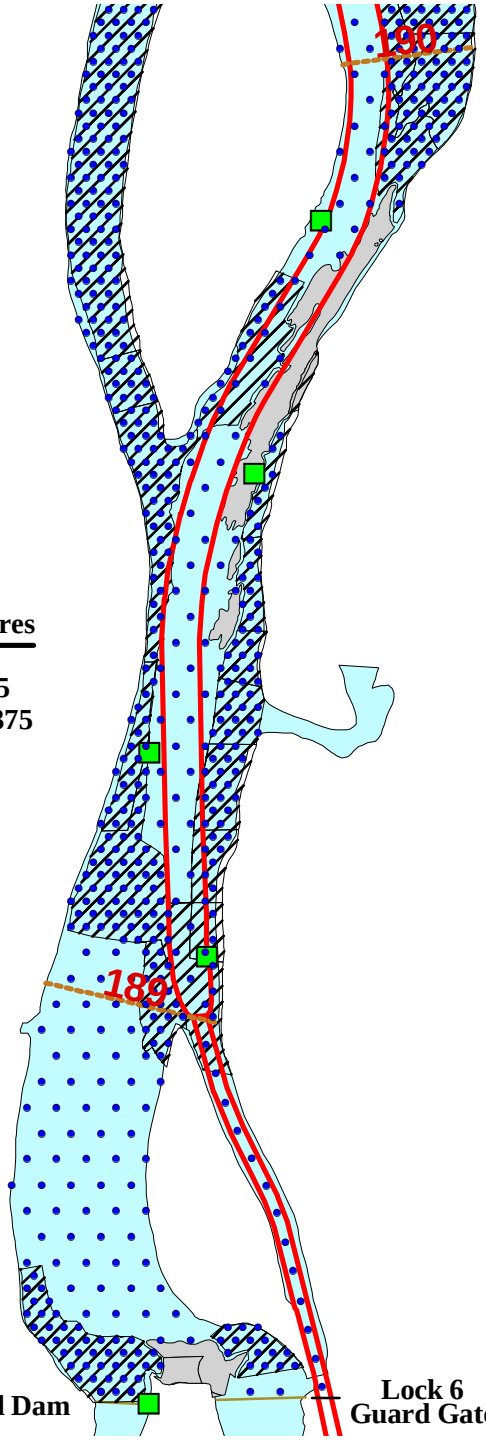

Approximate Number of Cores

River Mile 190 to 189: 695
River Mile 189 to TIDam: 375

Location Map

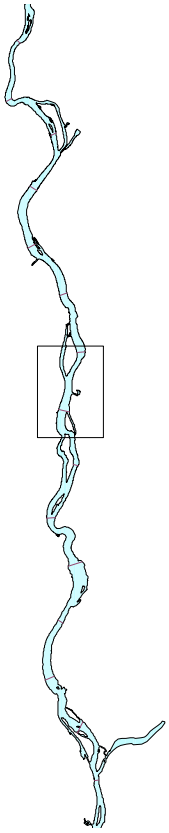

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Figure 2-2e. River Miles 190-TID, core sample locations in River Section 1

GENrem:133 **July 2002**

Legend

- **Proposed Sediment Sample Locations**
- **NOAA Buoys**
- **Navigational Channel - Approximate Location**
- **REM-3/10/Select**
- **Navigational Dredging**
- **Target Dredging**
- **Rocky Areas**
- **Hudson River**

N

1000 0 1000 Feet

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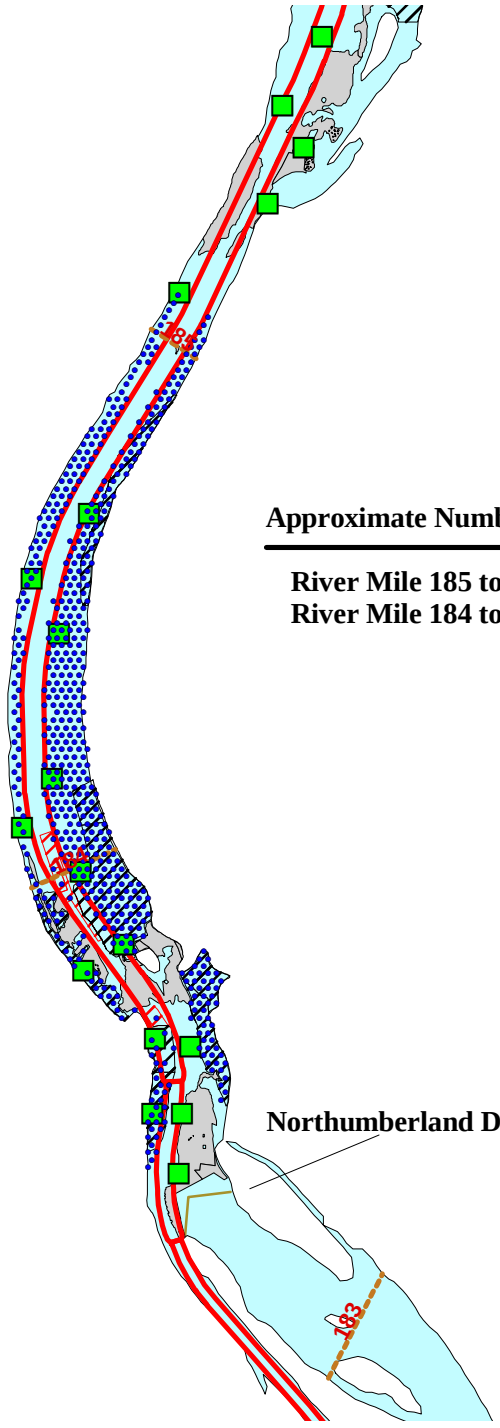

Approximate Number of Cores

River Mile 185 to 184: 389
River Mile 184 to 183: 194

Location Map

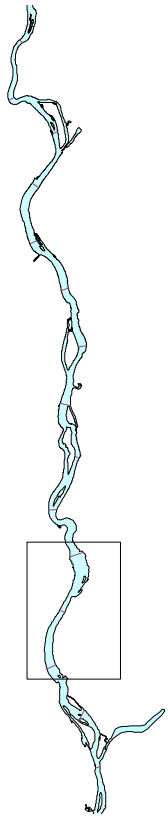

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Figure 2-2f. River Miles 185-183, core sample locations in River Section 2

GENrem:133 **July 2002**

Legend

- **Proposed Sediment Sample Locations**
- **NOAA Buoys**
- **Navigational Channel - Approximate Location**
- **REM-3/10/Select**
- **Navigational Dredging**
- **Target Dredging**
- **Rocky Areas**
- **Hudson River**

N

2000 0 2000 Feet

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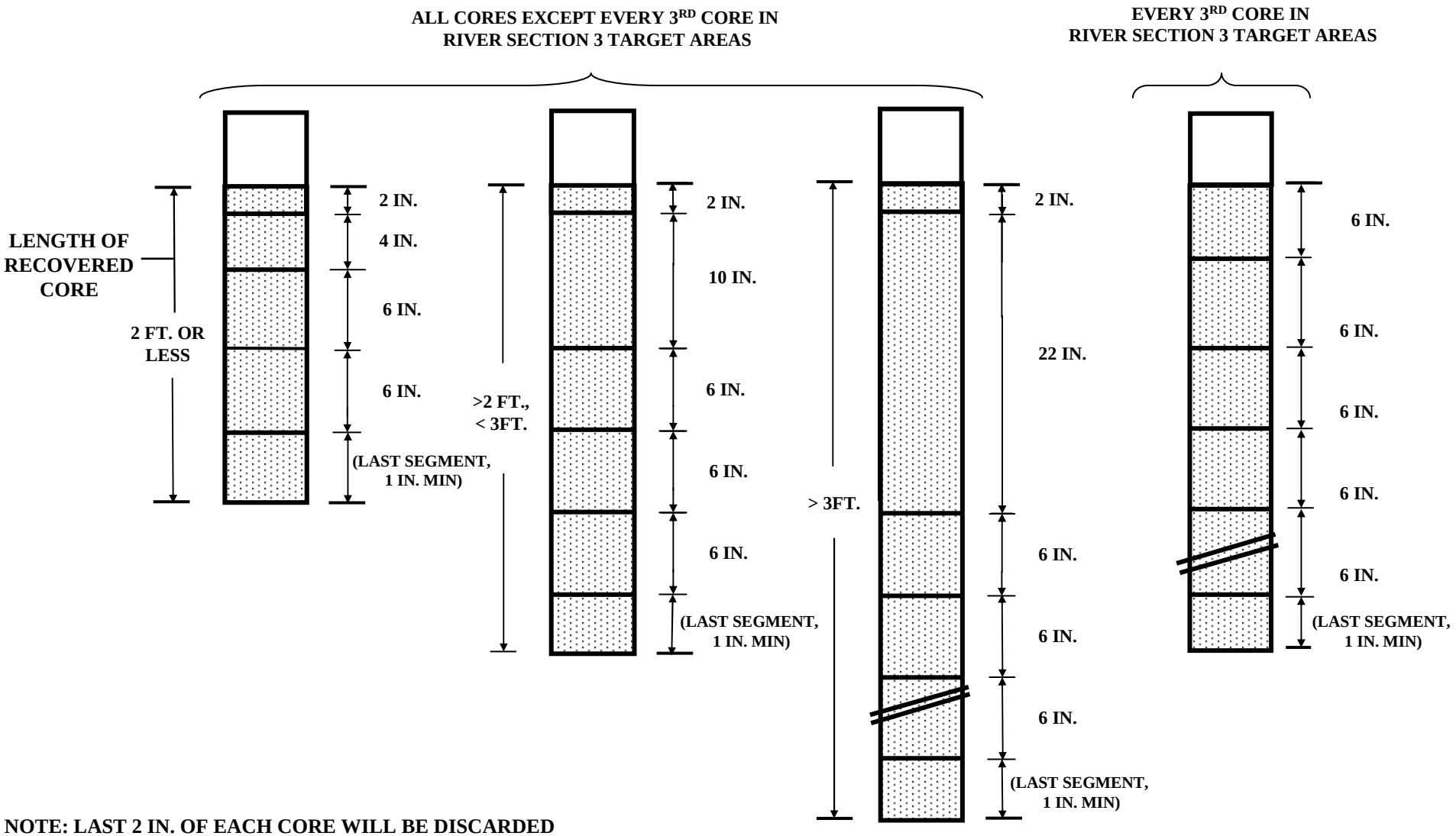

Figure 2-3. Core Segmentation Approach.

SCALE : NONE

GENrem 137 July 2002

IF: D:\GENrem\FSP\Core_segmentation2.ppt

HUDSON RIVER SEDIMENT SAMPLING AND ANALYSIS PROGRAM

Coring Field Log

Relinquished by:_____ Date: _____ Time: _____ Sampler:_____

Received by:_____ Date: _____ Time: _____ Weather:_____

Core ID	Date	Time	Northing	Easting	Water Depth (ft)	Probing Depth (in)	Sediment Type	Sediment Description	Sample Type **	Core Recovered	Tube Material *	Penetration (in)	Recovery (in)
										☐			
										☐			
										☐			
										☐			
										☐			
										☐			
										☐			
										☐			
										☐			
										☐			
										☐			

* Tube Material: A = Aluminum, L = Lexan

** Sediment Type: C = Core, G = Grab

Date Printed: 7/17/02

Figure 2-4. Example Field Log Form

SCALE : NONE

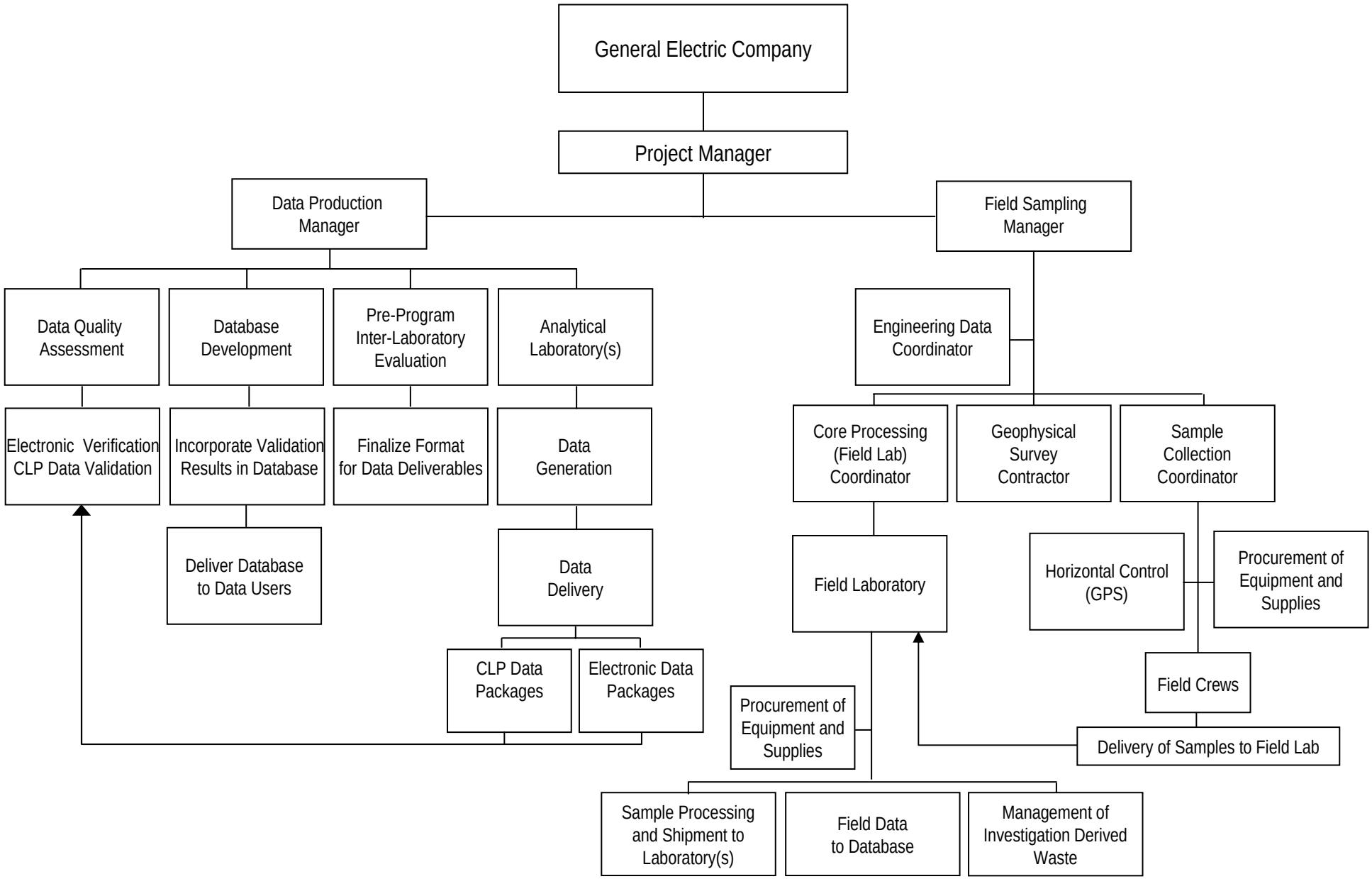

Figure 5-1. Conceptual Organizational Chart

SCALE : NONE