Imagine the result

2013 Sediment Sampling Plan

Pompton Lake Acid Brook Delta Area Project

DuPont Pompton Lakes Works

Pompton Lakes, New Jersey

EPA ID # NJD002173946, SRP PI#007411

July 2013

1. Introduction

A conceptual site model (CSM) describing conditions in Pompton Lake resulting from releases of site-related constituents from the former operations of the DuPont Pompton Lakes Works (PLW) in Pompton Lakes, NJ was used in the development of remedial alternatives for addressing impacted sediment within the lake (ARCADIS et. al, September 2011). The CSM was based on existing data collected from 1997 to 2010 as part of environmental investigations conducted within and around the Lake that consisted of: sediment sampling; surface water sampling; environmental biota sampling; benthic and methylmercury flux chamber analysis; and laboratory ecosystem testing. These investigations were completed under direct oversight of the U.S. Environmental Protection Agency (USEPA) and the New Jersey Department of Environmental Protection (NJDEP).

USEPA has recently requested additional sediment investigations to determine current conditions of the sediments within the Lake. A series of meetings were conducted through April and June 2013 with technical resources from the regulatory agencies and DuPont to discuss the scope of additional investigations. Following these meetings, DuPont submitted an updated CSM to the agencies in June 2013 to provide additional information collected after the submission of the CMI; identify areas of uncertainty within the CSM; and provide recommendations on additional sampling to address the data gaps (ARCADIS et al., June 2013). Subsequent discussions between DuPont and the regulatory agencies defined the specific tasks and details for the data collection efforts in resolving the identified data gaps.

The purpose of this document is to describe the tasks to be completed and identify the methods to be used to address the areas of uncertainty. Sampling procedures will follow those described in previous sampling plans [e.g., DuPont Corporate Remediation Group (CRG), August 2004; CRG, January 2009] and are included in Appendix A.

2. Areas of Uncertainty

Based on a review of the current CSM and existing data as provided in the draft CSM technical memorandum (ARCADIS et al., June 2013), the following areas of uncertainty were identified for further investigation.

1) The 2011 and 2007 bathymetry comparison showed that, within the Ramapo River channel, two general areas of apparent sediment surface elevation decreases are

observed along with some larger areas of apparent sediment surface elevation increases. The 2011 survey did not extend down the lower Ramapo River channel to the dam, so potential changes in this area are unknown.

2) USEPA expressed concerns regarding the age and extent of data used to develop the CSM; and the ability of the CSM to provide a comprehensive understanding of the nature and extent of mercury as it relates to defining the final remedy for sediments within the lake. While data used to construct the CSM has been collected over time, DuPont believes the data are sufficient to understand the distribution of mercury within the lake, the fate and transport of mercury and sediments, and the potential exposure pathways. In order to confirm the CSM, additional data collection activities will be completed to meet the following objectives:

   - Historical Validation: Confirm the current understanding of mercury deposition within the lake – a subset of historical sediment sampling locations outside the 26-acre remedial area will be sampled and analyzed for mercury to evaluate whether the historical data are still valid

   - Data Set Adequacy: Confirm that the extent of the mercury concentrations in sediment has been adequately defined – additional sediment sampling will be conducted outside the 26-acre remedial area to verify that the extent of mercury is consistent with the CSM (i.e., in the lower Ramapo River channel) and to confirm mercury concentrations in areas where the sediment surface elevation has changed

3) In order to confirm the CSM and ecological exposure and receptors based on any new data, impacts or changes to the ecological evaluation need to be assessed. New data collected outside the proposed 26 acre remedial limit should be evaluated for the potential fate of mercury and associated exposure within the Ramapo River channel sediments to verify the current understanding that mercury in sediment does not pose a significant threat to ecological receptors.

3. Data Collection Efforts

Additional investigations will be conducted in 2013 to address the uncertainties identified in Section 2. Investigations to address uncertainties #1 and 2 are summarized below. Ecological evaluations to address data uncertainty #3 were submitted under separate cover in the Pompton Lake Ecological Investigations

Framework Document (URS Corporation [URS], June 2013), and are not discussed further herein.

3.1 Sediment Characterization (Uncertainty #1)

As indicated in the comparison of the 2011 and 2007 bathymetry, sediment surface decreases in elevation were noted in two areas. In addition, there was a data gap in the lower Ramapo River channel to the Pompton Lake Dam since no data for this stretch was available from 2011. To address the uncertainties and data gap, a bathymetric survey was performed in May 2013 to obtain current bathymetry and river bed characterization.

The survey consisted of single beam bathymetry and side scan sonar from Lakeside Avenue Bridge to the Pompton Lake Dam (excluding the area west of the previously identified RAO line). Completion of the side scan sonar work also included the collection of 30 representative samples (top 4 inches) for analysis of grain size distribution to assess the physical properties of the bed material. The resulting bathymetric and side scan sonar data (and grain size sample locations) are provided on Figures 3-1 through 3-3, respectively. Figures 3-4 and 3-5 provide a comparison of the 2007/2013 and 2011/2013 bathymetry, respectively. The following initial general observations have been noted based on the results of these comparisons; these data are undergoing further evaluation.

- The 2013 bathymetry shows an area of deeper water just downstream of Lakeside Avenue Bridge, along with deeper water areas along the length of the lower Ramapo River channel.

- The 2013 side scan sonar results show areas of gravel/sand just downstream of Lakeside Avenue Bridge, a large area with vegetation in the lake, and primarily sand along the western portion of the lower Ramapo River and silt along the eastern portion.

- The bathymetric comparisons (2007/2011 versus 2013) show that the area downstream of Lakeside Avenue Bridge has decreased sediment surface elevations with changes within the majority of the remainder of the lake within the accuracy of the surveys (or showing increased sediment surface elevations). The lower Ramapo River primarily shows areas of decreased surface elevations along the length of the center area, and areas of no change or increased surface elevations along the shorelines.

- In general, areas of decreased surface sediment elevation exhibited in the 2007/2011 comparison appear to have increased surface sediment elevation when considering differences between 2011/2013, thereby indicating these areas have filled in since the 2011 higher flow events. These data are undergoing further evaluation.

The results from the bathymetry comparisons were used to guide selection of sample locations and will be used to inform future investigative and evaluation efforts.

3.2 Additional Sampling (Uncertainty #2)

Sampling will specifically be performed to validate historic data outside the 26-acre remedial area and obtain additional data in areas with potential profile changes; and supplement existing data within the lower Ramapo River channel. These sampling efforts are further described below. The standard operating procedure (SOP) for core collection and processing is provided in Appendix A.

- Historic Validation: To address the uncertainty that the historical core data may not be representative of current conditions, sediment cores will be collected from approximately 30% of the historical core locations outside of the 26-acre remedial area (including the lower Ramapo River channel) and analyzed for mercury. The target locations were selected to include locations with higher mercury concentrations considering historic data results. A total of 54 sediment cores will be collected (see Figures 3-5 and 3-6), with 42 locations in Pompton Lake and 12 locations in the lower Ramapo River channel. The sampling intervals are intended to mimic previous core collection, and will target the top and bottom of the sediment layer (0 to 0.5 feet and 0.5 feet of bottom sediment layer), with the intermediate 0.5 foot layer also submitted for analysis if the recovered core has greater than 2 feet of sediment thickness. The sediment data from both the historical and newly collected core will be compared to verify whether conditions have significantly changed using the statistical evaluation approach outlined in Appendix B.

- Data Set Adequacy: To confirm that the extent of mercury is consistent with the CSM and determine concentrations in areas where the sediment surface elevation has changed, sediment cores will be collected in areas with limited data in the lower Ramapo River and in area(s) with a change in surface sediment elevation where mercury was previously identified in sediment above the delineation criteria (see Figures 3-5 and 3-6) and analyzed for mercury. These cores can be further grouped into the subcategories listed below.

- Areas with similar to or increased surface sediment elevation: Cores will be collected on an approximate 100-meter by 100-meter grid (approximately 300 feet by 300 feet). A total of 18 cores will be collected.

- Areas with decreased surface sediment elevation: Cores in these areas will be collected on an approximate 50-meter by 50-meter grid (approximately 150 feet by 150 feet). A total of 8 cores will be collected.

- Supplemental data: Cores will be collected in groupings of five in between existing historic transects in the lower Ramapo River channel to increase the sampling frequency in this area. A total of 25 cores (5 groupings) will be collected.

Collected cores will be visually evaluated for material type and stratigraphic layers, and then segmented 0-6, 6-12, 12-30 inches, and every 18 inches thereafter to the bottom of sediment to assess mercury levels at surface and at depth. The segmentation scheme will be altered as necessary to accommodate stratification in recovered material layers. The segment below the sediment layer will be archived for potential future analysis.

3.3 Additional Investigations Downstream of Pompton Lake Dam (Uncertainty #2)

A general stream characterization will be conducted downstream of the Pompton Dam to Riverside Park to determine areas of deposition and guide selection of potential future sample collection locations. These efforts will consider the existing data downstream of the Pompton Dam in the planning and evaluation of potential downstream deposition of materials from Pompton Lake, including the 2004/2012 dam evaluation sampling (2004 sample result was 2.4 mg/kg and 2012 mercury results range from 0.11 to 0.34 mg/kg) and 2010 field reconnaissance and sampling (lead and mercury levels ranged from 3.9 to 80 mg/kg and non-detect to 1.4 mg/kg, respectively) (ARCADIS et al., June 2013). The investigations will include qualitative characterization of substrates to identify sediment depositional areas, collection of grab samples to visually validate substrate type (top 4 inches), and field mapping of locations and flood plain features. The number and locations of grab samples will be determined in the field during investigation efforts.

3.4 Quality Assurance/Quality Control

All cores will be collected and processed consistent with previous efforts and in accordance with the SOPs provided in Appendix A. It is anticipated that all sampling will be conducted with disposable equipment. All samples will be submitted to Lancaster Laboratories, a New Jersey certified laboratory for total mercury analysis. Quality Assurance/Quality Control (QA/QC) sampling and procedures will be performed consistent with past sampling events (Parson, June 2010), and will be collected in accordance with the QA/QC methods described in the 2005 New Jersey Department of Environmental Protection (NJDEP) *Field Sampling Procedures Manual.* A summary of analytical method and quality assurance indicators is provided in the table below.

Parameter	Mercury
Matrix	Sediment
Analytical Method	7471A
Sample Container	300 ml glass jar
Preservative	None
Preservations	Cool, 4°C
Holding Time	28 days
Method Detection Limit (mg/kg)	0.012
Practical Quantitation Limit (Reporting Limit) (mg/kg)	0.1
Required Precision (Maximum Relative % Difference)	35
Required Accuracy (Relative % Recovery)	70-130

The electronic data resulting from the sampling efforts will be reviewed via the DuPont Data Review (DDR) process. The DDR is an automated internal review process used by the ADQM group to determine if the data are usable. The data are run through an automated program and a series of checks are performed. The data are evaluated against hold time criteria, checked for blank contamination, and assessed against matrix spike (MS)/matrix spike duplicate (MSD) recoveries, relative percent differences (RPDs) between these samples, and laboratory control sample (LCS)/control sample duplicate (LCSD) recoveries, RPDs between these samples, RPDs between laboratory replicates, and surrogate spike recoveries. The DDR applies the following data qualifiers to analysis results, as warranted.

Qualifier	Definition
B	Not detected substantially above the level in the laboratory of field blanks.
R	Unusable result. Analyte may or may not be present in the sample.
J	Analyte present. Report value may not be accurate or precise.
UJ	Not detected. Reporting limit may not be accurate or precise.

QA/QC will be performed on field samples to assess the accuracy and representativeness of samples collected. Field QA/QC checks will include the following:

- Duplicate – 1 per 20 samples minimum
- Equipment Blank – 1 per 50 samples (as needed when using non-disposable equipment)
- Temperature Blank – one per shipment container

Laboratory QA/QC checks will include the following:

- MS/MSD – 1 per 20 samples minimum

All QA/QC samples will be analyzed for total mercury using the method presented above. The DDR process outlined above will be performed to determine data useability. It should be noted that inherent variability is anticipated due to the nature of the matrix and constituents and that differences may not be an indicator of data quality issues.

3.5 Schedule

It is anticipated that collection and processing of the sediment cores (total of 105 cores) will require 2 to 3 weeks to complete, excluding the additional investigations downstream of the Pompton Dam (Section 3.3) as the extent of these efforts will be determined in the field. An additional 6 to 8 weeks is estimated to be necessary for laboratory analyses, the DDR process, and data and statistical evaluations.

3.6 Health and Safety Plan

A site-specific Health and Safety Plan has been developed that is consistent with the requirements of OSHA 1910.120. DuPont has also developed a series of tools (e.g., project safety analysis, site work permits, etc.) that are used to ensure hazards are identified and where possible eliminated or measures put into place to mitigate the potential for injury. A copy of the project safety analysis (SOP) is included in Appendix A.

4. References

ARCADIS, O'Brien & Gere, Parsons, and URS. September 2011. *Pompton Lake Acid Brook Delta Area Revised Corrective Measures Implementation Work Plan. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey.*

ARCADIS, O'Brien & Gere, Parsons, and URS. June 2013. *Draft Technical Memorandum: Conceptual Site Model. Pompton Lake Acid Brook Delta Project. DuPont Pompton Lakes Works.*

CRG. August 2004. *Delta Sampling Work Plan*. Draft submitted April 2004, and finalized August 2004.

CRG. January 2009. *Acid Brook Delta Uplands Remedial Investigation Work Plan. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey.*

NJDEP. 2005. Field Sampling Procedures Manual.

Parsons. June 2010. *Uplands Remedial Investigation Report. PI#007411. Pompton Lakes Works, Pompton Lakes, New Jersey*.

URS. June 2013. *Draft Pompton Lake Ecological Investigations Framework Document. DuPont Pompton Lakes Works, Pompton Lake, New Jersey.*

Figures

City: SYR Div/Group: SWG Created By: K. Ives Last Saved By: kives
Project (B0042322.0003.00002)
Q:\Dupont\PomptonLake\BathymetryComparison_2013\mxd\2013_Bathymetry_v2.mxd 7/2/2013 10:51:57 AM

NOTES:

1. THE BASE MAP WAS PREPARED BY R.C.C DESIGN, INC. AND IS BASED UPON ACTUAL FIELD SURVEY AND AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 28, 2007, AND REPRESENTS THE CONDITIONS FOUND EXCEPT SUCH EASEMENTS OF IMPROVEMENTS, IF ANY, BELOW THE SURFACE LANDS AND NOT VISIBLE. THE APPROXIMATE WATER SURFACE ELEVATION SHOWN HEREIN WAS MEASURED AT TIME OF AERIAL SURVEY, AND MAY VARY BASED ON CURRENT SITE CONDITIONS. HORIZONTAL AND VERTICAL DATUMS ARE BASED ON NAD 83 AND NAVD 88, RESPECTIVELY.

2. THE 2013 BATHYMETRIC SURVEY WAS PERFORMED BY AQUA SURVEY, INC. ON MAY 13, 2013. THE SURVEY IS A SINGLE BEAM AND SINGLE FREQUENCY SURVEY.

LEGEND

2013 BATHYMETRY (FT)

- 168.46 - 170
- 170 - 172
- 172 - 174
- 174 - 176
- 176 - 178
- 178 - 180
- 180 - 182
- 182 - 184
- 184 - 186
- 186 - 188
- 188 - 190
- 190 - 192
- 192 - 194
- 194 - 196
- 196 - 198
- 198 - 200

- 2011 CMI WP REMOVAL AREA LIMIT
- APPROXIMATE DECEMBER 2012 PERMIT MODIFICATION RAO LINE
- BATHYMETRIC CONTOUR

DUPONT POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

2013 BATHYMETRY

ARCADIS

FIGURE
3-1

NOTE:

1. THE BASE MAP WAS PREPARED BY R.C.C DESIGN,INC. AND IS BASED UPON ACTUAL FIELD SURVEY AND AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 28, 2007, AND REPRESENTS THE CONDITIONS FOUND EXCEPT SUCH EASEMENTS OF IMPROVEMENTS, IF ANY, BELOW THE SURFACE LANDS AND NOT VISIBLE. THE APPROXIMATE WATER SURFACE ELEVATION SHOWN HEREIN WAS MEASURED AT TIME OF AERIAL SURVEY, AND MAY VARY BASED ON CURRENT SITE CONDITIONS. HORIZONTAL AND VERTICAL DATUMS ARE BASED ON NAD 83 AND NAVD 88, RESPECTIVELY.

2. THE SIDE SCAN SONAR SURVEY EVENT, INCLUDING COLLECTION OF GRAB SAMPLES, WAS PERFORMED BY AQUA SURVEY, INC. ON MAY 14-15, 2013.

LEGEND

- ▲ GRAB SAMPLE LOCATION
- DECEMBER 2012 PERMIT MODIFICATION RAO LINE
- 2011 CMI WP REMOVAL AREA LIMIT

DUPONT POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

2013 SIDE SCAN SONAR AND GRAB SAMPLE LOCATIONS

ARCADIS

FIGURE
3-2

City: SYR Div/Group: SWG Created By: K. Ives Last Saved By: kives
Project (B0042322.0003.00002)
Q:\Dupont\PomptonLake\BathymetryComparison_2013\mxd\SideScanSonar_withSedClass.mxd 7/2/2013 11:07:28 AM

NOTE:

1. THE BASE MAP WAS PREPARED BY R.C.C DESIGN,INC. AND IS BASED UPON ACTUAL FIELD SURVEY AND AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 28, 2007, AND REPRESENTS THE CONDITIONS FOUND EXCEPT SUCH EASEMENTS OF IMPROVEMENTS, IF ANY, BELOW THE SURFACE LANDS AND NOT VISIBLE. THE APPROXIMATE WATER SURFACE ELEVATION SHOWN HEREIN WAS MEASURED AT TIME OF AERIAL SURVEY, AND MAY VARY BASED ON CURRENT SITE CONDITIONS. HORIZONTAL AND VERTICAL DATUMS ARE BASED ON NAD 83 AND NAVD 88, RESPECTIVELY.

2. THE SIDE SCAN SONAR SURVEY EVENT, INCLUDING COLLECTION OF GRAB SAMPLES, WAS PERFORMED BY AQUA SURVEY, INC. ON MAY 14-15, 2013.

LEGEND

- GRAB SAMPLE LOCATION
- DECEMBER 2012 PERMIT MODIFICATION RAO LINE
- 2011 CMI WP REMOVAL AREA LIMIT

SEDIMENT CLASSIFICATION

- GRAVEL/SAND
- SAND
- SILT
- VEGETATION

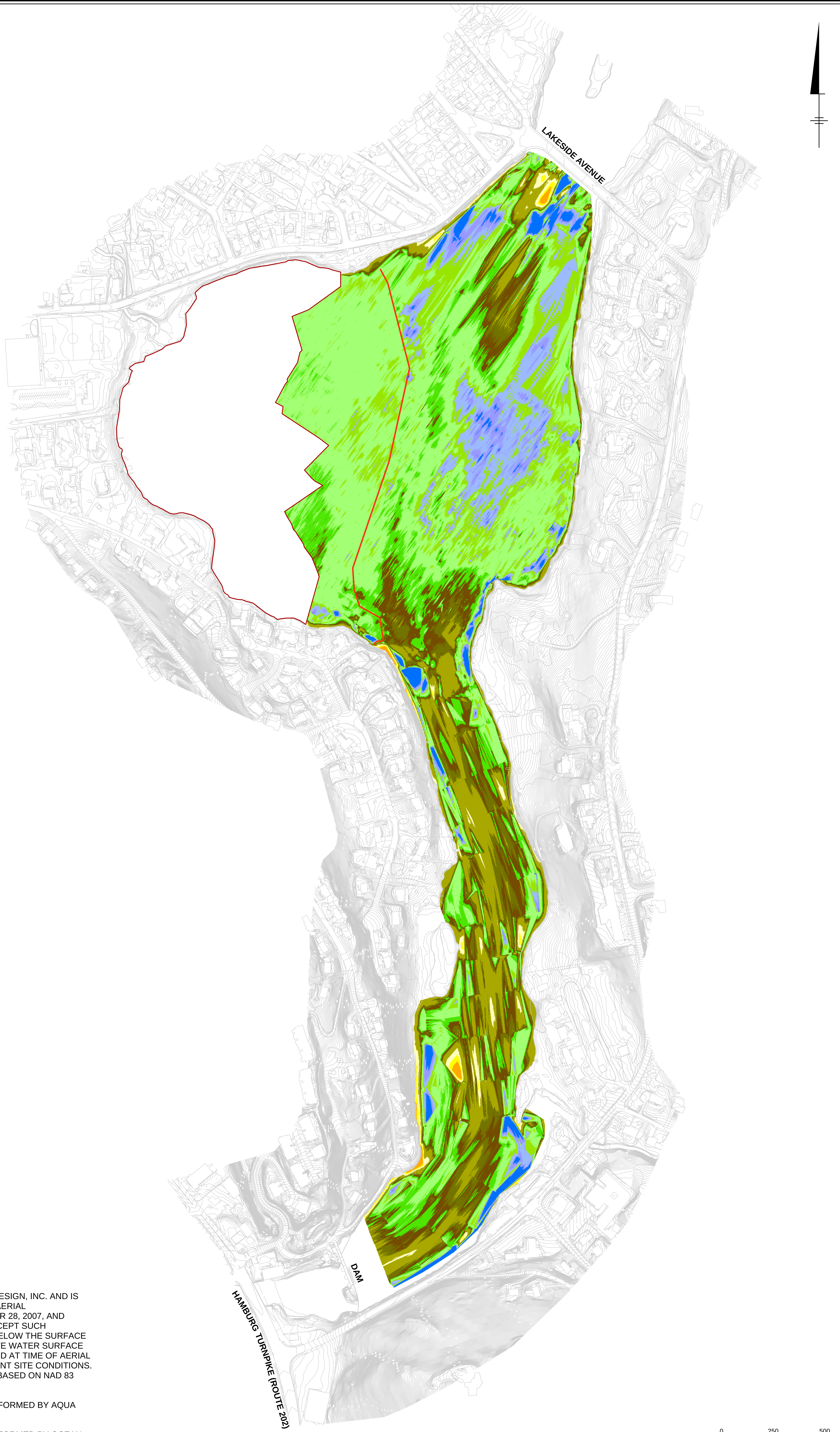
DUPONT POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

2013 SIDE SCAN SONAR, SEDIMENT CLASSIFICATIONS AND GRAB SAMPLE LOCATIONS

ARCADIS

FIGURE
3-3

City: SYR Div/Group: SWG Created By: K. Ives Last Saved By: kives
Project (B0042322.0003.00002)
Q:\Dupont\PomptonLake\BathymetryComparison_2013\mxd\BathymetryComparison_2007vs2013_v2.mxd 7/2/2013 10:49:08 AM



NOTES:

1. THE BASE MAP WAS PREPARED BY R.C.C DESIGN, INC. AND IS BASED UPON ACTUAL FIELD SURVEY AND AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 28, 2007, AND REPRESENTS THE CONDITIONS FOUND EXCEPT SUCH EASEMENTS OF IMPROVEMENTS, IF ANY, BELOW THE SURFACE LANDS AND NOT VISIBLE. THE APPROXIMATE WATER SURFACE ELEVATION SHOWN HEREIN WAS MEASURED AT TIME OF AERIAL SURVEY, AND MAY VARY BASED ON CURRENT SITE CONDITIONS. HORIZONTAL AND VERTICAL DATUMS ARE BASED ON NAD 83 AND NAVD 88, RESPECTIVELY.

2. THE 2013 BATHYMETRIC SURVEY WAS PERFORMED BY AQUA SURVEY, INC. ON MAY 13, 2013.

3. THE 2007 BATHYMETRIC SURVEY WAS PERFORMED BY OCEAN SURVEYS, INC. IN APRIL/MAY 2007.

LEGEND

2013 AND 2007 BATHYMETRY COMPARISON RESULTS (FT):

APPARENT EROSION
- > -8.18 AND ≤ -4
- > -4 AND ≤ -3
- > -3 AND ≤ -2
- > -2 AND ≤ -1
- > -1 AND ≤ -0.75
- > -0.75 AND ≤ -0.5

CHANGE WITHIN THE ACCURACY OF SURVEY
- > -0.5 AND ≤ -0.25
- > -0.25 AND ≤ 0.25
- > 0.25 AND ≤ 0.5

APPARENT DEPOSITION
- > 0.5 AND ≤ 0.75
- > 0.75 AND ≤ 1
- > 1 AND ≤ 6.5

2011 CMI WP REMOVAL AREA LIMIT

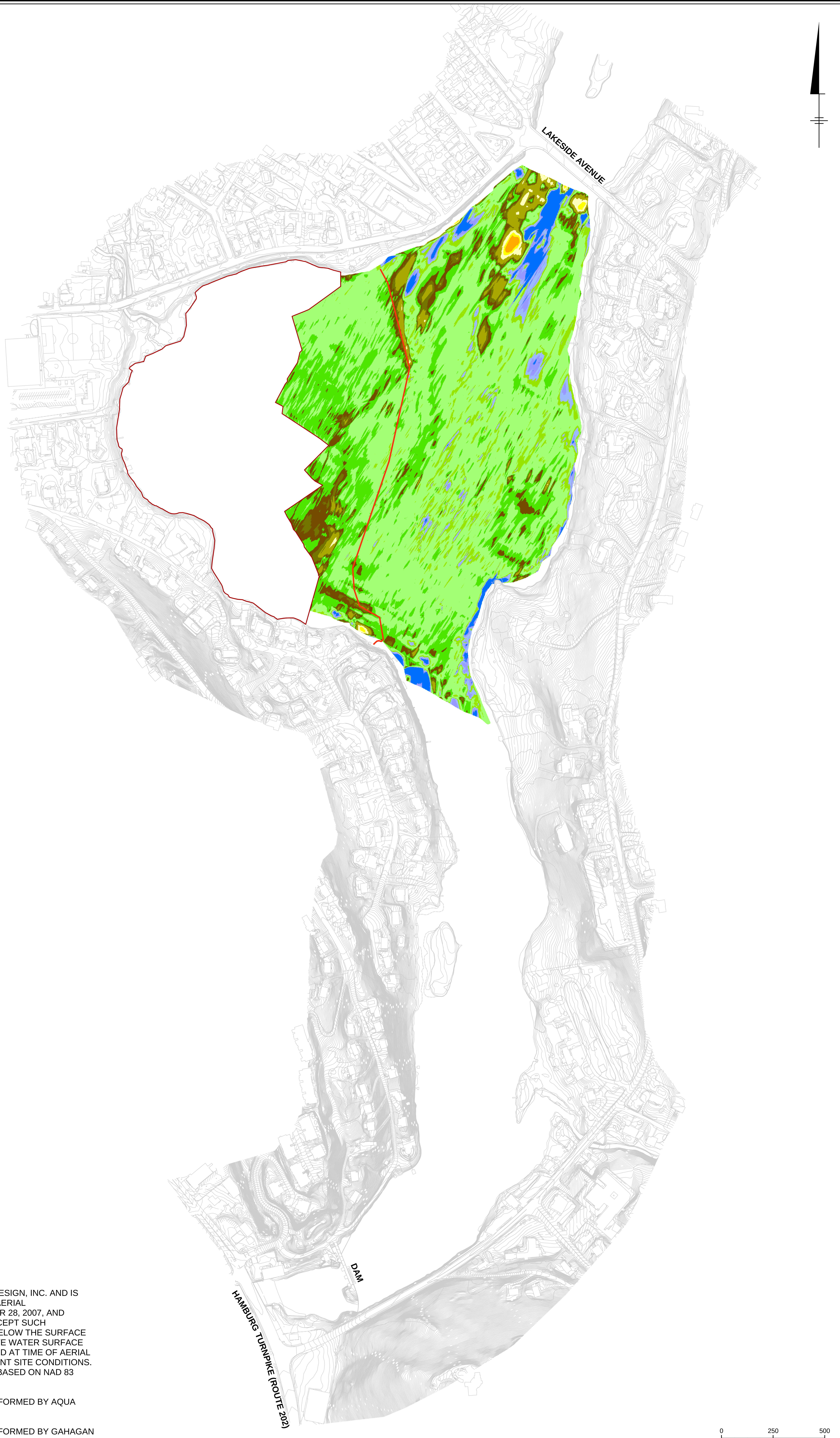
APPROXIMATE DECEMBER 2012 PERMIT MODIFICATION RAO LINE

DUPONT POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

BATHYMETRY COMPARISON RESULTS: 2007 AND 2013

ARCADIS

FIGURE
3-4



NOTES:

1. THE BASE MAP WAS PREPARED BY R.C.C DESIGN, INC. AND IS BASED UPON ACTUAL FIELD SURVEY AND AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 28, 2007, AND REPRESENTS THE CONDITIONS FOUND EXCEPT SUCH EASEMENTS OF IMPROVEMENTS, IF ANY, BELOW THE SURFACE LANDS AND NOT VISIBLE. THE APPROXIMATE WATER SURFACE ELEVATION SHOWN HEREIN WAS MEASURED AT TIME OF AERIAL SURVEY, AND MAY VARY BASED ON CURRENT SITE CONDITIONS. HORIZONTAL AND VERTICAL DATUMS ARE BASED ON NAD 83 AND NAVD 88, RESPECTIVELY.

2. THE 2013 BATHYMETRIC SURVEY WAS PERFORMED BY AQUA SURVEY, INC. ON MAY 13, 2013.

3. THE 2011 BATHYMETRIC SURVEY WAS PERFORMED BY GAHAGAN & BRYANT ASSOCIATES, INC. ON NOVEMBER 3, 2011.

LEGEND

2013 AND 2011 BATHYMETRY COMPARISON RESULTS (FT):

APPARENT EROSION
- > -5.94 AND ≤ -4
- > -4 AND ≤ -3
- > -3 AND ≤ -2
- > -2 AND ≤ -1
- > -1 AND ≤ -0.75
- > -0.75 AND ≤ -0.5

CHANGE WITHIN THE ACCURACY OF SURVEY
- > -0.5 AND ≤ -0.25
- > -0.25 AND ≤ 0.25
- > 0.25 AND ≤ 0.5

APPARENT DEPOSITION
- > 0.5 AND ≤ 0.75
- > 0.75 AND ≤ 1
- > 1 AND ≤ 7.5

2011 CMI WP REMOVAL AREA LIMIT

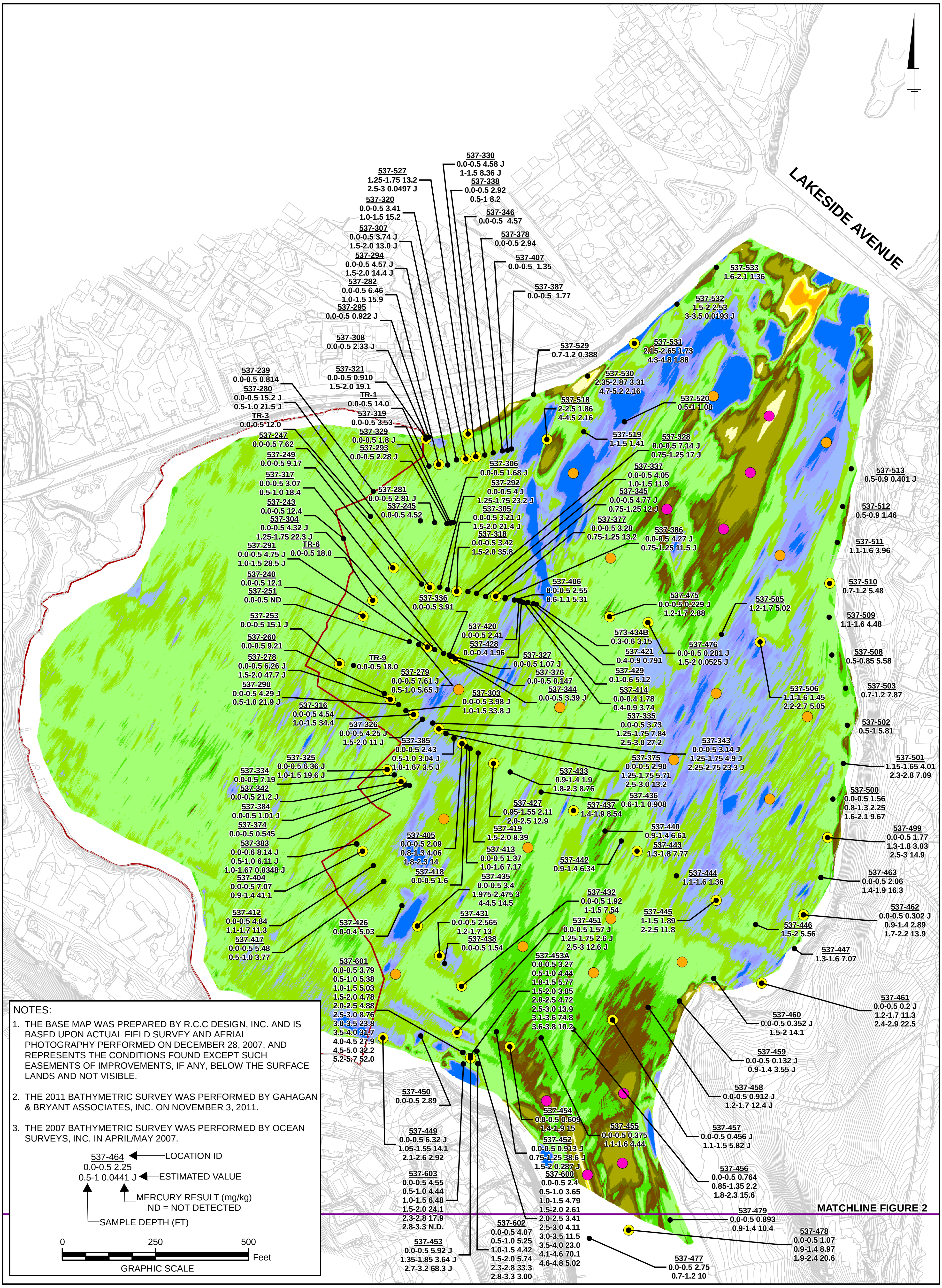
APPROXIMATE DECEMBER 2012 PERMIT MODIFICATION RAO LINE

DUPONT POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

BATHYMETRY COMPARISON RESULTS: 2011 AND 2013

ARCADIS

FIGURE
3-5



NOTES:

1. THE BASE MAP WAS PREPARED BY R.C.C DESIGN, INC. AND IS BASED UPON ACTUAL FIELD SURVEY AND AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 28, 2007, AND REPRESENTS THE CONDITIONS FOUND EXCEPT SUCH EASEMENTS OF IMPROVEMENTS, IF ANY, BELOW THE SURFACE LANDS AND NOT VISIBLE.
2. THE 2011 BATHYMETRIC SURVEY WAS PERFORMED BY GAHAGAN & BRYANT ASSOCIATES, INC. ON NOVEMBER 3, 2011.
3. THE 2007 BATHYMETRIC SURVEY WAS PERFORMED BY OCEAN SURVEYS, INC. IN APRIL/MAY 2007.

537-464 ← LOCATION ID
0.0-0.5 2.25
0.5-1 0.0441 J ← ESTIMATED VALUE
MERCURY RESULT (mg/kg)
ND = NOT DETECTED
SAMPLE DEPTH (FT)

0 250 500 Feet
GRAPHIC SCALE

LEGEND

- 2003-2007 OR 2010 AREA A/B SAMPLE LOCATION

PROPOSED SAMPLE LOCATIONS
- DATA ADEQUACY - AREAS WITH DECREASED SURFACE SEDIMENT ELEVATION
- DATA ADEQUACY - AREAS WITH SIMILAR TO/INCREASED SURFACE SEDIMENT ELEVATION
- DATA ADEQUACY - SUPPLEMENTAL
- HISTORICAL VALIDATION

2007 AND 2011 BATHYMETRY COMPARISON RESULTS (FT):

APPARENT EROSION
- > -6.14 AND ≤ -4
- > -4 AND ≤ -3
- > -3 AND ≤ -2
- > -2 AND ≤ -1
- > -1 AND ≤ -0.75
- > -0.75 AND ≤ -0.5

CHANGE WITHIN THE ACCURACY OF SURVEY
- > -0.5 AND ≤ -0.25
- > -0.25 AND ≤ 0.25
- > 0.25 AND ≤ 0.5

APPARENT DEPOSITION
- > 0.5 AND ≤ 0.75
- > 0.75 AND ≤ 1
- > 1 AND ≤ 6
- 2011 CMI WP REMOVAL AREA LIMIT

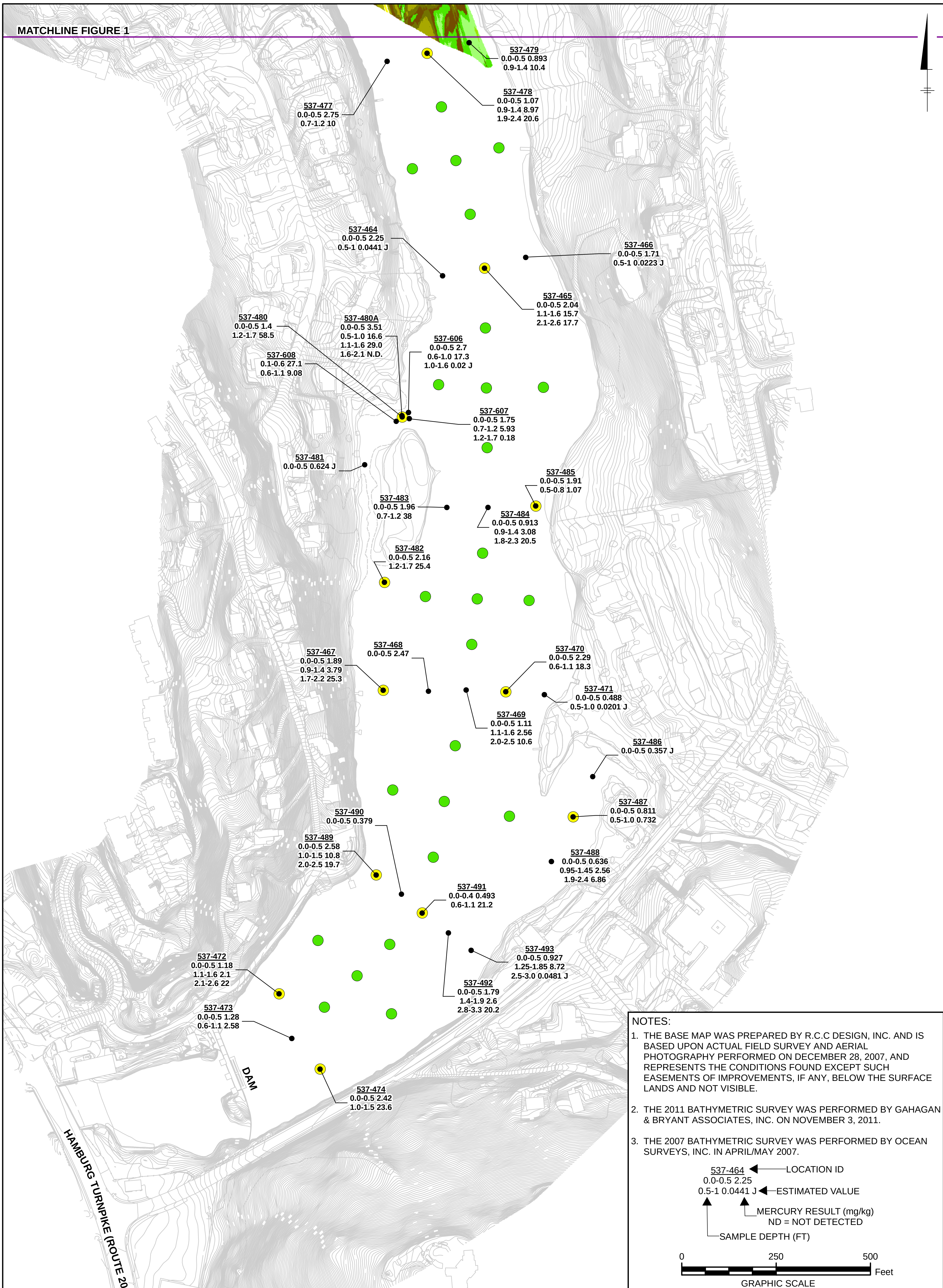
DUPONT POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

POMPTON LAKE AND RAMAPO RIVER PROPOSED SAMPLING LOCATIONS

ARCADIS

FIGURE
3-6

City: SYR Div/Group: SWG Created By: K. Ives Last Saved By: kives
DuPont
Q:\Dupont\PomptonLake\BathymetryComparison_2013\mxd\ProposedSampleLocations_South.mxd 7/2/2013 11:00:57 AM



NOTES:

1. THE BASE MAP WAS PREPARED BY R.C.C DESIGN, INC. AND IS BASED UPON ACTUAL FIELD SURVEY AND AERIAL PHOTOGRAPHY PERFORMED ON DECEMBER 28, 2007, AND REPRESENTS THE CONDITIONS FOUND EXCEPT SUCH EASEMENTS OF IMPROVEMENTS, IF ANY, BELOW THE SURFACE LANDS AND NOT VISIBLE.
2. THE 2011 BATHYMETRIC SURVEY WAS PERFORMED BY GAHAGAN & BRYANT ASSOCIATES, INC. ON NOVEMBER 3, 2011.
3. THE 2007 BATHYMETRIC SURVEY WAS PERFORMED BY OCEAN SURVEYS, INC. IN APRIL/MAY 2007.

LEGEND

- 2003-2007 OR 2010 AREA A/B SAMPLE LOCATION

PROPOSED SAMPLE LOCATIONS

- DATA ADEQUACY
- DATA ADEQUACY - SUPPLEMENTAL
- HISTORICAL VALIDATION

2007 AND 2011 BATHYMETRY COMPARISON RESULTS (FT):

APPARENT EROSION
- > -6.14 AND ≤ -4
- > -4 AND ≤ -3
- > -3 AND ≤ -2
- > -2 AND ≤ -1
- > -1 AND ≤ -0.75
- > -0.75 AND ≤ -0.5

CHANGE WITHIN THE ACCURACY OF SURVEY
- > -0.5 AND ≤ -0.25
- > -0.25 AND ≤ 0.25
- > 0.25 AND ≤ 0.5

APPARENT DEPOSITION
- > 0.5 AND ≤ 0.75
- > 0.75 AND ≤ 1
- > 1 AND ≤ 6

DUPONT POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

LOWER RAMAPO RIVER PROPOSED SAMPLING LOCATIONS

ARCADIS

FIGURE **3-7**

ARCADIS

Appendix A

Standard Operating Procedures

Standard Operation Procedure: Sediment Sampling

The protocol set forth in this Standard Operating Procedure (SOP) outlines the field procedures for the collection of sediment via vibracoring, Lexan® tubing, and grab samples using a hand-held dredge. Procedures for sediment handling, packaging, and shipping are also outlined.

I. Sediment Sampling via Vibracoring

The general procedures to be followed when collecting sediment samples using a vibracore are outlined below.

<u>Materials</u>
The following materials will be available, as required, during sediment sampling via vibracoring:

- Health and safety equipment (as required by the Health and Safety Plan);
- 24-foot aluminum decked boat equipped with outboard motor, derrick, and winch assembly;
- Vibracoring device (Rossfelder P-3C) and associated equipment;
- Spuds, anchor, concrete blocks;
- Aluminum tubing with end caps;
- Pipe cutter (or other appropriate device);
- Differential Global Positioning System (DGPS) survey equipment;
- Disposable aluminum pans;
- Disposable spatulas;
- Appropriate sample containers and forms;
- Coolers with ice;
- Field notebook;
- Camera;
- Surveyor's rod;
- Duct tape;
- Calibrated probe rod; and
- Six-foot rule.

<u>Sediment Sampling Procedures</u>
Sediment samples will be collected from a specially designated boat designed for vibracoring. Samples will be collected at designated locations. The procedures for collection of sediment samples via vibracoring are provided below.

1. Don health and safety equipment (as required in the Health and Safety Plan).

2. Use DGPS surveying techniques to maneuver the sampling vessel to the target sample location. Secure the vessel in place using spuds, anchors, or tie lines.

3. Measure the total depth of water using a surveyor’s rod to the nearest 0.1 foot, and record the water surface elevation with the DGPS.

4. Obtain the sediment depth through probing by manually pushing a 5/8-inch outside diameter calibrated steel pipe into the sediment as far as possible using reasonable human force 3 to 5 feet away from the target

location. The depth of refusal will be interpreted as the interface between soft sediment and rock or stiff bottom. Record sediment depth, type, and presence of debris or obstructions in the field book.

5. Once the targeted area is deemed suitable for core collection select an appropriate length of 3-inch outside diameter aluminum core tube based on the probing information. Deeper sediments will be sampled with core tubes custom cut on the boat from 12 feet tube sections.

6. Mount a clean coring tube into the vibracoring device.

7. Lower the coring apparatus with the core tube attached vertically through the water column tube end first, until it just reaches the top of sediment.

8. Vibrate the core to refusal. Measure and record the depth of core tube penetration into the sediments in the field book.

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

10. Before the bottom of the tube breaks the water surface, place a cap over the bottom end of the tube while still submerged to prevent loss of material from the core tube. The cap will be placed on the core by reaching down into the water from the center of the sample vessel. Secure the cap in place with duct tape when brought on board the vessel.

11. Water overlying the core tube in the coring apparatus will be allowed to drain prior to removal of the core tube.

12. Estimate the recovered length of the sediment core and note it in the field notebook. The length of the cores recovered in aluminum tubing will be determined directly by lowering a clean aluminum measuring device into the top of the tube. The distance to the top of the sediment in the core tube will be subtracted from the total tube length for a recovered sediment length.

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

    - If the recovered length of the sediment core is more than 60% of the penetration depth, keep the core.
    - If insufficient amount of material is recovered, set the intact core tube aside for potential future use, and perform the following steps as necessary.
        - An additional attempt will be made at a minimum distance of 2 feet from the previously attempted location.
        - A maximum of three attempts to collect a core will be made for a given location.
        - If all three attempts to collect a core are unsuccessful based on recovery alone (i.e., less than 60% recovery), retain the core with greatest recovery for analysis and indicate that the targeted recovery was not achieved (dispose other cores).

14. After successful core recovery enter additional information into the field notes: date; time of recovery; sample position; water depth (feet) and water surface elevation; core penetration depth (feet); core recovery depth (feet); and observations, including probing results.

15. Remove the core tube from the vibracore device and place a second cap on the top of the core tube. As necessary, and while keeping the core upright, use a pipe cutter (or other appropriate device) to make a

horizontal cut in the core tube approximately one inch above the sediment. Secure the cap in place with duct tape. Rinse the outside of the core tube with a small amount of river or lake water.

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

17. Store the core vertically while on the vessel and transport to the processing area.

18. Upon delivery of the cores to the processing area, measure the recovered sediment in the core tube and begin draining the overlying water by drilling a hole just above the sediment interface.

19. Prepare a clean set of disposable aluminum pans for sectioned core segments. Mark each container with location and sample depth.

20. Due to the potential for soft/loose surface sediment, as necessary the upper sections (to one foot depth) may be sectioned using a pipe cutter (or other appropriate device) with the core left in a vertical position. Each of these sections will be carefully transferred into a disposable aluminum pan.

21. For lower sample sections, the core tube will be placed in a horizontal position and electric shears will be utilized to cut the tube lengthwise to expose the full intact core.

22. Physical descriptions of each core will be obtained and changes in stratigraphy noted. Characteristics include the general soil type based on the Unified Soil Classification System, approximate grain size, presence of observable biota, odor, and color. Obtain photographs of the sediments as possible.

23. Remove representative samples based on the designated segmentation scheme.

24. Homogenize samples in a disposable aluminum pan as necessary.

25. Place homogenized sample in appropriate sample containers and cap.

26. Label all sample containers.

27. Place filled sample containers on ice in a cooler or specifically designated refrigerator.

28. Follow procedures for packing, handling, and shipping with associated chain-of-custody procedures of samples as described in Section III.

29. Record required information on the appropriate forms and/or field notebook.

30. Quality assurance/quality control samples will be obtained as specified in the sampling plan.

II. Sediment Sampling via Lexan® Tubing and a Hand-Held Dredge

<u>Materials</u>

The following materials will be available, as required, during sediment sampling via Lexan® Tubing and a Hand-Held Dredge:

- Health and safety equipment (as required by the Health and Safety Plan);

- Cleaning equipment;
- Disposable aluminum pans;
- Disposable spatulas;
- Appropriate sample containers and forms;
- Coolers with ice;
- Field notebook;
- Differential Global Positioning System (DGPS) survey equipment;
- Camera;
- Anchor/concrete blocks;
- Boat and motor;
- Rope;
- Surveyor's rod;
- Duct tape;
- Lexan® tubing with end caps;
- Calibrated probe rod;
- Hacksaw;
- Steel core driver;
- Vacuum pump;
- Piston sampler/check valve push core device;
- Hand-held dredge; and
- Six-foot rule.

<u>Sediment Sampling Procedures</u>
Sediment samples will be collected from a boat using either Lexan® tubing or a hand-held dredge. Samples will be collected at designated locations. The procedures for collection of sediment samples via these methods are provided below.

Sediment Sampling Procedure Using Lexan® Tubing

1. Don health and safety equipment (as required in the Health and Safety Plan).

2. Clean reusable sampling equipment as follows: non-phosphate detergent and distilled water wash; distilled water rinse; rinse equipment with solvent (hexane); distilled water rinse; allow to air dry and wrap in aluminum foil.

3. Use DGPS surveying techniques to locate the proposed sample location and position the boat with anchors.

4. Measure the total depth of the water using a surveyor's rod to the nearest 0.1 foot, and record the water surface elevation with the DGPS.

5. Obtain total sediment depth through probing by manually pushing a 5/8-inch outside diameter calibrated steel pipe into the sediment as far as possible using reasonable human force 3 to 5 feet away from the target. The depth of refusal will be interpreted as the interface between soft sediment and rock or stiff bottom. Record sediment depth, type, and presence of debris or obstructions in the field book.

6. Once the targeted area is deemed suitable for core collection, select an appropriate length of Lexan® tubing based on the probing information.

7. Lower a section of Lexan® tube vertically until it just reaches the top of the sediment. Sections of Lexan® tube may need to be spliced together or the Lexan® tube may be attached to a check valve core device.

8. Push the Lexan® tube with a straight vertical entry into the sediment so as to secure a reliably representative core sample. Measure and record the depth of core tube penetration into the sediments in the field book.

9. Drive the tube until refusal using a steel core driver and measure the additional distance. This procedure is performed to obtain a "plug" at the bottom of the core and prevent the loose sediment from escaping.

10. Place a vacuum pump on the top end of the Lexan® tube and create a vacuum to prevent the sediment from escaping (note this is not needed if using a check valve core device).

11. Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

12. Before the tube is fully removed from the water, place a cap on the bottom end of the tube while it is still submerged to prevent loss of material from the core tube. The cap will be placed on the core by reaching down into the water.

13. Keeping the tube upright, wipe the bottom end dry and seal the end with duct tape and label. Measure the length of sediment recovered and evaluate the integrity of the core. If additional cores are necessary to obtain a sufficient sample, repeat the coring procedure at the location adjacent to the previous one sampled.

14. While keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately one inch above the sediment.

15. Re-cap the cut end of the tube, seal the cap with duct tape, and mark this end as "top".

16. Wipe the tube dry and store the core vertically while on the vessel and transport to the processing area.

17. Record the following additional information in the field book: date; time of recovery; sample position; water depth (feet) and water surface elevation; core penetration depth (feet); and core recovery (feet); and observations, including probing results.

18. Obtain photographs of the tube prior to, and after, slicing the tube open as possible.

19. Place the core tube in a horizontal position and cut the tube lengthwise to expose the full intact core.

20. Physical descriptions of each core will be obtained and changes in stratigraphy noted. Characteristics include the general soil type based on the Unified Soil Classification System, approximate grain size, presence of observable biota, odor, and color. Obtain photographs of the sediments as possible.

21. If sample sectioning is required, slice tube open or push sediment from the tube and slice according to the designated segmentation scheme.

22. Prepare a clean set of disposable aluminum pans for core segments as necessary and mark each container with location and sample depth. Homogenize samples in a disposable aluminum pan as necessary.

23. Place homogenized sample in appropriate sample containers and cap.

24. Label all sample containers.

25. Place filled sample containers on ice in a cooler or specifically designated refrigerator.

26. Follow procedures for packing, handling, and shipping with associated chain-of-custody procedures of samples as described in Section III.

27. Record required information on the appropriate forms and/or field notebook.

28. Quality assurance/quality control samples will be obtained as specified in the sampling plan.

Sediment Sampling Using a Hand-Held Dredge
As an alternative sediment sampling method, steps 7 through 16 may be replaced with steps a through g, for collection of grab sediment samples through use of a hand-held dredge as follows:

a. At each sample location, slowly lower open dredge from the side of the boat making sure that the end of the rope is maintained at all times until just above sediment surface and then drop the open dredge into the sediment.

b. Once the dredge has been allowed to settle into the bottom sediment, a hard pull on the rope will close the sediment inside the dredge.

c. Retrieve the dredge into the boat.

d. Tilt dredge and drain overlying water and then open the dredge to allow the sediment to empty onto a disposable aluminum pan.

e. Multiple casts will be made and composited at each location until sufficient sample volume is obtained.

f. Observe the sample and record descriptions in the field notebook.

g. If chemical laboratory analyses are being performed, rinse blanks will be obtained by pouring de-ionized water through a cleaned stainless steel dredge onto a cleaned stainless steel or disposable aluminum tray/pan. From the tray/pan, the appropriate sample containers will be filled. Rinse blanks should be collected at the start and finish of sampling activities.

III. Sediment Sample Handling, Packaging, and Shipping

<u>Materials</u>
All necessary materials were presented in Sections I and II.

<u>Handling</u>
A. Fill in sample label with:

- Sample type (e.g., sediment);
- Project number and site name;
- Sample identification code and other sample identification information, if applicable;
- Analysis required;
- Date;

- Time sampled;
- Sampler initials and affiliation;
- Sample type (composite or discrete); and
- Preservative added, if applicable.

B. Cover the label with clear packing tape to secure it onto the container.

C. Check the caps on the sample containers to ensure that they are tightly sealed.

D. Wrap the sample container cap with clear packing tape to prevent it from becoming loose.

E. Initiate chain-of-custody by designated sampling personnel responsible for sample custody (after sampling or prior to sample packing). Note: If the designated sampling person relinquishes the samples to other sampling or field personnel for packing or other purposes, the samplers will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.

Packing (only necessary for samples being sent from the site to a laboratory via express courier)

A. Using packing tape, secure the outside and inside of the drain plug at the bottom of the cooler that is used for sample transport (if applicable).

B. Place each container or package in individual polyethylene bags (Ziploc®-type) and seal.

C. Place one to two inches of cushioning material at the bottom of the cooler.

D. Place the sealed sample containers, including temperature blank, and package upright in the cooler.

E. Package ice in double lined Ziploc®-type plastic bags and place loosely in the cooler. Do not pack ice so tightly that it may prevent addition of sufficient cushioning material.

F. Fill the remaining space in the cooler with cushioning material.

G. Place the completed chain-of-custody forms in a large Ziploc®-type bag and tape the forms to the inside of the cooler lid.

H. Close the lid of the cooler and fasten with packing tape.

I. Wrap strapping tape around both ends of the cooler at least twice.

J. Mark the cooler on the outside with the following information: shipping address, return address, "Fragile" labels on the top and on one side, and arrows indicating "This Side Up" on two adjacent sides.

K. Place a signed custody seal label over front right and back left of the cooler lid and cover with clear plastic tape.

Shipping

A. All samples will be hand delivered or delivered by an express carrier within 48 hours or less from the date of sample collection.

B. The following chain-of-custody procedures will apply to sample shipping:

- Relinquish the sample containers to the laboratory via express carrier. The signed and dated forms should be included in the cooler. The express carrier is not required to sign the chain-of-custody forms. The sampler should retain the express carrier receipt or bill of lading.
- When the samples are received by the laboratory, the laboratory personnel shall complete the chain-of-custody forms by recording receipt of samples, measure and record the internal temperature of the shipping container, and then check the sample identification numbers on the containers to the chain-of-custody forms.

Standard Operating Procedure - *Project Safety Analysis*

Purpose

The purpose of this procedure is to provide guidance on how to conduct a project safety analysis.

Key Terms

The following definitions apply to terms used in this guideline:

Project Safety Analysis (PSA) - A process to identify field safety and health hazards which may be known or anticipated, and the associated control measures to be implemented. This process may be used at various points throughout the life cycle of the project.

PSA Team - A team of people who may be directly involved with the project or who have specific expertise in a given area which is unique to the project. At least one H&S professional should be a member of the team.

PSA Meeting- A formal meeting of the PSA team using this PSA procedure.

Responsibilities

Project Director (PD) - Responsible for verifying that PSAs are conducted for CRG-funded projects. The PD will ensure that all recommendations generated as a result of the PSA will be evaluated and implemented as agreed to by the team.

Project Manager (PM) - Responsible for ensuring that a PSA is completed for all applicable projects and that a PSA Leader and Scribe are assigned.

PSA Leader – Responsible for assembling a PSA team that includes all key project personnel as well as other appropriate resources as determined by project-specific health and safety concerns. Responsible for leading the team through the PSA process and verifying that the information generated during the PSA is adequately documented.

H&S Professional – Serves as a resource to ensure the adequacy of the PSA process to identify and address anticipated safety concerns. This may be a DuPont or supplier H&S professional.

PSA Team - Responsible for identifying the hazards associated with the project tasks and evaluating measures to mitigate the hazards.

Scribe - Responsible for taking thorough notes and completing the PSA forms. The PSA Leader and the Scribe should not be the same person if at all possible.

Application

This procedure shall be applied to all CRG-funded field projects regardless of project complexity, duration, or scope of work. The PSA process should be initiated during the developmental phase of all field projects after a scope of work has been determined. Field projects are defined as environmental, (e.g., site investigations, periodic GW monitoring, remediation, construction and operation of pump and treat systems), or construction or demolition activities managed by the CRG. It is not mandatory that PSAs be completed for general services not linked to fieldwork such as plumbing for an office rest room, snow removal, replacing light bulbs or outlets, etc. However, the hazards associated with those activities should be addressed using a tool such as a work permit, daily safety briefing, etc. The PSA checklist and process could also be used in these cases if appropriate.

Procedure

1. The PM, in communication with the PD, should determine the most appropriate timing for the PSA(s) based on the project life cycle. Ideally, it should be scheduled after a work plan has been developed but in advance of mobilization.

2. The PM should select a PSA Leader for the process. The PSA Leader is responsible for assembling a PSA team and scheduling the necessary time to conduct the PSA; in general, approximately two hours.

3. The team must include the following: Project Director, Project Manager, DuPont Site Representative (DSR), a Health and Safety professional and a contractor representative. <u>Note:</u> If these key participants are not available, the PSA should be postponed. Other participants may include Site Supervisor, Site Safety Officer, field team members and facility representatives.

4. The PSA Leader should consider resources from outside the project. Select additional participants to provide additional expertise in project-specific health and safety concerns based on their abilities and experience in dealing with the unique concerns of the given project. PSA members are not required to be project team members and it is not necessary for all project team members to participate in a PSA.

5. Page one of the checklist (Background Information) should be completed at the onset of the PSA to identify key project participants and elaborate on project team roles and responsibilities. The last two pages of the checklist (Documentation & DSR Preparation) are to be completed prior to the meeting, but **are not** intended to be shared with the contractor who will be performing the work. They are intended to be used by the project team to assist in staffing the project.

6. Prior to the PSA meeting, provide a copy of the form (sheets A-E) to the participants, allowing sufficient time for review. Although it is not required, "front-end-loading" of the form may streamline the process and assist in facilitating the discussion. If performed, it should not preempt the discussion of the hazards or omit the need to document those items discussed.

7. At the beginning of the PSA meeting, the PD, PM, or PSA Leader should provide an overview of the project scope of work and specific details of each task to be performed. In addition, key project roles and responsibilities should be discussed. After the PSA team has an understanding of the project activities, the team shall review each hazard identified on the PSA checklist.

8. Beginning with Checklist A, each hazard that is applicable to the project should be noted on the checklist. The team should identify the specific hazard and determine a means of controlling or eliminating the hazard. <u>Note:</u> This is intended to be an interactive process (a dialogue, not a monologue). If the form is front-end-loaded, the PSA Leader should avoid reading the form to the participants.

9. The Scribe should capture the discussion within the checklist comment section, detailing the specific hazard and the mitigation technique agreed to by the team. It is critical that good notes are kept.

10. The PSA meeting should allow the time necessary to allow adequate time for discussion and to consider "what if" scenarios outside the checklist.

11. If additional research needs to be performed on a hazard, an individual of the PSA team should be identified to follow-up on the item and provide the information for inclusion into the draft PSA.

12. A draft PSA report should be developed and circulated to the team for review and comment. All changes should be agreed upon by the team before final issuance. The final PSA will be used to supplement the HASP.

13. The completed PSA checklist shall be reviewed with all field personnel, maintained on-site along with the other site documents (HASP, WMP, etc.), reviewed periodically, and used as an audit tool.

14. The final copy of the PSA should be filed (either electronically or hard copy) with the project files for future reference.

15. For projects that are ongoing or periodic in nature (semi-annual groundwater monitoring), the project team must review and update the PSA as necessary to reflect changing conditions (i.e. seasonal differences). It is not required that the PD or an H&S professional attend this review. This review and any changes should be documented and the updated PSA appropriately filed.

References

DuPont Corporate Remediation Group Procedure SHE-O-14 Work Permit / Safety Briefing

Background Information

Note: The Background Information, Documentation, and the DuPont Site Representative (DSR) Preparation Checklist pages will be completed PRIOR TO ASSEMBLING PSA team. The Background Information page WILL be discussed during the PSA meeting.
The purpose of the Background Information page is to

- Introduce key project team members,
- Verify that adequate and appropriate resources have been assigned, and
- Provide a background on the scope of work to facilitate discussion.

The Documentation and DuPont Site Representative (DSR) Preparation Checklist WILL NOT be discussed with the contractor during the call. The purpose of the Documentation and DuPont Site Representative Preparation Checklist are to verify that:

- The appropriate front end loading of the project has been completed,
- Appropriate support documents are in place, and
- The assigned DSR is properly equipped and prepared to meet project and Client expectations.

PSA Date:			
Site Name:			
Project Name:			
	List Names Below. If present during the PSA meeting, also Check Box		
PSA Participants * If these key participants are not available, the PSA should be postponed.	Project Director*:		☐
	Project Manager*:		☐
	DuPont Site Rep*.		☐
	Site Supervisor*:		☐
	Scribe for PSA*:		☐
	H&S Professional*:		☐
	Contractor Representatives*:		☐
	Field Team Members:		☐
	Site Safety Officer:		☐
	Facility Representatives:		☐

Are there any Short Service Employees (SSEs) who will be working on this project? An SSE is any partner or contractor personnel with less than 6 months experience in the same job type, with his/her present employer. If so, list the names of SSEs below.	☐ Yes	☐ No
Who is serving as the field mentor for those individuals? List names below.		
Are there specific training or certification requirements to perform the work (i.e., HAZWOPER 40-hour training, heavy equipment operator credentials, forklift training, etc.)? If so, list requirements below.	☐ Yes	☐ No
Brief Summary of the Scope of Work:		

Checklist A Physical Hazards				
Category	**Item**	**Subject**	**No**	**Yes (add comments below)**
Physical Hazards	**A**	Terrain, Topography		
	B	Overhead obstructions		
	B1	If yes, has an OHOP been prepared?		
	C	Underground obstructions (e.g. electric, water, gas, cable)		
	C1	Will intrusive activities be performed?		
	C2	If yes, review Underground Obstructions SOP and complete flowchart.		
	D	Elevated work (over 5 feet) to be performed?		
	D1	Has a fall protection plan been developed?		
	D2	Has a rescue plan been developed?		
	E	Excavation, Trenches		
	E1	If yes, who is the competent person?		
	E2	How will the excavation be sloped/shored/barricaded?		
	F	Will heavy equipment be used?		
	F1	Equipment should be inspected under both static and loaded conditions.		
	G	Traffic (flow and congestion)		
	G1	If yes, has this been discussed with the contractor?		
	G2	What requirements will there be for spotters?		
	H	Slip, Trip, or Fall Potential		
	I	Weather (heat, ice and rain)		
	I1	Has heat stress or cold stress been identified?		
	J	Rigging, Suspended Loads		
	J1	If yes, who is the qualified rigger?		
	K	Confined Space Activity		
	K1	If yes, has a rescue team been trained and notified?		
	L	Heat/ignition sources (powered tools, torches, lamps)		
	M	Explosion potential (static, vapor, storage)		
	N	Is there a potential for a fire?		
	O	Rotating Equipment/Moving Parts		
	O1	Will personnel be exposed to rotating/moving parts?		
	O2	What additional guards can be installed to minimize exposure?		
	P	Pinch Points		
	Q	Drill Rigs		
	Q1	If a drill rig will be used, does the potential exist to encounter flammable/combustible gases (methane, etc.)		
	Q2	If the answer to Q2 is “yes” specify what type of Combustible Gas Indicator will be used, how often and where the monitoring will take place, and the action limit.		
	R	Will there be work over / adjacent to water?		
	S	Will drum handling be performed?		
	T	Are there any noise sources?		
	U	Will there be any use of high pressure water or steam?		
	V	What hand safety concerns are associated with the SOW?		
	V1	What hand PPE is required?		
	V2	Is there special tool(s) to be used to reduce the hazard?		

	V3	Are additional precautions, techniques, etc. to be used?		
	W	What ergonomic concerns are associated with the SOW (i.e., lifting, repetitive motion, materials handling)?		
	X	What hand or power tools will be used?		
	X1	Who will perform initial inspection of hand tools?		
	X2	Who will perform initial inspection of power cords & GFCIs?		

Checklist A Physical Hazards	
Comments	
Item	
A – Terrain	
B – Overhead Hazard	
B1 – OHOP	
C – Underground Haz	
C1 - Intrusive Activity	
C2 – Underground Obstruction Summary of findings & avoidance measures	
D - Elevated Work	
D1 - Fall Protection	
D2 - Rescue Plan	
E – Excavation	
E1 – Competent	
E2 - Slope/shored	
F - Heavy Equipment	
G - Traffic	
G1 – Discussed	
G2 - Spotter	
H - S/T/F	
I - Weather	
I1 - H/C Stress	
J - Rig/Sus. Loads	
J1- Qualified Rigger	
K - Confined Space	
K1 - Rescue Team	
L - Heat/Ignition	
M - Explosion	
N - Fire	
O - Rotating/Moving	
O1 - Exposure	
O2 - Guards	
P - Pinch Points	
Q - Drill Rigs	
R - Water Work	
S - Drum Handling	
T - Noise	
U - High Press. H20	
V - Hand Safety	
V1 - PPE Req.	
V2 - Special tools	
V3 - Add. Precaution	
W - Ergo concerns	
X- What hand tools	
X1- Hand tool insp.	
X2- Power tool insp.	

Checklist B Chemical Hazards				
Category	**Item**	**Subject**	**No**	**Yes (add comments below)**
Chemical Hazards	**A**	Are contaminants present (most recent data)?		
	B	What are the concentration levels?		
	C	Are the contaminants toxic (e.g. carcinogen, mutagen, neurotoxin)?		
	D	Do routes of exposure include inhalation, ingestion, and dermal absorption?		
	E	Are there PPE requirements? If yes, what are the levels of protection? Specify Levels A, B, C, D, or modified D below and describe any specific non-typical requirement.		
	F	Are there air monitoring requirements?		
	G	Is there a potential that respirator use will be required to complete this work?		
	G1	If so, list the names of the individuals who will wear respirators and be prepared to provide documentation of fit tests and medical clearances.		
	H	Are there products to be used in the execution of the work?		
	H1	Are Material Safety Data Sheets available and have they been reviewed?		
	H2	Will chemical addition or treatment be performed?		
	H3	Will the use of any products or materials result in heat generation or off-gassing?		
	I	Will sample preservatives be prepared in the field?		
	J	Is there proximity to Site Chemical Operations? If yes, specify the hazards if exposed to these operations.		
	K	Are area orientations required?		
	L	Are additional permits/notifications required?		

Checklist B Chemical Hazards	
Comments	
Item	
A - Contaminants	
B - Concentration	
C - Toxicity	
D - Exposure Routes	
E - PPE	
F - Air Monitoring	
G - Respirator Use	
G1 - Names, etc.	
H - Work Products	
H1 - MSDS	
H2 - Chemical Add.	
H3 - Off Gassing	
I - Sample preserve	
J- Chem. Operations	
K - Orientation	
L - Permits Required	

Checklist C Other Hazards				
Category	**Item**	**Subject**	**No**	**Yes (add comments below)**
Driving	**A**	Will transportation involve personal, rental or company car? If yes, be specific as to type of car.		
	A1	Are drivers familiar with vehicle to be used (e.g., brakes, mirrors, lights, small vs. large vs. SUV)?		
	A2	Will equipment / cargo be transported in the backs of vehicles being used by the project team?		
	A3	Are directions to the site available?		
	A4	Is the vehicle in good condition, inspection current, and well maintained (tires, windshield wipers and fluid, brakes, etc.)?		
Site Access Req.	**B**	Are there any special security requirements for work at the site (i.e., Homeland Security)?		
	B1	Is Maritime Security Act training required?		
	B2	Are security background checks required for site entry?		
	B3	Is substance abuse testing required?		
	B4	Is local Area Safety Council Training required?		
Project Audits	**C**	What is the audit requirement for this project based on project duration (< or > 2 weeks)? Note: A minimum of 1 audit is required for EVERY project regardless of project length.		☐ Self Audit ☐ Scheduled Audits
	C1	Who will develop the required audit schedule?		
Biological Hazards	D	Are there biological hazards present (e.g., poisonous plants, vectors, wild animals, snakes, ticks, bees)?		
Communications	**E**	Have adequate means of communication been established (cell phones, plant radios, etc.)?		
	E1	Means of communication with facility?		
	E2	Means of communication between field team members?		
	E3	Have cell phone numbers been exchanged as appropriate?		
Buddy System	**F**	If there are circumstances where individuals must work alone?		
	F1	Has a buddy system been developed for the work?		
	F2	Have adequate provisions regarding check in and communication been made to assure individual safety?		
Other Hazards	**G**	Are there any other hazards applicable to the fieldwork being performed?		
Management of Change	**H**	Do all parties understand the importance of and the process to identify and/or manage changing field conditions?		
Unexpected Occurrences	**I**	Do all parties understand the the definition of an Unexpected Occurrence and are they familiar with the expected reporting and investigation process?		

Checklist C **Other Hazards**	
	Comments
Item	
A - Transportation	
A1 - Driver Familiar	
A2 - Cargo	
A3 - Directions.	
A4 - Car Requirements	
B - Security	
B1 - Maritime Act	
B2 - Background Cks	
B3 - Drug Test	
B4 - ASCT Require	
C- Audit Frequency	
C1- Audit Schedule	
D - Bio Hazard	
E- Communications	
E1 - Facility Com.	
E2 - Field Com.	
E3 - Cell phone #s	
F - Alone Worker	
F1- Buddy System	
F2 – Check in policy	
G - Other Hazards	
H - Change Management	
I- Unexpected Occurrence	

Checklist D
Project Security Planning

Note: This section may be omitted if deemed unnecessary by the Project Team

Category	Item	Subject	No	Yes (add comments below)
Project Security Planning	**A**	Is this project located in an area where the personal security of the field team may be a concern? (Refer to current DuPont travel restrictions)		
	A1	Is it necessary to have a stand alone Project Security Plan developed?		
	B	Have project personnel exchanged contact information (phone numbers)?		
	B1	Has Emergency Contact information (back home) been exchanged?		
	C	Have preferred and varied travel routes travel to and from the site/hotel etc. been identified and communicated		
	C1	Have areas to be avoided been identified (seek guidance from regional Security Manager)		

Checklist D
Project Security Planning

Comments

Item	
A -	
A1	
B -	
B1	
C-	
C1	

Checklist E
Non Regulated Process Hazards

Note: This section to be completed if a non-regulated process is involved.

Category	Item	Subject	No	Yes (add comments below)
Non Regulated Process	**A**	Is there an O&M Manual?		
	A1	Does it address requirements such as safety interlock/valve inspection frequency?		
	B	Pipe code and classification		
	B1	Are materials of construction consistent throughout?		
	B2	Are valves and sample ports easily accessible?		
	B3	Are valves and joints adequately supported?		
	C	Electrical classification and codes		
	D	Are there lockout/tagout requirements (electrical, mechanical, hydraulic, and pneumatic)?		

Checklist E
Non Regulated Process Hazards

Comments

Item	
A - O&M manual	
A1 - Valves	
B - Pipes	
B1 - Construction	
B2 - Accessible	
B3 - Supported	
C - Electrical	
D - Lock out/tag out	

Checklist F
Process Safety Hazards

Note: This section **only applies if** the project involves a process that is covered by 29 CFR 1910.119. If so, then a formal Process Hazards Assessment (PHA) must be conducted.

Category	**Item**	**Subject**	**No**	**Yes (add comments below)**
Process Safety Hazards	A	Highly Hazardous Chemicals as determined by 1910.119		
	B	Steam Processes		
	C	High Pressure >3000 psi		
	D	Heat Generation		
	E	Chemical Addition		
	F	Management of Change		

Checklist
Process Safety Hazards

Comments

Item	
A - Hazardous Chem.	
B - Steam	
C - High Pressure	
D - Heat Generation	
E - Chem. addition	
F- Mgmt Change	

Documentation

(These sections are not to be covered during the PSA but are a planning tool to be used by the PD/PM/DSR for project planning & preparation.)

Category	Item	Subject	No	Yes (add comments below)
HASP	A1	Is the HASP current for the scope of work? Provide date and title of HASP in the comments section.		
	A2	Is there a HASP addendum that addresses the scope of work? Provide date, number, and title of Addendum in the comments section.		
	A3	Has a copy of the pertinent document(s) been made available to the project team?		
Scope of Work	B1	Is there a written scope of work for the project? Provide date and title of document.		
	B2	Has a copy of the scope of work been made available to key project members?		
WMP	C1	Is the waste management plan current for said activities? If yes, list date and title of WMP.		
	C2	Has the WMP been reviewed by a member of the WM Network and the field team? If yes, list the names of the individuals.		

Comments

Item	
A1 - HASP Title	
A2 - HASP Add.	
A3 - HASP Received	
B1 - SOW Title	
B2 - SOW Reviewed	
C1 - WMP Title	
C2 - WMP Reviewed	

Variance

Supply justification for not completing geophysical survey in accordance with CRG SHE Procedure for Underground Obstruction.

Justification	
PD Signature	
PM Signature	
Date	

DSR Preparation Checklist

Instructions: To be completed by PM and DSR prior to mobilization as part of the front-end loading process. Note: The DSR is the individual on site who represents DuPont. While the DSR's responsibilities may vary by project, a basic understanding of the following items is required on all projects, regardless of the DSR's project-specific responsibilities (e.g. Site Supervisor, Site Safety Officer, Construction Manager, Sampler).

Check the box (place an X in the Item field) once the item is discussed.	
Item	
	Review project goals and objectives with DSR and how current scope fits in with overall project
	Permit requirements related to the work (e.g. federal, state, local, E&S, plant, internal)
	Technical Specifications/Drawings/Work Plan
	Contract-type (lump sum, unit price, or T&M) and how they relate to field management responsibilities
	Contract administration (responsibility as a "Receiver" in the **B**uy/**R**elease, **R**eceive, **P**ay process, Cost Tracking, Progress Meetings, Meeting Minutes, etc.)
	Health and Safety Plan
	Waste Management Plan
	Fieldwork Documentation Requirements
	Communication 1. Lines of Communication within the Project Team (CRG, plant, contractor, subcontractors) 2. How to address regulatory visits/questions if they arise 3. How to address Community issues/visits/questions if they arise

Together, we have thoroughly reviewed the project related information and requirements listed above for the project:

Site Name	
Project/Task	
Project Manager	
DSR(s)	
Date	

POMPTON LAKES WORKS – DAILY WORK PERMIT

SECTION I – PROJECT INFORMATION

Date:	
Start Time:	
End Time:	

Project Name:	
Work Location:	

Work Description (summary of tasks/equipment)**:**

Level of Protection (If other than "D" or "Modified D", explain)

Project Personnel (including company/affiliation**)**		

SECTION II – SPECIAL PROCEDURES AND PERMITS

	Needed	Completed		Needed	Completed
Excavation Permit	❐	❐	Traffic Control	❐	❐
Confined-Space Entry Permit	❐	❐	Work Over Water	❐	❐
Open Flame Permit	❐	❐	Explosive Materials	❐	❐
Hot Work Permit	❐	❐	Equipment Inspection Checklist	❐	❐
Elevated Work Permit	❐	❐	Radiation, X-Ray, Laser	❐	❐
Lockout/Tagout	❐	❐	Other __________________	❐	❐

SECTION III – APPROVAL

Approved by: ____ Date: ______________________________

SECTION IV – TAILGATE MEETING SUMMARY

Primary Hazards of Concern & Controls

Tailgate Summary: ____

____

____

Are all personnel present for the tailgate meeting? Yes ❐ No ❐

Have all vehicles and equipment been inspected? Yes ❐ No ❐

Has the work area been inspected? Yes ❐ No ❐

Any work area changes that require updates to the JSA/PSA? Yes ❐ No ❐

SSO/DSR Signature: ____ **Date**: ________________

In Case of Emergency: *Contact Security at Front Gate by radio or calling 973-835-1300, and then contact Site Representative.*

JOB SAFETY ANALYSIS

JSA APPROVED: __________

Site H&S Rep.

Hazards	Required PPE	Hazard Control Options/Procedures
❐ Overhead Utilities	❐ Level D w/ Hard Hat	❐ De-Energized Lines; ❐ Insulation blankets; ❐ Wire Spotter; ❐ Marked Work Zone; ❐ Required clearance =______ ft.
❐ Electrical	❐ Level D w/Hard Hat ❐ Electrical Protective Gloves	❐ Lockout/Tagout Procedures; ❐ LO/TO Permit; ❐ Confirm equipment is de-energized;
❐ Underground Utilities	❐ Level D w/Hard Hat	❐ Utility Markouts; ❐ Review As-Builts; ❐ Subsurface Survey; ❐ Dig Permit; ❐ Marked Work Zone; ❐ Required clearance =_____ ft.
❐ Fire Hazard	❐ Level D	❐ Appropriate fire extinguisher on-site; ❐ Fire watch established
❐ Slip, Trip & Falls	❐ Level D	❐ Inspect work area; ❐ Identify/mark hazards; ❐ Electrical/extension cords secured; ❐ Work area free of debris
❐ Hand Hazards	❐ Work gloves ❐ Cut-resistant gloves ❐ Nitrile Gloves ❐ Butyl Rubber Gloves	❐ Evaluate hazard type and select the appropriate gloves; ❐ Inspect and wear appropriate gloves; ❐ Identify sharp edges and objects; ❐ Only use safety blades/knives
❐ Vehicular Traffic	❐ High-visibility clothing/vest ❐ ANSI Reflective clothing	❐ Traffic Barricades; ❐ Police Traffic Control; ❐ Traffic Warning Signs; ❐ Traffic Cones; ❐ Flagman; ❐ Lane Closure
❐ Manual Lifting	❐ Back-Support Belts	❐ Review Proper Lifting Technique; ❐ Back-Support Belts; ❐ Identify objects that require machine lifting; ❐ Identify objects that require 2-man lifting
❐ Noise (>85dBA)	❐ Ear plugs ❐ Ear muffs ❐ Dual Ear Protection	❐ Identify high-noise work areas; ❐ Isolate noise generating equipment/process; ❐ Administrative restrictions on exposure time; ❐ Proper selection and use of hearing protection
❐ Hand & Power Tools	❐ Work gloves ❐ Anti-vibration gloves	❐ Inspect tools for general condition; ❐ Identify PPE for each tool; ❐ Extension cords are GFCI; ❐ All tools have proper guards; ❐ Power tool operators are trained and experienced
❐ Ladders	❐ Level D	❐ Inspect condition before use; ❐ Select appropriate ladder for task; ❐ Ladder is either held or tied off; ❐ Ladder is on stable ground; ❐ ladder is extended at the correct angle;
❐ Scaffolds	❐ Level D	❐ Inspect general condition before use; ❐ Tags in place; ❐ Properly secured; ❐ Toe-boards in place; ❐ Footings adequate
❐ Pinch Points	❐ Level D	❐ Identify pinch points: ____ ____
❐ Heavy Equipment	❐ High-visibility clothing ❐ Level D w/hard hat	❐ Establish communication protocols with operator; ❐ Identify pedestrian walkways/throughways; ❐ Identify equipment work zone
❐ Cranes/Lifting Equipment	❐ High-visibility clothing ❐ Level D w/hard hat	❐ Work zone identified and marked; ❐ Signalman assigned; ❐ Tag lines in use; ❐ Personnel protected from overhead load; ❐ Lifting equipment inspected daily; ❐ Rigging selected by qualified person
❐ Excavations	❐ Level D	❐ Excavation permit; ❐ Excavation designed by qualified engineer; ❐ Properly selected and applied slopping/shoring; ❐ Inspected daily before entering; ❐ Access/Egress in place ❐ Safe Zone established and identified with barricades/signs
❐ Heat Stress	❐ Proper clothing	❐ All workers trained to recognize heat stress symptoms; ❐ Shade available for rest period; ❐ Liquids available for workers; ❐ Heat Stress Monitoring
❐ Cold Stress	❐ Proper clothing	❐ All workers trained to recognize cold stress symptoms; ❐ Shelter available;
❐ Biological Hazards	❐ Level D; ❐ Tyvek coveralls; ❐ Air horn; ☐ Pesticides	❐ Apply pesticides to clothing and person before entering wooded areas; ❐ Sound air-horn on regular schedule; ❐ Maintain radio communication with base; ❐ Perform tick-check at end of field work
❐ Chemicals	❐ Level D; ❐ Level C; ❐ Chemical apron & face shield	❐ Perform a JSA to determine appropriate protective clothing; ❐ Establish Decontamination procedures;
❐ Asbestos or Lead Paint	❐ Level C w/APR	❐ Asbestos or Lead-based paint controls in place; ❐ Exposure monitoring performed; ❐ Presence of asbestos/lead confirmed

Describe Activities to be Performed	List Potential Hazards

ARCADIS

Appendix B

Pompton Lake and Ramapo River – Proposed Statistical Evaluation Approach

Pompton Lake and Ramapo River – Proposed Statistical Evaluation Approach
Pompton Lake Acid Brook Delta Area Project
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

The proposed statistical approach has been developed considering the United States Environmental Protection Agency's (USEPA's) Data Quality Objective (DQO) Process for site investigations. The approach utilizes an abbreviated version of the first five steps of the process as outlined below.

1. State the problem

The concern at the Site is mercury concentrations in sediments (both surface and at depth) in Pompton Lake and the lower Ramapo River channel. As a result of extreme hydrologic events since the last time mercury concentrations in the sediment were characterized (2007), the concentration of mercury may have significantly changed with Pompton Lake and the lower Ramapo River channel.

2. Identify the goals of the study

The primary goal of the study is to:

a. Determine whether use of historic data is acceptable to characterize mercury concentrations by sampling at previously sampled locations to confirm the mercury concentration in sediment is consistent with CSM and/or consistent with patterns observed with potential changes in concentration as a result of erosion/deposition patterns.

3. Identify the information inputs

Available information includes:

a. Mercury concentrations for 169 sediment locations collected from 2003 through 2007 and a handful of locations in 2010 in Areas A and B. The data was generally collected for the upper 6 inches and the lower 6 inches of sediment above either a peat layer or gravelly layer. Where the sediment depth was greater than 2 feet, an additional 6 inch sample was obtained around the mid-depth.

b. Sediment thickness/elevation at the time of sampling for the core locations.

c. Bathymetric survey data collected in 2007 south of the bridge in Oakland down the Ramapo River channel to the dam, 2011 south of Lakeside Avenue Bridge to the start of the lower Ramapo River channel, and 2013 south of Lakeside Avenue Bridge to the dam (excluding Acid Brook Delta).

d. A hydrodynamic model for the study area developed to simulate the extreme high flow event which occurred in August 2011.

e. Sediment grain size data which was obtained from approximately 30 surface sampling locations in 2013. Side scan sonar data within Pompton Lake and the lower Ramapo River channel obtained in 2013.

New data which is scheduled to be available as a result of this study include:

a. 2013 mercury concentrations at 54 of the locations previously sampled in Pompton Lake (42 locations) and the lower Ramapo River (12 locations). Sampling intervals will be consistent with previous sampling efforts same for surface and subsurface intervals, with any mid layer samples archived at this time.

b. 26 new locations in Pompton Lake (8 in areas with decreased surface sediment elevation and 18 in areas with similar to or increased surface sediment elevation based on 2007 and 2011 bathymetric survey comparisons) and 25 new locations in the Lower Ramapo River reach.

4. Define the boundary of the study

The geographic boundaries include the Ramapo River just downstream of Lakeside Avenue Bridge (upstream) to the Pompton Lake Dam (downstream). The previously defined 26-acre remediation area is excluded from this investigation. The bottom depth of sediment of interest for this investigation is the peat layer or the coarse gravel layer underlying finer sediments. Within the boundaries defined above, two specific areas of investigation include Pompton Lake and the lower Ramapo River. Field activities will be conducted during the 2013 field season and data interpretation to begin upon receipt/validation of chemical analysis results.

5. Develop the analytical approach

The following approaches are suggested:

a. Comparison of historic data from select sites to be resampled to the full historic dataset

   i. This will establish the range of values from locations being resampled to the full data set. By design, selection of the locations to be resampled was biased to target locations with elevated mercury levels (in consideration of surrounding data points). Sediment thickness data should also be checked for artifact sampling bias.

   ii. The data comparison could be done on a whole site or by stratification into lake and river channel locations.

   iii. This helps establish the historical population statistics to which new data from resampled sites will later be compared.

   iv. Product possibilities include table of comparative summary statistics and visual graphics (CDF or histogram) to demonstrate the known bias in approach.

b. Comparison for historic (2007) and recent (2013) data at resampled locations

   i. Given that previous locations are to be resampled, a paired analysis relating old to new data should be attempted – although natural near field variability may make meaningful results from the analysis problematic.

      1. A paired t-test (parametric) or Wilcoxon t-test (non-parametric) may be conducted.

2. X-Y plot of 2007 vs. 2013 by location could be generated.

3. Separate analysis of surface and subsurface mercury data.

4. Subsurface data which in most cases would be less disturbed could be used to demonstrate the potential influence of natural variability.

5. Analysis of sediment depth conducted as well.

6. Data analysis could be as whole site or by lake/river.

ii. Although collected from the same general locations, the data could instead be treated as two independent populations (2007 vs. 2013) with a more general t-test (or non-parametric Mann Whitney U or Wilcoxon Rank Sum test) run to see if there are statistically significant changes in the mean value for surface and subsurface mercury concentrations.

1. Again this could be performed on a whole site or lake/River basis

iii. Changes in the concentration (expressed either as absolute or percentile) between the 2007 and 2013 data should be related to change in apparent sediment thickness.

1. The sediment surface elevation increases/decreases could be either numerical value (erosion of 0.40 feet) or used to create categorical variable (erosion vs. deposition).

iv. The thickness changes themselves could also be compared to estimated changes in thickness developed from the bathymetric survey in 2007 and 2013. In Pompton Lake locations with erosion followed by deposition will be noted and potentially segregated.