

Technical Support for the Selection of Additional Sediment Removal Areas Pompton Lake Corrective Action Implementation Pompton Lakes, New Jersey

Overview

This memorandum was prepared as a supplement to the Remedial Action Selection Report/Corrective Measures Study (RASR/CMS; DuPont CRG, 2009) to present the technical support for the selection of additional sediment removal areas in Pompton Lake outside of the 26-acre project area defined in the *2011 Corrective Measures Implementation (CMI) Work Plan* (ARCADIS et al., 2011). The additional sediment removal areas were identified based on a weight-of-evidence evaluation of environmental data collected in 2013 and historical data collected in previous investigations of Pompton Lake. Additional sediment removal areas were selected based on the weight-of-evidence evaluation to be consistent with the Remedial Action Objectives (RAOs) of the Pompton Lake Acid Brook Delta (ABD) Project, as stated in the *2009 Acid Brook Delta Area Remedial Action Selection Report/Corrective Measures Study* (DuPont CRG, 2009):

- Reduce the potential for mercury methylation in the near-shore sediments.
- Reduce the area of exposure of ecological receptors to elevated mercury concentrations in delta sediments.

The following sections summarize the rationale for selecting each area for additional sediment removal. In addition, an evaluation of the overall reduction in mercury exposure that may be associated with the removal of sediment from these areas is presented.

Selection of Additional Sediment Removal Areas

The selection of additional sediment removal areas outside of the 26-acre CMI Work Plan project area was based on a weight-of-evidence evaluation of data collected as part of extensive environmental investigations conducted since the early 1990s. The weight-of-evidence evaluation incorporated data from analytical sediment sampling, bathymetric surveys and hydrodynamic modeling, and datasets collected as part of ecological investigations completed with Pompton Lake, as summarized in the following documents:

- *2013 Pompton Lake Ecological Investigation Report* (URS, 2014)
- *Technical Memorandum: Updated Conceptual Site Model* (ARCADIS et al., 2014)
- *Draft Technical Memorandum: Conceptual Site Model* (ARCADIS et al., 2013)

Based on the weight-of-evidence evaluation, three additional areas outside of the 26-acre CMI Work Plan project area were selected for additional sediment removal to further support the RAOs for sediment in Pompton Lake (Figure 1):

- Expanded ABD Removal Area: Expansion of the 2011 CMI Work Plan removal area.
- Area A: Near-shore area adjacent to the southern extent of the expanded ABD removal area.
- Island Area: Area surrounding the island owned by the Borough of Pompton Lakes in the southern portion of Pompton Lake.

The following sections summarize the rationale for selecting each area for additional sediment removal.

Expanded Acid Brook Delta Removal Area

The expanded ABD removal area includes an extension of the 26-acre CMI Work Plan removal area, as illustrated in Figure 1. Additional sediment removal within the expanded ABD removal area is consistent with the RAOs of reducing the potential for mercury methylation in near-shore sediments and reducing the area of exposure of ecological receptors to elevated mercury concentrations in sediment. The results of investigations within the ABD indicate that the greatest total mercury (THg) and methylmercury (MeHg) concentrations in sediment and surface water are located near the mouth of Acid Brook and generally decrease with increasing distance from Acid Brook (DuPont CRG, 2006; DuPont CRG, 2008). Expansion of the ABD removal limit beyond the 26-acre CMI Work Plan removal limit further reduces the area of potential exposure to elevated sediment mercury concentrations near the ABD.

The expansion of the removal area within the ABD reduces the potential for mercury methylation by further removing THg in sediment in an area that could be potentially favorable for methylation. In general, areas within the ABD are shallow and typically contain greater total organic carbon (TOC) content and acid volatile sulfide (AVS) concentrations, which have been positively correlated with MeHg concentrations in surficial sediments (DuPont CRG, 2006; URS, 2014). Concentrations of MeHg measured in sediment and pore water samples collected from stations located outside of the expanded ABD removal area in the Ramapo River channel were lower and generally consistent with concentrations measured in the remaining portions of Pompton Lake and upstream reference areas. MeHg concentrations in pore water within the expanded ABD removal area were in the lower range of concentrations measured in near-shore stations adjacent to the mouth of Acid Brook (Exponent and ANSP, 2003). However, at several locations within the expanded ABD removal area, the MeHg concentrations measured in pore water and biological tissue samples [larval and adult midge (Chironomidae) tissues] were in the upper range of concentrations measured in areas of Pompton Lake outside of the ABD (URS, 2014). As a result, the additional sediment removal will reduce overall exposure to MeHg in exposure media within the expanded ABD removal area, particularly in larval and adult midge tissue, which will subsequently reduce the potential for MeHg exposure to upper trophic receptors (e.g., fish, spiders, birds, bats) that may forage in this area of Pompton Lake.

Area A

Additional sediment removal will be conducted in Area A, a shallow near-shore area adjacent to the southern extent of the expanded ABD removal area (Figure 1). The results of analytical sampling of sediments conducted in this area in 2007, 2010, and 2013 indicated elevated subsurface (> 2.5 feet) concentrations of THg relative to other areas of Pompton Lake outside of the ABD. In addition, the comparison of bed sediment elevations from bathymetric surveys conducted in 2007 and 2013 indicate the potential for a decrease in bed sediment elevation in the vicinity of Area A during high flow events within the river system (ARCADIS et al., 2014). Given the elevated subsurface THg concentrations in sediment and the potential for a decrease in bed sediment elevation in this area, additional sediment removal will be conducted to reduce the potential for future exposure of subsurface materials that may contain elevated THg concentrations.

Island Area

Sediments in near-shore areas surrounding the island owned by the Borough of Pompton Lakes in the southern portion of Pompton Lake will also be included in the removal action (Figure 1). Sediment removal in this area is consistent with the RAOs of reducing the potential for mercury methylation in

near-shore sediments and reducing the potential area of exposure to elevated concentrations of mercury in sediment.

Data collected as part of the 2013 Ecological Investigation indicated that concentrations of MeHg in exposure media sampled adjacent to the Island Area were slightly elevated relative to other areas of Pompton Lake outside of the ABD (URS, 2014). MeHg concentrations in sediment, pore water, larval and adult midge tissues, and spider tissues, were in the upper range of concentrations measured in Pompton Lake outside of the ABD. These findings indicate that the shallow, near-shore depositional sediments with increased sediment TOC and AVS concentrations that surround the island may be favorable to mercury methylation. The reduction of MeHg concentrations in these matrices will reduce the potential for MeHg exposure to upper trophic receptors (e.g., fish, birds, bats) that may forage in the vicinity of the island. Sediment removal to reduce THg concentrations in potentially favorable conditions for methylation will also reduce the overall area of ecological exposure to elevated mercury concentrations in sediment within Pompton Lake.

Overall Reduction in Methylmercury Exposure Concentrations

As identified in the ecological conceptual site model (ECSM) presented in the 2013 *Ecological Investigation Report*, the primary ecological exposure pathway of concern for mercury is exposure to and bioaccumulation/biomagnification of MeHg into aquatic and riparian food webs associated with Pompton Lake. Consistent with the RAOs, additional sediment removal areas were selected with the goal of reducing overall ecological exposure to MeHg within Pompton Lake outside of the ABD.

An evaluation of data representative of post-remedy exposure conditions indicates that the additional removal of sediment will likely reduce MeHg concentrations within Pompton Lake to exposure concentrations that are consistent with reference areas. Available data from the 2013 Ecological Investigation were analyzed to evaluate the potential reduction in MeHg exposure concentrations following the sediment removal in the three additional areas described in the preceding section. Exposure media selected for the evaluation included abiotic and biotic data from the 2013 Ecological Investigation that could be attributed to a relatively localized exposure area surrounding the sampling point. Select exposure media included sediment, pore water, larval midge tissue, adult midge tissue, and spider tissue; broader ranging receptors evaluated in the 2013 Ecological Investigation, including fish, birds, and mammals were not included in the evaluation due to the greater spatial range of these receptors and the uncertainty in attributing exposure to specific sampling stations.

MeHg analyses of select abiotic and biotic exposure media were evaluated based on the following relevant exposure scenarios for Pompton Lake outside of the ABD:

- Current Conditions: Includes 2013 MeHg analyses for select matrices conducted within Pompton Lake outside of the ABD.
- Post-Remedy Conditions: Includes 2013 MeHg analyses for select matrices from samples collected within the areas where no sediment removal is proposed as part of the corrective action; these results are used to estimate potential exposure concentrations following the completion of sediment removal.
- Reference Conditions: Includes 2013 MeHg analyses for select matrices from samples collected upstream of Pompton Lake; these results are used to represent regional background concentrations representative of exposure concentrations in areas that are not influenced by the Pompton Lake Works.

Table 1. Comparison of geometric mean methylmercury (MeHg) concentrations in select media for exposure scenarios in Pompton Lake outside of the ABD and reference areas.

Exposure Medium	Units	Geometric Mean Methylmercury (MeHg) Concentrations			Conclusion of Paired One-Tailed Statistical Comparisons (Current or Post-Remedy > Reference)
		Pompton Lake Outside of the ABD		Upstream Reference Condition	
		Current Condition	Post-Remedy Condition		
Pore water	ng/L	0.087	0.081	0.074	Current & Post-Remedy \nrightarrow Reference
Bulk sediment	ng/g dw	0.610	0.499	0.347	Current & Post-Remedy \nrightarrow Reference
Larval midge tissue	ng/g ww	3.70	3.66	3.09	Current & Post-Remedy \nrightarrow Reference
Adult midge tissue	ng/g ww	12.1	10.2	8.76	Current & Post-Remedy \nrightarrow Reference
Wolf spider (Lycosidae) tissue	ng/g ww	95.3	67.8	62.6	Post-Remedy \nrightarrow Reference
Long-jawed orb weaver spider (Tetragnathidae) tissue	ng/g ww	68.8	66.3	58.9	Current & Post-Remedy \nrightarrow Reference

Table 1 presents the geometric mean MeHg concentrations for select abiotic and biotic exposure media for the relevant exposure areas defined above. The geometric mean concentration was used as a concentration representative of the central tendency of each dataset because multiple datasets did not follow a normal distribution. MeHg concentrations representing relevant exposure scenarios within Pompton Lake outside of the ABD were statistically compared to MeHg concentrations representing exposure in reference areas. To maximize the power of these comparisons, statistical analyses used one-tailed tests evaluating whether exposure concentrations are significantly greater in the current conditions or post-remedy conditions scenarios when compared to the reference conditions. Paired one-tailed tests between current conditions/post-remedy conditions and reference conditions were conducted using parametric t-tests or non-parametric Mann-Whitney U tests, depending on the underlying distribution of the test datasets. Concentrations in the current or post-remedy conditions exposure scenarios were considered to be significantly greater than reference exposure conditions based on an alpha (α) of 0.05.

The analysis presented in Table 1 indicates that the additional removal of sediment will reduce MeHg concentrations in exposure media attributed to relatively localized exposure areas. Based on one-tailed statistical tests, MeHg concentrations in most exposure media within Pompton Lake outside of the ABD are not considered to be significantly greater than upstream reference concentrations under current conditions; therefore, further reduction of MeHg concentrations in these exposure media would likely strengthen these statistical conclusions. Removal of sediment in the three additional areas results in a further reduction in post-remedy geometric mean MeHg concentrations in each exposure medium. As a result, MeHg concentrations in samples representative of post-remedy conditions are not considered to be significantly greater than upstream reference conditions in any of the select exposure media based on the results of one-tailed statistical tests. The results of the analyses suggest that under post-remedy conditions, MeHg exposure in these select media will be no greater in Pompton Lake when compared to upstream reference areas.

Reduced MeHg concentrations in these select exposure media will reduce overall MeHg exposure to upper trophic receptors (e.g., fish, birds, and bats) that may forage in the vicinity of Pompton Lake. These reductions are consistent with the RAOs of reducing the potential for mercury methylation in near-shore sediments and reducing the area of exposure of ecological receptors to elevated mercury concentrations in sediment (DuPont CRG, 2009).

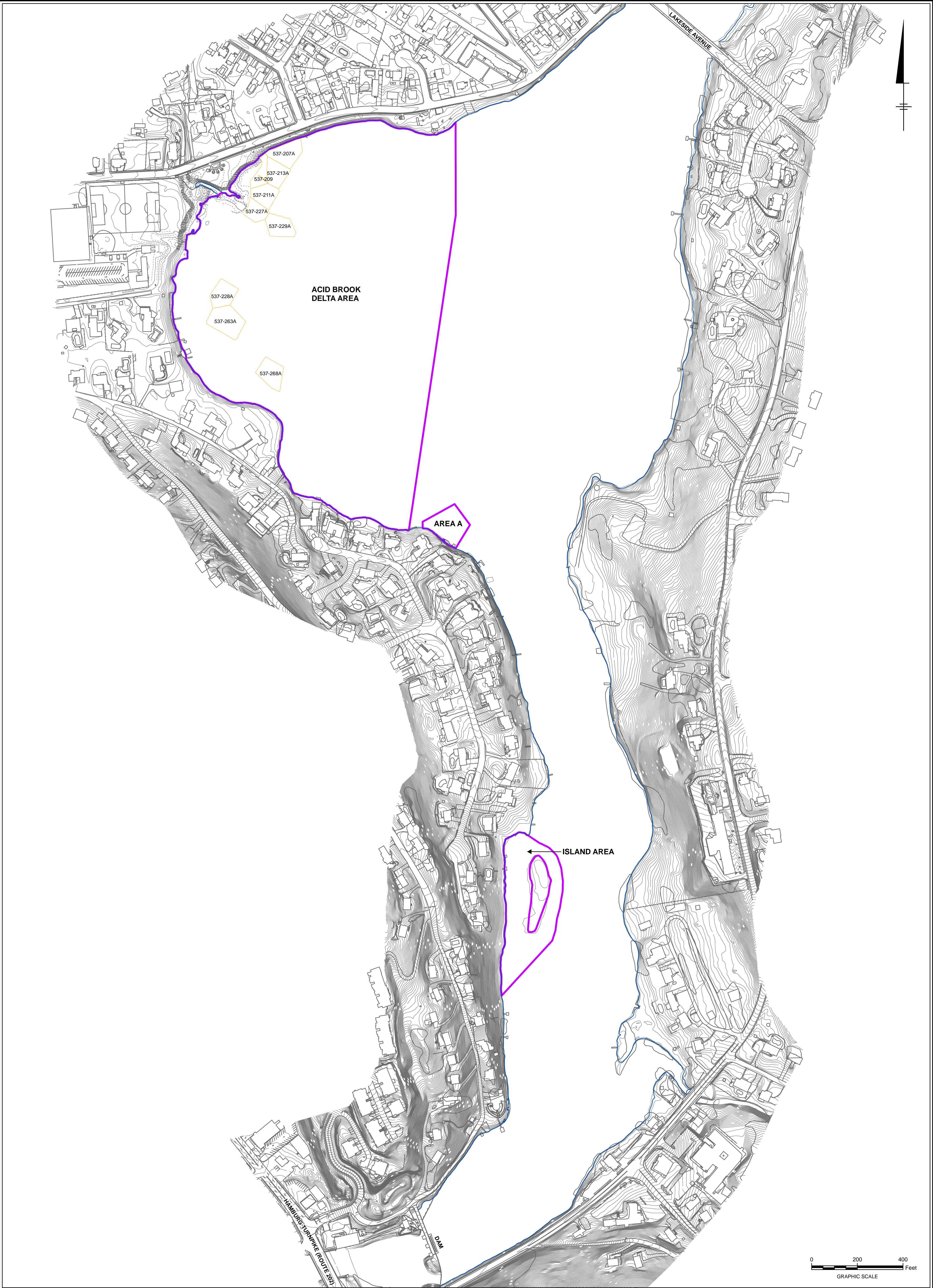
Summary


The results of a weight-of-evidence evaluation incorporating data from analytical sediment sampling, bathymetric surveys and hydrodynamic modeling, and ecological investigation datasets identified three

additional areas for sediment removal to further support the RAOs for sediment in Pompton Lake. In two of the three areas (Expanded ABD Removal Area and Island Area), additional sediment removal will result in an incremental reduction in exposure concentrations and, therefore, a reduction in overall exposure to ecological receptors foraging within Pompton Lake based on current conditions. Sediment will be removed from an additional area (Area A) to reduce the potential of future exposure to elevated mercury concentrations in subsurface sediments in an area with the potential for decreases in sediment bed elevation during high flow events. The incorporation of these additional sediment removal areas into the corrective action further supports the RAOs for Pompton Lake by reducing the potential for mercury methylation in near-shore sediments and reducing the area of exposure of ecological receptors to elevated mercury concentrations in sediment.

References

- ARCADIS, Anchor QEA, LLC, and O'Brien & Gere. 2014. *Technical Memorandum: Updated Conceptual Site Model*. DuPont Pompton Lakes Works. March 2014.
- ARCADIS, O'Brien & Gere, Parsons, and URS. 2013. *Draft Technical Memorandum: Conceptual Site Model*. Pompton Lake Acid Brook Delta Project. DuPont Pompton Lakes Works. June 2013.
- ARCADIS, O'Brien & Gere, Parsons, and URS. 2011. *Pompton Lake Acid Brook Delta Area Revised Corrective Measures Implementation Work Plan*. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey. September 2011.
- DuPont CRG. 2009. *Acid Brook Delta Area Remedial Action Selection Report/Corrective Measures Study*. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey. September 2009.
- DuPont CRG. 2008. *Revised Remedial Investigation Report*. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey. January 2008.
- DuPont CRG. 2006. *Draft Remedial Action Proposal for Acid Brook Delta Sediments*. Pompton Lakes Works, Pompton Lakes, New Jersey. September 2009.
- Exponent and ANSP. 2003. *Revised. Acid Brook Delta Ecological Investigation Phase 2 Reports*. DuPont Pompton Lakes Works, Pompton Lakes, New Jersey. Prepared by Exponent and the Academy of Natural Sciences – Philadelphia. January 2003.
- URS. 2014. *2013 Pompton Lake Ecological Investigation Report*. DuPont Pompton Lakes Works. March 2014.



LEGEND <div>— APPROXIMATE FULL POOL ELEVATION (201.4')</div> <div>..... 0.5-FOOT TOPOGRAPHIC CONTOUR</div> <div>— 1-FOOT TOPOGRAPHIC CONTOUR</div> <div> CORRECTIVE ACTION IMPLEMENTATION AREA</div> <div> AREAS OF TARGETED PEAT REMOVAL</div>	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. HORIZONTAL AND VERTICAL DATUMS ARE BASED ON NAD 83 AND NAVD 88, RESPECTIVELY. 2. THE TOPOGRAPHIC SURVEY IS BASED ON AN UPDATED SURVEY COMPLETED BY URS IN 2011 IN THE AREA NEAR ACID BROOK. 3. FOR THE THIESSEN POLYGONS ASSOCIATED WITH LOCATIONS 537-207A, -209A, -213A, -227A, -228A, -229A, -263A, AND -268A, 6 INCHES OF PEAT IS PROPOSED FOR REMOVAL. FOR THE THIESSEN POLYGON ASSOCIATED WITH LOCATION 537-211A, 12 INCHES OF PEAT IS PROPOSED FOR REMOVAL.	DUPONT POMPTON LAKES WORKS POMPTON LAKES, NEW JERSEY
		CORRECTIVE ACTION IMPLEMENTATION AREAS
		<div></div> <div>FIGURE 1</div>