DRAFT

Honeywell

Onondaga Lake

Monitoring and Maintenance Plan

October 2017

PARSONS

ACKNOWLEDGEMENTS

The Onondaga Lake Monitoring and Maintenance Plan was developed by Parsons for Honeywell with extensive input from multiple organizations. Contributing parties include Anchor QEA, Upstate Freshwater Institute and the State University of New York College of Environmental Science and Forestry.

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APPENDICES

LIST OF ACRONYMS

AMP	Ambient Monitoring Program
BAP	Biological Assessment Profile
BERA	Baseline Ecological Risk Assessment
BSQV	bioaccumulation-based sediment quality value
CCR	Construction Completion Report
cm	centimeters
CPOI	chemical parameters of interest
CQAP	Construction Quality Assurance Plan
DDT	Dichlorodiphenyltrichloroethane
DUSR	Data Usability Summary Report
ECL	Environmental Conservation Law
ESD	Explanation of Significant Differences
ft.	feet / foot
GAC	granular activated carbon
HI	hazard index
HSI	habitat suitability index
ILWD	in-lake waste deposit
IRM	Interim Remedial Measure
MERC	Modified Erosion Resistant Cap
M&M	maintenance and monitoring
mm	millimeter
mg/kg	milligrams per kilogram
MNR	Monitored Natural Recovery
MPC	Modified Protective Cap
ng/L	nanograms per liter
NAPL	non-aqueous phase liquid
NAVFAC	Naval Facilities Engineering Command

LIST OF ACRONYMS (CONTINUED)

NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NYSCC	New York State Canal Corporation
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OCDWEP	Onondaga County Department of Water Environment Protection
OLMM	Onondaga Lake Monitoring and Maintenance
OLMMP	Onondaga Lake Monitoring and Maintenance Plan
OM	Operations and Monitoring
OM&M	Operations, Monitoring and Maintenance
PCB	Polychlorinated Biphenyls
PCDD	Polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PEC	probable effects concentration
PECQ	probable effects concentration quotient
PDI	Pre-Design Investigation
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
SCA	Sediment Consolidation Area
SEC	sediment effects concentrations
SMU	Sediment Management Unit

LIST OF ACRONYMS (CONTINUED)

SOP	standard operating procedures
SU	Syracuse University
SUNY-ESF	State University of New York College of Environmental Science and Forestry
SVOC	Semivolatile Organic Compound
SWQS	Surface Water Quality Standards
TDS	total dissolved solids
TEQs	Toxic Equivalents
TLC	Thin Layer Cap
TOC	total organic carbon
TOGS	Technical and Operations Guidance Series
TWG	Technical Working Group
UFI	Upstate Freshwater Institute
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Service
VOC	Volatile Organic Compound
WB 1-8	Wastebeds 1-8
WBB/HB	Wastebed B/Harbor Brook
WQMMP	Water Quality Management and Monitoring Plan

EXECUTIVE SUMMARY

Honeywell continues the progress toward achieving the goals of the Onondaga Lake Record of Decision (ROD) and the community's vision for a restored Onondaga Lake with the development of this Onondaga Lake Monitoring and Maintenance Plan (OLMMP). The ROD remediation plan, which was selected by the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (USEPA), included a combination of dredging and capping – environmental cleanup standard methods that addressed the contamination in lake sediments and water. Lake dredging was completed in November 2014, a year ahead of schedule. About 2.2 million cubic yards of material were removed from the bottom of the lake. Capping was completed in December 2016. More than 3 million cubic yards of material consisting primarily of sand, activated carbon, and gravel were used to cap 475 acres of the lake bottom, providing a new habitat layer.

The Honeywell team developed and implemented, with oversight by NYSDEC, a remedy design that was approved by NYSDEC and is effective and meets the objectives outlined in the ROD. The design was developed by a team consisting of more than 100 local engineers and scientists working with nationally recognized experts from various universities, research institutions, and specialty engineering firms, NYSDEC, USEPA, and with input from community stakeholders. Similarly, this OLMMP was developed by Parsons for Honeywell with input from many of the same team members, including Anchor QEA, Upstate Freshwater Institute (UFI) and State University of New York College of Environmental Science and Forestry (SUNY ESF) NYSDEC and USEPA.

Restoring diverse, functioning and sustainable habitats to the remediated areas of Onondaga Lake is one of the top priorities of this remedial program. Therefore, habitat considerations are a significant component in the long-term monitoring and maintenance plan for the lake. Habitat restoration is scheduled to be completed in late fall of 2017. Habitat considerations were a major factor in developing cap thicknesses. Dredging areas and depths were also influenced by habitat considerations because post-remediation water depths were developed to achieve specific habitat-based goals. The cap will provide long-term chemical isolation of underlying impacted sediments. It will be resistant to erosive forces such as wind/wave-generated currents, tributary and other inflows, and ice. It will also provide a suitable habitat substrate that plants, animals, and fish can use without impacting the chemical isolation layer.

This OLMMP presents the approach for verifying achievement of the Preliminary Remediation Goals (PRGs) set forth in the ROD. It describes a comprehensive and robust program that will provide the data used to support decision making associated with remedial and restoration[1] goals for Onondaga Lake. The monitoring program will permit the tracking of progress

[1] The term restoration used herein refers to the habitat reestablishment and habitat enhancement activities that will be completed as part of the remedy. Additional restoration activities may be completed separately as part of the Natural Resource Damage Assessment process.

towards, and ultimately verification of, remedy effectiveness in achieving the PRGs and, therefore, the Remedial Action Objectives (RAOs).

The monitoring and maintenance program will be conducted with oversight by NYSDEC within a dynamic framework that allows flexibility in data collection, decision making, and implementation of response actions. The framework includes several components:

- Remedy and habitat reestablishment/enhancement goals and objectives
- Performance / success criteria
- Decision criteria
- Response actions

Within this framework there are independent monitoring elements for significant aspects of the remedy and their associated goals. These elements are:

- SMU 8 Monitored Natural Recovery
- Biota Tissue
- Surface Water
- Cap Maintenance and Monitoring
- Habitat Reestablishment and Biological Response
- Wastebeds 1-8 Shoreline Stabilization Turbidity Monitoring
- Institutional Controls

The multiple monitoring elements are combined in a single plan to facilitate an efficient review and implementation process by maintaining consistency, clarity, and context for each program. Each monitoring element is described in a separate section and associated work plan (as presented as appendices), each of which describe the monitoring objective(s), the criteria for attainment, data collection, the determination of criteria achievement, and options if criteria are not being met. Table ES.1 provides a summary of the schedule for each monitoring element presented in this document.

Results from this monitoring program will be provided to NYSDEC on an annual basis and will be made available to the public. Any approved changes to the monitoring program will be included in addenda to each component-specific work plan. In addition to the information included in annual reports, a comprehensive report will be issued approximately every five years starting in 2019. The comprehensive report will summarize the preceding five years of monitoring data, and will include evaluations of trends over time, which is particularly applicable for components for which changes are more gradual, such as fish tissue concentrations, MNR progress and wetland vegetation restoration. Additional analysis and/or reporting will be included in the five-year comprehensive report, and will be available for the USEPA Five-Year reviews. The first USEPA Five-Year Review occurred in 2015, and concluded "*The OU2 remedy, which includes dredging, capping, habitat restoration, nitrate addition and monitored natural recovery, is expected to be protective of human health and the environment upon completion. In the interim, remedial activities conducted to date are operating as intended to protect human health and the environment.*" The second USEPA Five-Year Review is scheduled to occur in 2020.

SECTION 1

INTRODUCTION

1.1 PURPOSE AND SCOPE

This Onondaga Lake Monitoring and Maintenance Plan (OLMMP) presents the criteria, monitoring program, and decision-making framework for measuring progress towards, and attainment of, the remedial goals set forth in the Record of Decision (ROD; New York State Department of Environmental Conservation [NYSDEC], and United States Environmental Protection Agency [USEPA], 2005). It also incorporates modifications to the remedy as documented in the August 2014 Explanation of Significant Differences (ESD) as well as in design addenda and design revision documents issued during the remedy construction period. Lake dredging was completed in November 2017, a year ahead of schedule. About 2.2 million cubic yards of material was removed from the bottom of the lake. Capping was completed in December 2016. More than 3 million cubic yards of material consisting primarily of sand, activated carbon, and gravel was used to cap 475 acres of the lake bottom, providing a new habitat layer. Habitat restoration is scheduled to be completed in late fall of 2017.

This OLMMP includes seven separate, but related, elements that when combined comprise the Onondaga Lake Monitoring and Maintenance (OLMM) program. The individual monitoring and program elements of the OLMM program that are discussed in this OLMMP include:

- SMU 8 Monitored Natural Recovery (MNR)
- Biota Tissue
- Surface Water
- Cap Maintenance and Monitoring
- Habitat Reestablishment and Biological Response
- Wastebeds 1-8 Shoreline Stabilization Turbidity Monitoring
- Institutional Controls

The OLMM program is one of several monitoring programs associated with the Onondaga Lake remedy. Construction and operations related programs had goals different from those of the OLMM program and are therefore discussed in separate documents, including the Construction Quality Assurance Plan (Parsons and Anchor QEA, 2012a), Water Quality Management and Monitoring Plan (Parsons and Anchor QEA, 2012b), and the Remediation Community Health and Safety Plan (Parsons, 2011). The long-term maintenance and monitoring associated with the sediment consolidation area (SCA) is included in the SCA Post-Closure Care Plan (Parsons and Geosyntec, 2017) and includes inspection, monitoring, maintenance and reporting requirements for the final SCA cover system, stormwater management system, and leachate management system (Attachment 1). Groundwater and environmental monitoring of the SCA (Wastebed 13) is being

done as part of the Wastebeds 9 through 15 closure (O'Brien & Gere, 2014). A summary graphic that depicts the organization for all Honeywell lake-related monitoring programs is provided in Figure 1.1.

Implementation of the remedy for Onondaga Lake was completed in accordance with a Consent Decree (United States District Court, Northern District of New York, 2007; 89-CV-815 between Honeywell and NYSDEC). The remedy for Onondaga Lake is described in the ROD for the Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site. In addition to prescribing the remedy, the ROD also references environmental monitoring to be performed before, during, and following remediation of Onondaga Lake. These monitoring programs will:

- Provide a comprehensive description of baseline chemical and biological conditions and facilitate remedy design
- Evaluate potential effects on the lake during implementation of the remedy
- Evaluate the effectiveness of the remedy in achieving the RAOs and PRGs as well as the long-term integrity of the remedy

The OLMM program discussed in this document was designed to meet the ROD requirement for monitoring referenced in the last bullet. The activities described in the first two bullets either were met by the Pre-Design Investigations and Baseline Monitoring programs (first bullet), or were met by the construction monitoring programs (second bullet).

This OLMMP describes the process for determining the attainment of remedial and restoration goals and the decision framework for implementing response actions. The primary mechanism for linking the remedial goals with the monitoring results and decision making process are the performance and success criteria. These criteria are the outcomes expected to result from the implementation of the remedy. Interpretation of monitoring results with respect to the performance and success criteria supports an efficient decision making process, and allows for targeted maintenance or program enhancements (i.e., response actions), when necessary.

Detailed monitoring work plans are provided as appendices to this document. A Quality Assurance Project Plan (QAPP) or plans that address each component of the monitoring program covered in this document will be submitted separately. In many cases, this document references work plans associated with monitoring activities conducted previously by Honeywell that were part of the approved baseline monitoring and/or pre-design investigation programs. Baseline monitoring associated with program components such as fish tissue and MNR began prior to remedy implementation and continued throughout the remedy construction period, which concluded in 2016. Activities detailed in this plan are associated with the post-construction monitoring.

Results from this monitoring program will be provided to NYSDEC on an annual basis. Any approved changes to the monitoring program will be included in addenda to each component-specific work plan. In addition to the information included in annual reports, a comprehensive report will be issued approximately every five years starting in 2019. The comprehensive report

will summarize the preceding five years of monitoring data, and will include evaluations of trends over time, which is particularly applicable for components for which changes are more gradual, such as fish tissue concentrations, MNR progress and wetland vegetation restoration. Additional information regarding the reporting schedule can be found in Section 10 of this report.

1.2 BACKGROUND

The remedy for the lake, specified in the ROD (NYSDEC and EPA, 2005), included dredging and capping of the most significantly impacted lake sediments combined with monitored natural recovery following remediation of upland sources that affect the lake. The remedy also included a nitrate addition study[2] that was implemented as a three-year pilot test to determine if formation of methylmercury in the hypolimnion of Sediment Management Unit (SMU) 8 could be significantly reduced using this method. Based on the success of the three-year pilot test, nitrate addition is continuing as part of the long-term remedy. Monitoring associated with nitrate addition is summarized in Section 5 (Surface Water Monitoring) and is detailed in the NYSDEC-approved Operation and Monitoring Plan for Nitrate Addition (Parsons and Upstate Freshwater Institute [UFI], 2014). Finally, the remedy included habitat reestablishment in dredged and capped areas of the lake and habitat enhancement in other areas of the lake where habitat stressors have been identified as a concern.

The ROD for Onondaga Lake defines the RAOs for the site. RAOs are identifiable goals to protect human health and the environment. RAOs for Onondaga Lake, per the ROD, are listed below.

- RAO 1: To eliminate or reduce, to the extent practicable, methylation of mercury in the hypolimnion.
- RAO 2: To eliminate or reduce, to the extent practicable, releases of contaminants from the in-lake waste deposit (ILWD) and other littoral areas around the lake.
- RAO 3: To eliminate or reduce, to the extent practicable, releases of mercury from profundal (SMU 8) sediments.
- RAO 4: To be protective of fish and wildlife by eliminating or reducing, to the extent practicable, existing and potential future adverse ecological effects on fish and wildlife resources, and to be protective of human health by eliminating or reducing, to the extent practicable, potential risks to humans.
- RAO 5: To achieve surface water quality standards, to the extent practicable, associated with chemical parameters of interest (CPOIs) (NYSDEC and USEPA, 2005, p. 35).

To achieve the RAOs, PRGs were developed to provide specific goals to address the three primary affected media within the lake: sediment, fish tissue, and surface water. PRGs for Onondaga Lake, as per the ROD, are listed below.

[2] The ROD included a pilot oxygenation study which was subsequently modified to a nitrate addition study based on further evaluation of lake data.

- PRG 1: Achieve applicable and appropriate sediment effects concentrations (SECs) for CPOIs and the bioaccumulation-based sediment quality value (BSQV) of 0.8 milligrams per kilogram (mg/kg) for mercury, to the extent practicable, by reducing, containing, or controlling CPOIs in profundal and littoral sediments.
- PRG 2: Achieve CPOI concentrations in fish tissue that are protective of humans and wildlife that consume fish. This includes a mercury concentration of 0.2 mg/kg in fish tissue (fillets) for protection of human health based on the reasonable maximum exposure scenario and USEPA's methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms of 0.3 mg/kg in fish tissue. This also includes a mercury concentration of 0.14 mg/kg in fish (whole body) for protection of ecological receptors. These values represent the range of fish tissue PRGs.
- PRG 3: Achieve surface water quality standards, to the extent practicable, associated with CPOIs (NYSDEC and USEPA, 2005, p. 35).

Goals for the habitat reestablishment and enhancement components of the remedy specified by the ROD are described in the *Draft Remedial Design Elements for Habitat Restoration* (Parsons, 2012) (also referred to as the lakewide habitat plan which was required by the ROD). The overall goal for the habitat reestablishment and enhancement is to achieve ecological systems that function naturally, are self-sustaining, and are integrated with the surrounding habitats. From this overall goal, three general restoration goals were developed to guide development of the habitat reestablishment and enhancement designs:

- The first general restoration goal is to maintain or improve:
  - size, diversity, and ecological function of wetlands
  - connectivity of the lake habitats with adjacent stream and upland habitats
  - ecological function of the littoral zone
  - ecological function of the shoreline habitat
  - habitat conditions of the profundal zone
  - conserve and/or create habitats for threatened and/or endangered or rare species
- The second restoration goal is to design conditions that discourage the establishment of invasive species, to the extent practicable.
- The third restoration goal is to develop conditions that require minimal maintenance and promote public use of the lake.

Each of the above restoration goals are associated with defined objectives and success criteria that were developed in association with the Habitat Technical Working Group.

Honeywell conducted extensive data collection activities to support design of the selected remedy, which supplement data collected by Honeywell and others for the Remedial Investigation (RI) (TAMS Consultants, 2002) from 1992 to 2002, and provide a baseline dataset for comparison to post-remedy results. In addition to past and ongoing monitoring efforts by Honeywell, other organizations have completed various monitoring efforts within Onondaga Lake in recent years, including Onondaga County Department of Water Environment Protection (OCDWEP), Upstate Freshwater Institute, State University of New York College of Environmental Science and Forestry (SUNY-ESF), Syracuse University (SU), and NYSDEC. The OCDWEP has conducted extensive annual monitoring of both water quality and biological communities in accordance with Onondaga County's requirement to address municipal wastewater discharges to the lake. UFI and SUNY-ESF also have conducted water quality and biological monitoring within Onondaga Lake and its tributaries. Details of these programs as well as United States Geological Service (USGS) activities are provided in the Baseline Monitoring Scoping Document for the Onondaga Lake Bottom Subsite (Parsons, 2008). NYSDEC has conducted annual fish sampling in Onondaga Lake as the primary basis for the New York State Department of Health (NYSDOH) assessment of the state fish consumption advisory. Where appropriate, data from these and other programs can and will be used to supplement the OLMM program data and support the decision-making process.

1.3 OLMMP DOCUMENT ORGANIZATION

- Section 1 is the introduction to this OLMMP, outlining the purpose, scope and organization of the monitoring and maintenance program.
- Section 2 presents the broad framework of the maintenance and monitoring program.
- Section 3 presents the SMU 8 Monitored Natural Recovery monitoring scope.
- Section 4 presents the biota tissue monitoring scope.
- Section 5 presents the surface water monitoring scope.
- Section 6 presents the cap maintenance and monitoring scope.
- Section 7 presents the Habitat Reestablishment and Biological Response monitoring scope.
- Section 8 presents the Wastebeds 1-8 shoreline stabilization turbidity monitoring scope.
- Section 9 presents a summary of Institutional Controls.
- Section 10 presents a summary of the monitoring program organization, schedule and deliverables.
- Section 11 includes references used in creating this OLMMP.
- Appendices A-F present detailed work plans for the various monitoring components.

SECTION 2

MONITORING AND MAINTENANCE PROGRAM OVERVIEW

The overall purpose of the monitoring program is to provide data to support the decision-making process regarding attainment of remedial and restoration goals for the lake. This monitoring will permit both the evaluation of changes that result from remedial action and verification of remedy effectiveness in achieving the RAOs and PRGs, and facilitate maintaining the remedy as designed. The monitoring program for Onondaga Lake has three broad objectives:

- The first program objective is to assess remedy effectiveness through analysis of certain chemical constituents in media (i.e., sediment, fish tissue, and water) and processes that were addressed in the RAOs (e.g., mercury methylation in the hypolimnion).
- The second program objective is to verify the physical condition and chemical isolation effectiveness of the cap. Data collection efforts for this program objective involve routine and event driven monitoring to ensure cap integrity is maintained, as well as chemical sampling to ensure chemical isolation is effective.
- The third program objective is to document the creation of the various targeted habitat types (i.e., habitat modules) and any associated biological responses. This objective will be evaluated through quantitative characterization of planted areas, combined with qualitative characterization of biological responses.

The monitoring will be conducted within a dynamic monitoring framework that allows flexibility in data collection, decision making, and implementation of response actions. The monitoring framework includes several components:

- Remedy and habitat reestablishment/enhancement goals and objectives
- Performance / success criteria
- Decision criteria
- Response actions

These components are commonly found in adaptive management programs used for water resource management (National Research Council [NRC], 2004), natural biological resource management (Lee, 1999), and ecosystem restoration (Thom, 1997). According to the NRC (2004), this type of framework is not a one-size-fits-all process. Instead, each monitoring program contains unique features that are dependent on the type of project, the process for developing the project, and a variety of other factors. Each component of the overall program is described in more detail in separate sections of this document.

2.1 DYNAMIC MONITORING FRAMEWORK

A dynamic monitoring framework provides the structure and processes that allow for adaptability when evaluating monitoring results to determine if the goals of the remediation and habitat reestablishment are being met, and if not, what response actions are most appropriate. A key part of the decision framework is the criteria against which the monitoring data are evaluated or compared to determine if the goals are being met.

2.1.1 Decision Criteria

For the OLMM program, there are two types of decision criteria: "performance" criteria which are used to evaluate the remediation, and "success" criteria that help assess achievement of habitat goals, respectively. Remediation performance criteria are either the numeric (quantitative) values specified for the PRGs in the ROD or narrative and quantitative goals associated with maintaining cap protectiveness. Success criteria are both quantitative and qualitative criteria that will be used to evaluate the habitat reestablishment/enhancement based on the goals and objectives of the Draft Habitat Restoration Plan (Parsons, 2012).

Within the decision making process, no single criterion determines immediate success or failure. Instead, a holistic approach is used so that if some criteria are not being met, a decision is made as to whether or not implementation of available response action(s) is warranted. For the OLMM program, response actions for each respective monitoring component are limited to those actions that will either directly facilitate attainment of criteria, aid determination of whether or not further response is warranted, or facilitate an understanding of why criteria are not being met. Response actions are discussed broadly in Section 2.1.2 and in detail in each section.

Under the dynamic decision making approach, there are three general outcomes for most components, each with a set of broad response alternatives adapted from USEPA (2004) and Naval Facilities Engineering Command (NAVFAC) (2007):

- Criteria[3] have been met.
  - Continue long-term monitoring (cap effectiveness).
  - No further activities necessary (MNR, fish tissue, surface water, and habitat).
- Criteria have not been fully met but show strong signs of being completely or partially met.
  - Continue monitoring to determine if criteria can be achieved without intervention.
  - Utilize trend analysis to estimate the anticipated time frame to reach the goal/criteria (as necessary).
  - Conclude response action(s) will likely result in achievement of one or more criteria and implement appropriate response action(s) and continue monitoring.

[3] For the purposes of the adaptive decision making discussion, the term "criteria" applies to both the "performance criteria" and the "success criteria."

  - Conclude response action(s) would not likely result in further achievement of criteria and terminate further activities.
- If criteria are not met or show only a slight trend toward being met, one or more of the following may occur:
  - Evaluate monitoring data and program design to determine if factors responsible for the observed results can be identified and revise the monitoring program design and/or goals if necessary.
  - Develop and implement appropriate response action(s) and continue monitoring.
  - Conclude available response action(s) would not result in further achievement of criteria and terminate further activities and monitoring.

Outcome "c" would occur in the potential scenario where additional response actions would not result in additional progress towards achieving the remedial goals specified in the ROD. For example, the goal for total dissolved mercury in surface water in Onondaga Lake is 0.7 nanograms per liter (ng/L) or lower, which is the lowest New York State surface water quality standard for the protection of human health due to fish consumption (NYSDEC and USEPA, 2005). However, it should be noted that this standard is exceeded on average in almost every water body in New York (NYSDEC, 2015). Therefore, if the ROD goal is not met, it may be appropriate to conclude that there are no additional response actions that would reduce dissolved mercury concentrations in surface water because background concentrations of regional water bodies with no known source of mercury are higher than the ROD goal. Any future technical impracticability evaluations, if required, would be discussed with and ultimately approved by NYSDEC and would be based on data from background or reference locations approved by NYSDEC. In addition, any proposed modifications to the monitoring program, including proposed termination of any monitoring, would be discussed with and ultimately approved by NYSDEC.

2.1.2 Response Actions

Response actions are activities or alterations that can be implemented if problems or deficiencies are identified. The combination of monitoring data and response actions satisfies the ROD requirement for contingency plans. Available response actions are limited to certain elements of the initial remediation, habitat reestablishment, and/or monitoring activities. Response actions include structural (or physical) activities such as repairing a damaged portion of the cap or planting additional vegetation and removing invasive plant species, or can be programmatic actions such as additional monitoring and/or analysis and modifications to monitoring design or criteria. Modifications to monitoring design could include additional studies outside of the original monitoring scope. The additional monitoring and/or analysis could be used to determine why goals are not being met, or what response actions may be appropriate. Onondaga Lake is a large and complex system so there are many extraneous variables that will likely influence remedy elements. Those elements of the remedy that were designed to be essentially static over time (e.g., chemical isolation layer integrity) generally have targeted structural response actions designed to correct significant issues. Those components that are more variable (e.g., habitat and ecosystem responses)

have response actions designed to provide the greatest opportunity of achieving criteria within the designated monitoring period, with the understanding that they are likely affected by forces outside the control of the remedy team and will fluctuate naturally over the monitoring period. To provide the best opportunity for success, adaptive management practices will be utilized during the monitoring period in coordination with NYSDEC.

SECTION 3

SMU 8 MONITORED NATURAL RECOVERY

The primary natural recovery mechanism operating in SMU 8 surface sediment is burial by incoming cleaner sediments that are continually being deposited from overlying water. Monitored natural recovery for the deep-water zone of Onondaga Lake, as described in the ROD for the lake bottom (NYSDEC and USEPA 2005), was selected as a component of the remedy based on analysis of the extensive long-term datasets available for the lake's deep-water zone and the accepted understanding that mercury strongly sorbs to sediment and is not degradable or substantially solubilized. Monitored natural recovery is projected to achieve the specified sediment remedial goals for the uncapped portions of SMU 8 as well as contribute to the achievement of the mercury BSQV, which is applied on an area-wide basis and includes consideration of SMU 8 and littoral zone capped and uncapped areas. Monitored natural recovery via sediment burial is a remedial method that has been implemented at other sites (Magar et al., 2009).

Substantial monitoring and design evaluation efforts have been completed over several phases of pre-design investigation work to support the effectiveness of MNR for SMU 8. Evaluations included various types of data analyses and mathematical modeling (natural recovery model evaluation described in Appendix M of the Final Design Report [Parsons and Anchor QEA, 2012c]). To support these evaluation efforts, surface sediment samples have been collected and analyzed for mercury at over 100 locations in the deep-water zone of Onondaga Lake. Results of those collection efforts have shown that mercury concentrations in the surface sediment have declined significantly between 1992 and the most recent sampling event in 2014. Sampling has also verified that mercury concentrations in near-surface sediment are substantially lower than mercury concentrations in deeper sediments, in SMU 8. The lower concentrations at shallower sediment depths correspond to recent conditions showing mercury loadings entering the lake are substantially lower than in the past. Surface sediment mercury concentrations measured in 2014 were lower than the concentrations predicted during the design, and sedimentation rates have been greater than the rate assumed in the model. Based on these findings, EPA concluded that natural recovery is progressing faster than predicted and the model used during the design to predict recovery was conservative (USEPA, 2015).

The rate and depth of mixing of relatively clean settling sediments from the water column with the underlying sediments is one of the key processes involved in predicting natural recovery in SMU 8. Mixing of sediments can result from physical processes such as currents driven by wind, and from movement of benthic organisms in the sediment, known as bioturbation. Presence of laminations (also called layering or varves) in sediments has been documented in SMU 8 sediments (see Attachment A of Appendix A), and is a good indication that vertical mixing is limited and that natural recovery is ongoing.

3.1 PERFORMANCE CRITERIA

The performance criteria for MNR based on ROD PRGs are:

- Achieve mercury probable effects concentration (PEC) of 2.2 mg/kg or lower on a point by point basis in the profundal zone within 10 years following the remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone.
- Achieve mercury BSQV of 0.8 mg/kg or lower on an area-wide basis within 10 years following the remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone.

3.2 MONITORING SUMMARY

The monitoring program for MNR in SMU 8 is designed to track the progress of natural recovery and provide data to document ongoing natural recovery. A year-to-year summary schedule has been developed to identify the monitoring and response actions for the MNR component (Table 3.1). The monitoring program will remain consistent with the data collected during 2007, 2008, 2010, and 2011 and will be conducted at regular three-year intervals throughout the monitoring period, which began in 2014 (including the collection of cores from the microbead areas in 2014 and 2015). Performance monitoring will continue for 10 years following the remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone or until performance goals are achieved, as determined by compliance sampling discussed in Subsection 3.3.

Collection and analysis of shallow sediment cores in SMU 8 will continue to be used as the primary method of determining MNR performance criteria attainment. Shallow cores will be collected every three years during the MNR period at the 20 locations sampled in 2014 and two new locations in the profundal zone for compliance with the PEC. Additional locations will be sampled in the profundal and littoral zones during two consecutive compliance sampling events to verify compliance with the BSQV in each of the five designated BSQV areas (Figure 3.1), and throughout the profundal zone for compliance with the PEC, as detailed in Appendix A. These data collection efforts will include analysis of mercury in the surface sediment. Shallow sediment cores will be sectioned into two intervals (0 to 4 cm and 4 to 10 cm) and analyzed for total mercury. Should the compliance depth be revised in the future, refinements of sediment sampling intervals may be needed. Sediment mercury results will be compared to the PEC and BSQV performance criteria noted above.

In addition to the routine PEC and BSQV analyses, the MNR monitoring scope includes an assessment of natural recovery by assessing the nine existing microbead marker plots. Microbead markers were initially deposited at nine 1,400 square foot deep water zone locations in June through July 2009 to assess mixing and sedimentation rates. Sediment core samples were collected at these microbead plot locations in late 2009 and 2010 to confirm microbead presence. Core sample collection from within the microbead plots will be repeated at three-year intervals throughout the monitoring period. Based on multiple years of SMU 8 sediment sampling following

microbead placement, preferred methodologies for monitoring microbeads have been established, reviewed and documented in the approved natural recovery monitoring work plan for 2014 to 2015. Subsequent monitoring events will be carried out consistent with these methodologies. Estimates of both sedimentation rates and mixing depth from microbead work will be used to help inform and adjust the model as appropriate.

MNR as an effective remedial alternative will be evaluated every three years as monitoring results are reviewed. The site-specific natural recovery modeling, as described in Appendix M of the Final Design Report (Parsons and Anchor QEA, 2012c), will be used as necessary throughout the monitoring period to compare results obtained from the monitoring program to the estimated course of natural recovery as indicated by modeling results (Parsons and Anchor QEA, 2012c) as well as the progress needed to reach the remediation goals for mercury PEC and BSQV by the end of the 10-year MNR monitoring period.

3.3 CRITERIA ATTAINMENT DETERMINATION

Sampling to confirm compliance with the mercury PEC and BSQV criteria will consist of two consecutive events. The first compliance sampling event will be subsequent to the event where routine monitoring indicates that performance criteria have been achieved. Compliance sampling may be completed for SMU 8 comprehensively or on an area-specific basis. Two comprehensive compliance sampling events will be completed within one to three years of one another (based on the results of the first event in consultation with NYSDEC), to confirm achievement of the mercury PEC performance criterion and BSQV criterion. If compliance of the PEC and/or BSQV criteria is not achieved in one of the compliance monitoring events, additional compliance events will be performed (for SMU 8 comprehensively or on an area-specific basis) until criteria are achieved in two consecutive events.

The performance criteria for MNR as outlined in Section 3.1 need to be met within the vertical interval of surface sediment that is relevant to potential exposures to benthic organisms intended to be protected within 10 years following remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone. This vertical interval of sediment is referred to herein as a "compliance depth." The compliance depth is the depth of sediment that will be considered in assessing compliance with sediment criteria. This sediment depth will be monitored over the course of the 10-year MNR period following dredging and capping or until performance criteria are achieved. The appropriate compliance depth for the mean PECQ of 1, the mercury PEC and the mercury BSQV in SMU 8 has been conservatively defined as the top 4 cm of sediment, which is consistent with results from the feasibility study (Parsons, 2004) and Appendix M of the Final Design Report (Parsons and Anchor QEA, 2012c). The sediment from 4 cm to 10 cm will also be evaluated in order to provide further data in the event of mixing deeper than the 4 cm compliance depth. An estimate of the depth of mixing will be determined from microbead cores collected during the oxygenated period; the minimum mixing depth is reflected in the depth of the oxygenated zone, typically indicated by light brown sediment. Lack of a brown surface layer will indicate negligible bioturbation. Additional methods, which will be discussed with and approved

by NYSDEC, may also be considered in the future depending on the results from the monitoring discussed above. In the event that oxygen remains in deep waters in the middle of the lake throughout the summertime in future years or factors change such that conditions with oxygen are predicted in advance, or more than 10 percent of the cores indicate a bioturbation depth greater than 4 cm, the appropriateness of the 4 cm, compliance depth will be reassessed at that time as natural recovery continues to be assessed. For example, if, in the future, bioturbation and mixing were determined to extend to sediments below 4 cm in a large area of SMU 8 (e.g., greater than 10 percent of the area), the compliance depth may be reassessed and potentially modified in consultation with, and if approved by, NYSDEC. This may include additional data collection to determine the depth of mixing and the area over which an increased mixing depth is present.

The mean probable effects concentration quotient (PECQ), calculated using chemical concentrations measured within the 0- to 4-cm depth interval, was used in SMU 8 to determine the extent and effectiveness of thin-layer and amended caps in SMU 8 (including the recent design revisions for the modified cap areas in RA-D-1 and RA-C-1). In the event that the compliance depth in SMU 8 is increased to a depth greater than 4 cm in the future, monitoring to deeper depths will be used to assess mean PECQ values in areas of SMU 8 where thin layer or amended caps were not placed as well as for cap monitoring in areas where caps were placed in SMU 8. Should compliance depth be increased, subsequent consideration will be given to the amount of time it could take to comply with the mercury PEC, the mercury BSQV, and the mean PECQ of 1, and/or implementation of response measures, as may be appropriate.

The mercury PEC is based on direct toxicity to sediment-dwelling organisms, and as such, the mercury PEC of 2.2 mg/kg needs to be met at each location. As described in Appendix M of the Final Design Report (Parsons and Anchor QEA, 2012c), the MNR model has been used to simulate mercury concentrations at each sampling point for the duration of the monitoring period, which extends to the year 2027 or until criteria are met. Results of the modeling, which are based on site-specific data, have been and will continue, as necessary, to be compared to the mercury PEC to assess attainment of the performance criteria if monitoring results do not already indicate the PEC is being met. Progress toward attainment of the PEC will be reviewed every three years as new monitoring results become available. Sampling efforts will not be discontinued until data from two consecutive monitoring events, within one to three years of one another (based on the results of the first event in consultation with NYSDEC), confirms achievement of the mercury PEC performance criteria and NYSDEC approves and agrees with these results, as detailed in Appendix A. If the PEC and BSQV criteria are achieved in two consecutive compliance verification events based on data collected from 0- to 4-cm depth interval, a decision will be made in consultation with NYSDEC as to whether monitoring of the depth of mixing would need to continue. Section 3.4 describes actions that may be taken in the event that mercury concentrations do not meet or based on modeling projections are not expected to meet the PEC of 2.2 mg/kg on a point by point basis within the 10 years following remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone.

The mercury BSQV is based on long-term bioaccumulation, so compliance with the mercury BSQV is based on mercury concentrations that are averaged over a large area based primarily on fish mobility. Accordingly, area-weighted average mercury concentrations must meet the mercury BSQV of 0.8 mg/kg within each of five subareas of the lake bottom that together cover the entire surface area of Onondaga Lake. The five lake subareas from north to south are designated as: North Basin, Ninemile Creek Outlet Area, Saddle, South Basin, and South Corner (Figure 3.1). The MNR model has been and will continue to be used, as necessary, to determine whether the area-weighted average mercury concentration within the compliance depth (top 4 cm of sediment in SMU 8 and 6 inches in the littoral zone) for each of the five sub-areas are expected to be below the BSQV of 0.8 mg/kg by the year 2027, within 10 years following remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone.

Progress toward attainment of the BSQV will be reviewed every three years as new monitoring results become available. Attainment of criteria will be determined separately for each of the five subareas, and monitoring in a subarea will be discontinued once attainment has been demonstrated for that area. Sampling efforts will not be discontinued until data from two consecutive compliance monitoring events confirms achievement of the BSQV performance criteria and NYSDEC approves and agrees with these results, as detailed in Appendix A. Monitoring to assess BSQV compliance will also include results from cap monitoring (in the habitat layer) in areas where the cap was placed (as noted in Appendix A) and the cap monitoring compliance for mercury is the PEC of 2.2 mg/kg. In the event that BSQV compliance is attained in a given zone after two comprehensive events but subsequent cap monitoring indicates mercury concentrations exceeding 0.8 mg/kg in the habitat layer, subsequent monitoring in capped and uncapped areas may be needed in that zone to confirm continued BSQV compliance across the entire zone. Section 3.4 describes actions that may be taken in the event that the area-weighted mercury concentrations for each subarea do not meet or are not expected based on modeling projections to meet the BSQV of 0.8 mg/kg within the 10 years following remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone.

3.4 RESPONSE ACTIONS

The approach for implementing natural recovery response actions outlined herein provides for periodically updating the evaluation of progress toward meeting remediation goals for mercury in Onondaga Lake deep-water zone sediment. This approach also provides an assurance that response actions can be implemented at any time in the future if remediation goals are not met or if unexpected results are encountered.

If natural recovery continues to suitably progress toward meeting the performance criteria, little, if any, additional work will be considered and monitoring will continue as scheduled. If remedial goals are not met within 10 years or natural recovery is not suitably progressing toward meeting the performance criteria as projected by the MNR model, including consideration of any changes to the bioturbation mixing depth, possible response actions that could be implemented will be discussed with NYSDEC. Implementation of response actions for MNR in SMU 8 would

be considered in the event that performance criteria are not met or will not likely be met within the 10-year MNR period. To date, natural recovery has been progressing faster than predicted, with no additional work or response actions necessary. MNR response actions that could be implemented, if necessary, are detailed below.

- If results of monitoring indicate that the performance criteria may be met in a reasonable timeframe without intervention, then monitoring will continue.
- If results of the monitoring indicate that the rate of recovery is substantially less than expected, options that may be considered include:
  - Conduct additional analysis and/or modeling of existing data to better understand the range of potential implications and/or to support decision making process regarding implementation of other possible response actions.
  - Collect additional data to help better understand existing results. This may include collection of data that provide insight to the mechanisms contributing to natural recovery such as mixing depth and sedimentation rates. Additional data analyses may also be necessary. These additional data may also be used to update our understanding of such mechanisms in the MNR model.
  - Consider additional procedures for unexpected or unknown events or circumstances (such as large storm events, unusual natural or anthropogenic discharge events, or remedial activities affecting SMU 8). For example, increased sediment trap monitoring could be implemented to determine concentration and mass of incoming material.
  - Finally, if results indicate that performance criteria (mercury PEC and/or mercury BSQV) will not be met within the 10-year MNR period, additional remedial activities, such as thin layer capping, will be evaluated and potentially implemented, as warranted.

3.5 REPORTING

Once sample collection, processing, and laboratory analyses and validation are completed, a data summary report will be prepared and submitted to NYSDEC that describes results from the sampling effort. The annual report will include:

- Description of any deviations from the Work Plan.
- Presentations of data.
- Confirmation that data is consistent with expectations.
- Recommendations for any revisions to the monitoring program and/or response actions, including backup documentation, based on the need for decisions points, or as a result of unexpected data.
- A data usability summary report (DUSR) for the laboratory analyses of mercury and solids content.

SECTION 4

BIOTA TISSUE

This section of the OLMMP describes the rationale and provides a general overview for the post-remediation Fish Tissue Monitoring Program, which is generally consistent with the Baseline Monitoring Program conducted by Honeywell from 2008 through 2011 to document pre-remediation conditions. The baseline monitoring program included sampling media for which PRGs were established in the ROD as well as other biota (e.g., zooplankton, benthics), as needed, which may help facilitate interpretation of the long-term results of the fish tissue monitoring program. Work included collection and chemical analysis of sport fish and prey fish, as well as fish community assessments, fish population surveys, and evaluation of fish diets. Fish collected for tissue analysis included fillet samples of Smallmouth Bass (*Micropterus dolomieu*), Brown Bullhead (*Ameiurus nebulosus*), Walleye (*Sander vitreum*), and Pumpkinseed (*Lepomis gibbosus*), and whole body small prey fish composites from the Minnow (Cyprinidae) [excluding Common Carp (*Cyprinus carpio*) and Goldfish (*Carassius auratus*)], and Killifish (Fundulidae) families. In addition, Alewife (*Alosa pseudoharengus*) less than 180 millimeters (mm) total length were collected and analyzed in some years. Tissue samples were analyzed for total mercury with a subsample analyzed for polychlorinated biphenyls (PCBs), DDT and metabolites, dioxins/furans (PCDD/PCDFs), hexachorobenzene, and lipids in some years. Fifty individuals per adult sport fish species were collected annually in 2008 through 2010; this was lowered to 25 individuals per species in 2011. Forty small prey fish composites were collected each year. Sport fish sampling was also conducted in June 2012 prior to the start of dredging/capping in July 2012 and included three of the four species (excluding Pumpkinseed).

Sampling was also conducted by Honeywell from 2012 (small prey fish only) through 2016 to track conditions during remediation. The adult sport fish monitoring during remediation followed the same basic design as the Baseline Monitoring Program with 25 individuals being collected for each of four species. In 2014, a fifth species, Common Carp, was collected at the request of NYSDEC. In 2015, Brown Bullhead was dropped from the program and replaced by Common Carp. For prey fish monitoring during remediation, 40 small prey fish composites were collected in 2012 and 2013. In 2014, the number of small prey fish composites was decreased to 24 and White Sucker (*Catostomus commersonii*) was added as a representative large prey fish. A summary of the monitoring program data through 2014 is available in USEPA's First Five Year Review Report (USEPA, 2015).

4.1 PERFORMANCE CRITERIA

The performance criteria for fish tissue are based on ROD PRG 2, which is to "achieve CPOI concentrations in fish tissue that are protective of humans and wildlife that consume fish. This includes a mercury concentration of 0.2 mg/kg in fish tissue (fillets) for protection of human health based on the reasonable maximum exposure scenario, and USEPA's methylmercury National

Recommended Water Quality criterion for the protection of human health from the consumption of organisms of 0.3 mg/kg in fish tissue. This also includes a mercury concentration of 0.14 mg/kg in fish (whole body) for protection of ecological receptors. These values represent the range of fish tissue PRGs."

Therefore, the performance criteria are:

- Mercury concentrations in Onondaga Lake sport fish fillet samples that are protective of human health (0.3 and 0.2 mg/kg wet weight)
- Mercury concentrations in Onondaga Lake prey fish whole body samples that are protective of wildlife (0.14 mg/kg wet weight)

These performance criteria will be compared to the fish tissue concentrations collected from the lake by species, with statistical evaluation, and not to individual fish. The results reported will include tables as well as figures of the mean, median, maximum and 95 percent confidence limits. In addition to the above summary statistics, scatterplots of all the collected data, by species, will be presented. It is understood that other metrics may be used by NYSDEC for assessing achievement of the human health and ecological protection RAOs and PRGs and by NYSDOH for relaxation of site-specific fish consumption advisories.

In addition to mercury in fish tissue, the monitoring program will also consider the following contaminants as points of reference for future evaluations of risk reduction for human and wildlife consumers of fish:

- Concentrations of organic compounds documented in Table 7 of the ROD (NYSDEC and USEPA, 2005) including PCBs in sport fish and prey fish, dioxins/furans in sport fish, and DDT + metabolites in prey fish
- Concentrations of hexachlorobenzene in sport fish and prey fish

Data for these organic contaminants and hexachlorobenzene will be reported as described for mercury. Dioxins/furans are analyzed in sport fish (fillet samples) and not prey fish (whole body samples) as this group of contaminants was determined to be a risk driver for human health exposure (fish consumption) and not ecological exposure, and DDT + metabolites are analyzed in prey fish and not sport fish as this group of contaminants was determined to be a risk driver for ecological exposure and not human health exposure. Data from appropriately-sized sport fish fillet samples can be used for assessing ecological exposure (i.e., wildlife consumption of prey fish) by converting from fillet to whole body concentrations utilizing conversion factors developed in the Onondaga Lake Baseline Ecological Risk Assessment (BERA) (i.e., 0.7 for mercury, 2.5 for PCBs, and 2.3 for DDTs and hexachlorobenzene) (TAMS, 2002b). As noted in the First Onondaga Lake Five-Year-Review report, these conversion factors may be reassessed with new data in the future.

Finally, the ROD notes that "The fish tissue PRG (PRG 2) primarily addresses RAO 4, which is to be protective of fish and wildlife by eliminating or reducing, to the extent practicable, existing and potential future adverse ecological effects on fish and wildlife resources and to be protective of human health by eliminating or reducing, to the extent practicable, potential risks to humans. A

result of such a reduction could be that humans may consume fish in accordance with the state's general advisory for eating sport fish..." The state's current general advisory for eating sport fish recommends that an individual can eat up to four (one-half pound) meals per month (which should be spaced out to about a meal a week). Therefore, the data will also be made available to NYSDOH for consideration while setting fish consumption advisories.

4.2 MONITORING SUMMARY

Fish Sampling

Since performance criteria include both human health and ecological exposures, sampling will include both adult sport fish (from a range of legal and/or edible sized fish for human health exposure) and prey fish (for ecological exposure). Monitoring will also include zooplankton sampling. Although there are no remedial goals for zooplankton, analysis of mercury and methylmercury concentrations will provide a measure of changes in potential exposure to fish that eat zooplankton and aid in understanding mercury cycling. Additionally, benthic macroinvertebrates will be collected in SMU 8 in 2017 to establish a baseline condition for this population that can be used as a comparison in the future, if needed.

Smallmouth Bass collected by SUNY ESF from Onondaga Lake during baseline monitoring.

During monitoring, it is important to collect sufficient numbers of fish (within the range of what is feasible) over multiple years due to inter-annual variability. In addition, it is important to sample the same species of fish each year and to include species that represent different trophic levels (e.g., benthivore, piscivore), consistent with USEPA guidance (USEPA, 2008). The species and numbers of samples collected for each sport fish and prey fish species or composite will be consistent with the baseline program, to the extent possible. Sample locations for both adult sport fish and prey fish will be dispersed around the lake consistent with the baseline monitoring program. These locations generally coincide with historical tissue sampling locations from the RI with some modifications to better target the remediated areas.

For sport fish species, a total of 25 individual fish for each of up to four adult sport fish species (including a higher trophic level piscivore and mid-level benthivore) will be collected for a total of up to 100 adult sport fish samples. Samples will be analyzed as NYSDEC standard fillets, consistent with NYSDEC's fish preparation procedures for contaminant analysis (NYSDEC, 2014a). Size ranges similar to those in the baseline monitoring program will be targeted to minimize variability associated with known covariation of tissue mercury concentration and fish

size (Sonesten, 2003). To the extent possible, the range of fish sizes typically consumed by humans will be well represented. The program currently targets Walleye (15 to 23 inches), Smallmouth Bass (12 to 20 inches), Pumpkinseed (6 to 8 inches[4]), and Common Carp (14 to 28 inches) and these species will continue to be sampled unless agreed to otherwise (e.g., if a species become scarce). Any recommended changes to the species and/or sample sizes to be collected in any given year will be discussed with, and approved by, NYSDEC in consultation with NYSDOH, prior to collection.

Biologists use a seine net to collect small prey fish from Onondaga Lake.

For prey fish species, composites of small fish (1 to 7 inches) and individual samples of large fish (7 to 24 inches) will be targeted. Size ranges are intended to be representative of fish sizes typically consumed by ecological receptors. The target species of prey fish for composites will be Banded Killifish, consistent with baseline monitoring, but may vary based on availability at the time of collection. Small prey fish composites, each consisting of a single species, will be comprised of multiple fish per sample, depending on individual weights, consistent with the baseline program. The large prey fish, White Sucker, will be analyzed as individuals on a whole-body basis.

Sampling will occur annually through at least 2020, when the second Five-Year Review is scheduled, in order to provide a seamless transition from baseline monitoring and monitoring during remedy construction. The anticipated scope and schedule for fish sampling through 2020 is presented in Table 4.1. All samples will be analyzed for total mercury. In 2017-2019, PCBs, hexachlorobenzene, dioxins/furans (12 samples/species), lipids and percent moisture will be analyzed in adult sport fish samples and PCBs, hexachlorobenzene, DDT + metabolites, and lipids will be analyzed in prey fish samples. Following the review of 2017-2019 data, the analyses to be conducted in 2020 will be evaluated and discussed with DEC. To minimize frequent lab-to-lab variability issues, Honeywell will use multi-year contracts with analytical laboratories to the extent practicable. Following review of the data annually and at five year intervals as part of the USEPA five-year review process, adjustments to the scope with respect to reduced sampling and analysis will be considered and any changes will be subject to NYSDEC approval, in consultation with NYSDOH.

Prior to submittal for analysis, total length and weight will be measured on each fish (both adult sport and prey fish), and otoliths or scale samples will be collected for age estimation in adult sport fish. Sex of adult sport fish will be determined, if possible, in the analytical laboratory during

4 Effort will be made to collect Pumpkinseed greater than 6 inches; however, if the target number of Pumpkinseed cannot be achieved, Pumpkinseed greater than 5 inches will be targeted.

the filleting process. Additional details regarding the sampling and analysis of fish tissue are provided in Appendix B.

Zooplankton Sampling

Mercury biomagnifies through the aquatic food chain and zooplankton act as an important lower trophic link between concentrations in water, phytoplankton, and fish. Monitoring mercury in zooplankton and *Daphnia*, which are large zooplankton that are important fish prey, may facilitate interpretation of the long-term results of the fish tissue monitoring program. Zooplankton will be collected from a single deep water station and analyzed for total mercury and methylmercury. If *Daphnia* are observed while samples are being collected and sufficient biomass can be collected, then separate *Daphnia* samples will also be submitted for analysis. The need to continue to collect these data will be assessed annually and discussed with NYSDEC. Further details regarding the sampling and analysis of zooplankton are provided in Appendix B.

Scientist from the Upstate Freshwater Institute uses a specialized net to collect zooplankton from Onondaga Lake.

Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates will be collected in SMU 8 in 2017 and analyzed for mercury and methylmercury to document baseline condition of this population that can be used as a point of comparison in the future, if needed. Samples will be collected from a mid-depth station at three SMU 8 locations and composited by location (i.e., three composite samples). The organisms composing the sample will be quantified by taxonomic grouping in the field. Further details regarding the sampling and analysis are provided in Appendix B.

4.3 CRITERIA ATTAINMENT DETERMINATION

Data collected during the fish tissue monitoring program will be used to assess remedy effectiveness by comparing post-remediation fish tissue data to the performance criteria. Mean annual tissue mercury concentrations with statistical evaluation by species will be used to determine when performance criteria have been met or if they are trending towards being met. The ROD estimated that concentrations of contaminants in fish will be reduced within ten years following completion of remedial activities (i.e., by 2026). To account for natural variability, performance criteria will be considered to have been met after multiple years of data indicate attainment. Performance criteria should be met at least three years in a row or four years out of five to verify achievement of goals. Fish monitoring will continue until NYSDEC/USEPA determine that the relevant RAOs and PRGs in the ROD have been achieved. The data will be provided to NYSDOH for consideration in setting fish consumption advisories, as changes to the advisories can denote trends toward meeting the PRG and RAO.

Mercury concentrations in Onondaga Lake are expected to decrease as a result of the remedy. However, it should be noted that according to NYSDEC (2015), "mercury is ubiquitous in New York waters" and that "wide-ranging health advisories limiting the consumption of fish are in place due to elevated levels of mercury in certain fish species" resulting primarily from atmospheric mercury deposition (NYSDEC, 2014b). In the Northeast, over 10,000 lakes, ponds and reservoirs and over 46,000 river miles are listed as impaired for fish consumption (New England Interstate Water Pollution Control Commission¸2007). In addition, all fresh waters in New York State are under a NYSDOH fish consumption advisory due in part to mercury contamination, as well as other factors. Eliminating the advisory is unlikely in the near future.

4.4 RESPONSE ACTIONS

If results indicate that performance criteria have been met, then the monitoring program will be discontinued following consultation with NYSDEC and USEPA. Discontinuation of monitoring may occur earlier for some species than others, depending on criteria attainment. In the event that other elements of the remedy attain their respective performance criteria but tissue concentrations do not, or if downward trends are delayed longer than anticipated, response actions may be implemented, which may include:

- Conduct additional analysis and/or modeling of existing data to better understand the range of potential implications and/or to support the decision-making process regarding implementation of other possible response actions or re-evaluation of tissue program design and goals. For example, tissue contaminant concentration and the size and/or age of individual fish may be evaluated to assess if specific size ranges are limiting attainment of the performance criteria or if younger or smaller fish are on a new trajectory that will likely result in lower tissue concentrations in the future. Additional information to be considered may include water quality data, MNR results, nitrate addition status and results, sediment/cap monitoring data, and background data to determine whether significant further reductions are practicable, with or without further remedial action.
- Collect additional data to help better understand existing results. Additional data may include water column mercury and PCB concentrations, zooplankton and benthic macroinvertebrate mercury concentrations, food web structure, and fish tissue mercury concentrations in other regional lakes approved by NYSDEC. Fish tissue data will also be evaluated in the context of the performance of other elements of the remedy. If, by the end of 2020, any specific advisories (more restrictive than four meals a month), based on mercury, PCBs, and dioxins/furans, within the Onondaga Lake Superfund site are still in effect, NYSDEC in consultation with NYSDOH reserves the right to request additional fish sampling. NYSDEC, in consultation with NYSDOH, will provide Honeywell with its rationale for any such determination at that time.

- Finally, if results are showing that performance criteria are not being met or trending towards being met, then alterations to the sampling program, additional remedial activities or an adaptive management scheme will be evaluated and potentially implemented, as warranted.

If future monitoring results indicate that fish tissue PRGs for mercury are being achieved, but that fish tissue concentrations for bioaccumulative organic contaminants identified in Table 7 of the ROD (i.e., for PCBs, PCDD/Fs, DDT and metabolites) do not fall within the target ranges included in the table, then an evaluation to determine why these target ranges are not being achieved will be conducted. This contingency was noted in USEPA's First Five-Year Review Report for the Onondaga Lake Bottom Site (September 2015).

4.5 REPORTING

Once sample collection and processing and, laboratory analyses and validation are completed, a data summary report will be prepared and submitted to NYSDEC that describes results from the sampling effort. The annual report will include:

- Description of any deviations from the Work Plan
- Presentation of fish data
  - Includes tables as well as figures of the mean, median, maximum and 95 percent confidence limits for each contaminant by species
  - Scatterplots of all the collected data, by species
  - Dioxin/Furan TEQs
- Presentation of other biota data (if collected)
- Confirmation that data are consistent with expectations
- Recommendations for any revisions to the monitoring program, including backup documentation, based on the need for decision points or as a result of unexpected data
- A data usability summary report for the laboratory analyses (including biometrics such as length, weight and percent lipids).

The comprehensive report, as previously discussed in Section 1.1, will present how the annual results compare to the performance criteria and to the data collected during baseline and long-term monitoring. Mercury and bioaccumulative organic contaminant concentrations (expressed as the annual mean and 95 percent upper and lower confidence limits of the mean) for each species will be compared to the performance criteria. In addition, trends in contaminant concentrations will be presented, with adjustment for factors such as location, age, length, and/or lipid content that may vary with concentration. Specifically, length-adjusted mercury concentrations for species that demonstrate a relationship between mercury concentration and length (i.e., Smallmouth Bass and Walleye); lipid-normalized PCB and hexachlorobenzene concentrations; dioxin/furan Toxic Equivalents (TEQs) for each species; and concentrations by sample location for localized species

will be reported. Any proposed changes to the monitoring program, along with justification for those changes, will also be included in the comprehensive reports, as necessary.

SECTION 5

SURFACE WATER

This section of the OLMMP describes the rationale and provides a general overview for surface water monitoring in Onondaga Lake. The monitoring described herein for evaluating attainment of PRG 3 was developed taking into consideration results from prior monitoring activities. Since issuance of the ROD, surface water sampling was conducted by Honeywell in 2005 as part of the Phase I Pre-Design Investigation and from 2008 through 2011 to establish baseline conditions prior to remediation. This included sampling done in 2010 and 2011 to establish baseline conditions as part of the process to develop the water quality sampling program completed to document compliance with criteria during dredging and capping.

Baseline monitoring included sampling media for which preliminary remediation goals were established in the ROD. The surface water component primarily included collection and chemical analysis of surface water from Onondaga Lake during each year of baseline monitoring. Most of the samples were collected from the mid-lake south deep location at various depths (most commonly 2 m, 12 m, 16 m, and 18 m). Additional samples were collected during 2011 in the north basin at the north deep location to demonstrate samples from the south basin are representative of conditions in the northern basin. Samples were collected monthly, biweekly, or weekly with the highest frequency just before and after fall turnover when conditions change rapidly. Samples were analyzed for unfiltered total mercury and methylmercury as well as water quality parameters such as nitrate and sulfide. In addition, many of the surface water samples (collected at 2 m water depth) were analyzed for filtered (dissolved) total mercury for comparison to the NYSDEC surface water quality standard for mercury. Additional surface water baseline collections included sampling at six near-shore fish tissue sampling locations in 2008 (once before and two times following fall turnover) and again in 2010 (once before and once after fall turnover). Analytes included unfiltered total mercury and methylmercury during both the 2008 and 2010 sampling events. In addition, dissolved mercury was also analyzed in samples from three locations during the 2010 sampling events. Water quality monitoring was also completed throughout dredging and capping, in accordance with the procedures and protocols set forth in the Water Quality Management and Monitoring Plan (WQMMP) (Anchor QEA and Parsons, 2012b).

5.1 PERFORMANCE CRITERIA

Mercury is the only CPOI that had surface water concentrations that consistently exceeded applicable standards and guidance values during the RI (ROD pg. 41) as well as subsequent to the RI, and will therefore be included in the remedial goal surface water monitoring. As documented in the USEPA First Five-Year Review (USEPA, 2015), concentrations of dissolved mercury measured in the deep basins (epilimnion and hypolimnion) of the lake have been below the 2.6 ng/L criteria based on protection of wildlife since 2008. Similarly, the criteria of 0.7 ng/L based on human consumption of fish has not been exceeded in the hypolimnion since 2012 and has only

been infrequently exceeded in the epilimnion. Infrequent exceedances of the criteria for certain Volatile Organic Compounds (VOCs) and Semivolatile Organic Compounds (SVOCs) and PCBs have also occurred during and/or subsequent to the RI and therefore sampling and analysis will also be included for VOCs, SVOCs and PCBs. The surface water analyte list and performance standards are shown in Table 5.1. The analyte list includes the CPOIs for which cap performance criteria were developed, excepting those for which there are no applicable NYSDEC surface water criteria. These CPOIs were identified as presenting the greatest potential risk in sediment based on concentration and toxicity considerations and therefore are appropriate for surface water monitoring. The performance criteria for surface water are the NYSDEC surface water quality standards (SWQS; Part 703) and Division of Water technical and operational guidance series ambient water quality standards and guidance values (Technical and Operations Guidance Series [TOGS] 1.1.1) for mercury, VOCs, SVOCs, and PCBs, as detailed below:

- Total dissolved mercury concentrations in Onondaga Lake surface water samples that are protective of wildlife (2.6 ng/L or lower) and of human health via fish consumption (0.7 ng/L or lower).
- VOC and SVOC concentrations in Onondaga Lake water samples that are protective of aquatic life (concentrations are chemical specific) (Table 5.1).
- PCB concentrations in Onondaga Lake surface water samples that are protective of wildlife (0.12 ng/L or lower) and of human health via fish consumption (0.001 ng/L or lower).

Calcite and ionic waste constituents are CPOIs as per the Onondaga Lake ROD. Stressors of concern listed in the ROD include calcium, chloride, salinity, ammonia, nitrite, phosphorus, sulfide, dissolved oxygen and transparency. As noted in the Onondaga County Annual Ambient Monitoring Program (AMP) reports from 2012 through 2015, the high concentration of total dissolved solids (TDS) in Onondaga Lake, which includes concentrations of cations and anions (calcium, chloride, sodium, sulfate, and others), is primarily associated with the natural hydrogeology of the lake and not with anthropogenic effects. The bedrock in Onondaga County is comprised of sedimentary rocks with high concentrations of calcium and sulfate, which contribute to the high TDS levels in Onondaga Lake and its tributaries. The stressors listed in the ROD have been routinely monitored by Onondaga County in the tributaries and deep portions of the lake as part of the AMP (which is reviewed and approved annually by NYSDEC). If the County no longer monitors these parameters in the future, Honeywell and NYSDEC will discuss the need to monitor these parameters under the OLMMP. In addition, Honeywell will review these Onondaga County data on an annual basis and provide a brief summary in its annual reports (unless otherwise directed by NYSDEC in the future).

5.2 MONITORING SUMMARY

Surface water monitoring to assess post-construction compliance with surface water performance criteria will involve sample collection in both littoral and mid-lake locations. Analytes for this monitoring program will include unfiltered and filtered (dissolved) total mercury, unfiltered methylmercury, VOCs, SVOCs and PCBs. Samples will be collected in the epilimnion

at the north deep and south deep locations (mid-lake) and in multiple littoral zone locations, as detailed in Appendix C. The littoral zone sampling locations were selected based on consideration of prior source areas and Interim Remedial Measures (IRMs) along the shore, including the Willis non-aqueous phase liquid (NAPL) recovery area, the Wastebed B/Harbor Brook (WBB/HB) shoreline, the Wastebeds 1-8 (WB 1-8) shoreline, and Ninemile Creek.

Mid-lake sampling for unfiltered and filtered (dissolved) total mercury and unfiltered methylmercury has been conducted annually since 2008 as part of the extensive nitrate addition pilot and subsequent long-term implementation, with details provided in each year's nitrate addition annual data summary report. This sampling utilized methods consistent with the approved baseline and nitrate addition pilot test efforts. Sampling since 2013 has been incorporated into the long-term nitrate addition program, with details provided in a separate approved Operations and Monitoring (OM) Plan for Nitrate Addition (Parsons and UFI, 2014). This sampling will continue throughout the duration of the nitrate addition program.

Specialized gloves and coveralls are utilized by scientists when collecting surface water samples to avoid contamination of the sample.

Littoral and profundal zone samples will be collected after completion of all remedial activities to verify the remedy is effective at maintaining CPOI SWQS in the littoral and profundal zones. Sampling is anticipated to begin in 2017 and will be conducted once prior to and once after fall turnover. During the pre-turnover event, samples will be analyzed for unfiltered and filtered (dissolved) total mercury, unfiltered methylmercury, VOCs, SVOCs and PCBs. Samples collected after turnover will be analyzed for unfiltered and filtered (dissolved) total mercury and unfiltered methylmercury. If VOCs, SVOCs and/or PCBs are detected above the standards during the pre-turnover event, they will also be analyzed during the subsequent post-turnover event. Sampling will continue for a minimum of two years until surface water criteria are achieved, as discussed in Section 5.3. The details for surface water sampling are included in Appendix C and the QAPP.

5.3 CRITERIA ATTAINMENT DETERMINATION

Attainment of unfiltered and filtered (dissolved) total mercury, VOCs, SVOCs and PCB criteria will be achieved when measured values are below surface water quality standards for two consecutive years, including pre- and post-turnover sampling events each year. However, a third year of monitoring may be required to demonstrate compliance depending on the results of the first two years of monitoring. The need for a third year of monitoring will be determined in consultation with NYSDEC. If concentrations remain above water quality standards, surface water monitoring data will be used to assess trends toward attainment (e.g., reduction in filtered total mercury concentration in the upper mixed layer over time). Additionally, mercury and

methylmercury monitoring would continue in accordance with the OM Plan for Nitrate Addition for as long as nitrate addition is used to control mercury methylation (Parsons and UFI, 2014).

Once goals are attained, additional sampling will not be required unless required as a response action related to potential non-attainment of fish tissue criteria, as discussed in Section 4. Surface water criteria for mercury will be considered achieved when all measured dissolved mercury data are below the 0.7 ng/L water quality standard. This standard is exceeded on average in almost every water body in New York (NYSDEC, 2015). Therefore, achievement of the 0.7 ng/L water quality standard for the protection of human health due to fish consumption may not be practicable. Any future technical impracticability evaluations, if required, would be based on discussions with NYSDEC and data from background or reference locations approved by NYSDEC.

5.4 RESPONSE ACTIONS

Surface water data will be reviewed to ensure that sampling is adequate to meet program objectives. The decisions regarding the need for implementation of response actions will be largely driven by trends in compliance with surface water quality standards. If surface water quality standards have not been attained or are not trending towards attainment within five years after completion of the remedy, then monitoring will continue and additional analysis and/or studies will be considered to assess the reason for non-attainment or lack of positive trend toward attainment.

5.5 REPORTING

Once sample collection, processing, laboratory analyses and validation are completed, a data summary report will be prepared and submitted to NYSDEC that describes results from the sampling effort. The annual report will include:

- Description of any deviations from the Work Plan.
- Presentation of data.
- Confirmation that data is consistent with expectations.
- Recommendations for any revisions to the monitoring program and/or response actions, including backup documentation, based on the need for decision points or as a result of unexpected data.
- A data usability summary report for the laboratory analyses.
- A brief summary of Onondaga County data collected to monitor for calcite and ionic waste constituents.

SECTION 6

CAP MAINTENANCE AND MONITORING

This section describes the maintenance and monitoring approach that will be used to verify long-term performance and success of the sediment cap placed within Onondaga Lake, as well as within the adjacent wetlands remediated as part of the lake remediation. These adjacent wetlands include the Wastebed B/Harbor Brook (WBB/HB) Outboard Area, the Ninemile Creek spits, and the Wastebeds 1-8 (WB 1-8) connected wetland.

The sediment cap has been designed to provide long-term chemical isolation with no anticipated cap maintenance or enhancement. The cap includes over 40 different design profiles across the capping area, each of which was developed based on goals and input parameters specific to a given area, including sediment contaminant concentrations, water depth, wave erosive forces, and habitat substrate goals. The design was based on an extensive set of site-specific data. For example, approximately 5,500 sediment porewater samples were collected and analyzed for contaminant concentrations for use in design of the chemical isolation layer. Numerous conservative factors were incorporated into the multi-layer cap design and construction which will contribute to its long-term effectiveness, including:

- Additional cap thickness beyond the design-specified minimum was placed during construction to ensure that the minimum thickness was achieved throughout the cap area. This material over-placement results in increased contaminant sorption and biological decay, and will ultimately lower concentrations throughout the cap and further extend its long-term performance. It also results in additional erosion protection and habitat substrate thickness. For example, in RA-A the total average over-placements for various areas of the cap ranged from approximately 4 to 18 inches. Detailed documentation of the over-placements that resulted during construction are provided in Appendix D.
- Additional granular activated carbon (GAC) beyond the design-specified minimum was incorporated into the chemical isolation layer to ensure the minimum required dose was achieved everywhere. As a result, most areas received significantly more than the required minimum, which results in additional sorption of organic contaminants and increased chemical isolation. Measured in situ GAC application rates typically exceeded the minimum required application rate by approximately 20 to 130 percent. In some areas where the application rate required by the design was lower than the minimum practical application rate for GAC of 0.1 lb./sf, measured in situ GAC application rates exceeded the minimum required by more than an order of magnitude. Detailed documentation of the GAC application rates measured during construction are provided in Appendix D.
- An additional 0.25 ft. of cap material beyond the required minimum thickness was placed to account for mixing of the bottom of the cap with the underlying sediment. This mixing layer was not considered in the design when evaluating chemical isolation. Field observations of cores collected during construction indicated that the mixing thickness was

consistently less than the assumed 0.25 ft.; therefore, this additional thickness allowance will further lower concentrations throughout the cap and extend its long-term performance.

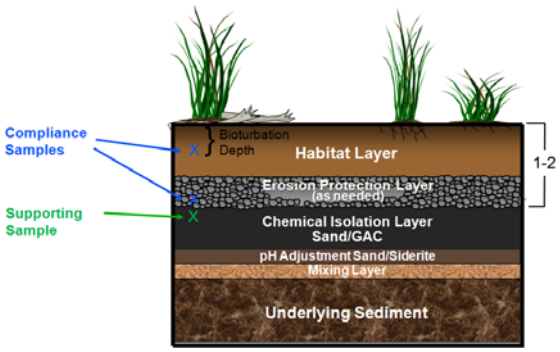
- The chemical isolation layer was designed based on 95th percentile contaminant porewater concentrations to achieve chemical isolation for a minimum of 1,000 years. This is a very conservative design, unmatched by any other cap design in the country.

The below subsections describe the long-term program that will be implemented to confirm that the sediment cap continues to achieve the chemical isolation and other performance criteria specified in the decision and design documents for each capping area. Specifics pertaining to the monitoring program, such as sampling locations and methods, are provided in the detailed Work Plan included as Appendix D. Although the cap design does not rely on maintenance, it may be performed if deemed necessary based on the results of the monitoring described herein.

The Construction Quality Assurance Plan (CQAP) (Parsons and Anchor QEA, 2012) details the construction monitoring activities that were implemented to confirm that the sediment cap has been constructed as designed. This section of the OLMMP describes the long-term monitoring plan for the sediment cap areas beginning after cap construction activities have been completed. The goal of the monitoring plan is to demonstrate that the cap remains physically stable (i.e., does not erode) and remains chemically protective over time. The cap maintenance response actions (if required) are also described in this section.

6.1 CAP DESIGN OVERVIEW

The cap design includes chemical isolation and habitat/erosion protection layers, and varies by cap modeling area and water depth due to varying physical and chemical conditions and habitat objectives, which require specific cap designs to achieve the performance criteria. In many cap areas, a single substrate meets both the habitat and erosion protection requirements. In other areas, the required habitat and erosion protection substrate requirements differ. In these areas, the habitat/erosion protection layer consists of a sub-layer of coarser substrate to meet erosion protection requirements, overlain by a sub-layer of finer substrate to meet habitat requirements. For convenience of reference herein, this layer is referred to as the habitat/erosion protection layer, regardless of whether this layer consists of one or two substrates. Specific details of the cap design within each remediation area are described in the *Onondaga Lake Capping, Dredging, Habitat and Profundal Zone (Sediment Management Unit 8)* Final Design (Parsons and Anchor QEA, 2012d). The design thicknesses and materials for the different cap layers in each RAs A through F, are shown in Figures 6.1 through 6.6.



General Schematic of Sediment Cap.

For a capping project of the scale of Onondaga Lake Remediation, it is not unusual to incur field conditions in minor areas throughout the implementation that may require adjustments to the dredging and capping program. Numerous minor changes to the lake dredging and capping design were developed by Honeywell and approved by NYSDEC during completion of the dredging and capping program. This included, but is not limited, to:

- Revisions to the nearshore capping and dredging design in RA-E in the vicinity of the active rail lines along the southeastern shoreline based on rail line stability considerations (Parsons and Anchor QEA, 2014a).
- Revisions to the dredging and capping design in RA-E at the mouth of Onondaga Creek based on navigational considerations (Parsons and Anchor QEA, 2014b).
- Revisions to the capping design in RA-E in the vicinity of the METRO deep water discharge line to avoid negative impacts to the discharge line (Parsons and Anchor QEA, 2014c).
- Development of Modified Protective Cap (MPC) designs for small areas of sediment movement during cap placement, as well as for other small areas where softer than anticipated sediments were present on relatively steep slopes, based on cap stability considerations. References for each of the MPC area Design Revisions are provided below:
  - MPC RA-B-1 (Parsons and Anchor QEA, 2015a)
  - MPC RA-C-1(Parsons and Anchor QEA, 2016a)
  - MPC RA-C-2 (Parsons and Anchor QEA, 2016b)
  - MPC RA-D-1 (Parsons and Anchor QEA, 2015b)
  - MPC RA-D-2 (Parsons and Anchor QEA, 2016c)
- Minor design revisions based on conditions observed in the field during cap construction or on-going design optimization throughout the construction program, as documented in Field Change Forms.

As-built drawings and related information such as post-construction bathymetry measurements are included as an attachment to Appendix D. This information was used in developing the detailed cap monitoring plan provided in Appendix D and will be used in future interpretation of cap monitoring results. As-built information is included in the Construction Completion Report (CCR) (Parsons and Anchor QEA, 2017).

6.2 LONG-TERM CAP PERFORMANCE CRITERIA

Performance criteria for the cap within Onondaga Lake were developed based on the RAOs presented in the ROD, and consistent with the Final Design. The ROD is also applicable to the WB 1-8 connected wetlands. Performance criteria for the Ninemile Creek spits and Outboard Area wetlands were developed based on the RAOs in the Ninemile Creek OU2 ROD (NYSDEC and USEPA, 2009) and Outboard Area Response Action Document (NYSDEC and USEPA, 2012). The performance criteria are consistent with the Final Design and subsequent revisions

documented in Section 6.1 above, which include design details for all of these areas. The long-term performance criteria for the various cap types are provided below.

6.2.1 Multi-layer Cap per the Final Design

Chemical Isolation Layer

- The long-term chemical isolation layer thickness performance criterion is to maintain a minimum thickness of 0.5 ft. in portions of RAs A and E in water depths from 20 ft. to 30 ft., as shown in Figures 6.1 and 6.5, respectively. In all other multi-layer cap areas within the lake and adjacent wetlands, the long-term chemical isolation layer thickness performance criterion is to maintain a minimum thickness of 1 ft.
- The chemical-specific performance criteria for the lake, Outboard Area, and WB 1-8 connected wetlands is the PEC for each of the 23 contaminants that have been shown to exhibit acute toxicity on a lake-wide basis (see Table 6.1), as well as the NYSDEC sediment screening criteria for benzene, toluene, and phenol.
- The chemical-specific performance criteria for the Ninemile Creek spits is consistent with the criteria set forth in the Ninemile Creek OU-2 ROD. (Additional details are provided in Section 6.3.1.2.)
- The cap has been designed to maintain chemical concentrations below the chemical-specific performance criteria specified above throughout the habitat/erosion protection layer for 1,000 years.
- In addition to the contaminant performance criteria, the cap is designed to maintain a pH less than 8 within the chemical isolation and habitat/erosion protection layers for 1,000 years. There may be short-term exceedances of the pH criteria, as described in Appendix I of the Final Design, as a result of porewater expression due to consolidation of underlying sediments. However, these impacts are expected to be relatively minor and of short duration.

Habitat/Erosion Protection Layer

- As specified above under Chemical Isolation Layer, the chemical isolation performance criterion for the cap is to maintain chemical concentrations below the chemical-specific performance criteria throughout the habitat/erosion protection layer for 1,000 years.
- Within the lake and adjacent wetlands, the design for the habitat/erosion layer included a minimum thickness of 1 ft. in water depths from 7 ft. to 30 ft., 1.5 ft. in water depths from 3 ft. to 7 ft., and 2 ft. in water depths from 0 to 3 ft. and in adjacent wetlands. The long-term habitat/erosion protection layer performance criterion is to maintain a minimum habitat/erosion protection layer thickness of 1 ft. throughout the capped area within the lake and adjacent wetlands. This is consistent with the basis for the cap design modeling, and allows for some movement of the habitat and/or habitat/erosion protection substrate in water depths less than 7 ft.
- The cap within the lake includes a minimum of 1 ft. of material which was designed to be stable even during a 100-year storm event. The cap design within the wetlands includes a

minimum of 0.375 ft. (4.5 inches) of material which was designed to be stable during a 100-year storm event overlain by a minimum of 1.625 ft. (19.5 inches) of topsoil, for a total of 2 ft. Portions of the wetlands are in areas where significant erosion potential exists due to wave action and ice scour. The stability of the topsoil portion of the habitat layer may not be sufficient to resist significant erosional forces in those areas, although establishment of vegetation will significantly improve the long-term substrate stability. This was acknowledged in the Final Design, based on discussions within the Habitat Technical Work Group, which states "*In many areas where the water depths are less than 3 to 4 ft., the upper portion of the habitat layer is finer-grained material containing organic matter, which has a grain size that is smaller than what is required to resist erosive forces. Therefore, this material will move naturally as a result of wind/wave action.*" This was the basis for assuming 1 ft. rather than 2 ft. for the habitat/erosion protection layer thickness for the purposes of chemical isolation modeling in the Final Design. Therefore, maintaining a minimum habitat/erosion protection layer thickness in the lake and wetlands of 1 ft. is appropriate and consistent with the Final Design.

- Within the Ninemile Creek spits, WBB/HB Outboard Area and WB 1-8 connected wetlands, the minimum design thickness of the erosion protection layer underlying the topsoil habitat layer is 0.375 ft. (4.5 inches). Therefore, to ensure a minimum habitat/erosion protection layer thickness of 1 ft. is maintained, the performance criteria will be to maintain a minimum topsoil habitat layer thickness of 0.625 ft. (7.5 inches) in these areas. Habitat success within the wetlands will be determined based on achievement of the habitat success criteria specified in Section 7. Therefore, replacement of habitat substrate may also be considered as a potential response action if habitat success criteria are not met due to loss of material from the habitat/erosion protection layer.
- Topsoil was placed in certain high erosion areas above the lake surface elevation to optimize potential habitat value, while recognizing that this material may be lost due to erosion. As detailed in the Wastebed B/Harbor Brook Outboard Area Wetlands Optimization Design Revision (Parsons and Anchor QEA, 2016d), topsoil was added to the surface of the cobbles followed by seeding/planting along the first 30 ft. of the Outboard Area berms and along the slope up to the barrier wall in areas not protected by the berms. This topsoil will likely be eroded during significant wind/wave events when the lake level is above the 363.3 ft. elevation of the plateaus in front of these areas. Topsoil was not specified in the shoreline design in the east and west naturalized shoreline areas (see Figure 6.4). However, it was added at Honeywell's discretion followed by seeding. These areas are also subject to significant erosional forces. If erosion of the topsoil occurs in any of these areas, it will not be replaced since ongoing erosion would be expected. This topsoil is not part of the cap and thus loss of this topsoil will not impact cap effectiveness.

Details on how cap sample results will be compared to the chemical-specific performance criteria are provided in Section 6.2.3.

6.2.2 Modified Protective Caps (MPCs) and Modified Erosion Resistant Cap (MERC)

MPC designs were developed subsequent to the Final Design in small areas where sediment movement occurred during cap placement, as well as in other small areas where softer than anticipated sediments were present on relatively steep slopes. In these small areas, the modified design and compliance points differ from those listed above. Most of the MPC designs include separate dedicated chemical isolation and habitat/erosion protection layers, although one or both of these layers is less than the 1 ft. minimum discussed above for the multi-layer caps specified in the Final Design. For multi-layer MPCs, the performance criteria will be consistent with those specified above for multi-layer caps, except the long-term thickness performance criteria for each layer will be consistent with the minimum thicknesses specified in the designs for each of these areas, as shown in Figures 6.2 through 6.4.

A subset of the MPCs (approximately 2 percent of the entire capped area) includes areas where underlying soft sediments limited the cap thicknesses such that it was not feasible to construct separate chemical isolation and habitat/erosion protection layers. These areas, which include areas of direct application of GAC with limited sand placement, are referred to as mono-layer caps. The areas specified as direct application of GAC also included sand to facilitate GAC placement. Furthermore, additional sand thickness is present in these areas as a result of capping operations in adjacent areas. For example, a total of six cores were collected from the two areas of direct GAC application in the littoral zone as part of the 2016 Cap Sampling Field Demonstration, and the minimum thickness of sand observed was 5.5 inches.

For mono-layer MPC areas, compliance will be verified based on meeting the PEC for each of the 23 contaminants that have been shown to exhibit acute toxicity on a lake-wide basis (see Table 6.1), as well as the NYSDEC sediment screening criteria for benzene, toluene, and phenol. Compliance will be based on concentrations measured within sample intervals collected from 0 to 0.5 ft., which corresponds to the anticipated bioturbation depth and is the zone of potential exposure for sediment-dwelling organisms. For mono-layer caps, including direct application areas, with a placed thickness less than 0.5 ft., sampling of the top 0.5 ft. may encounter underlying sediments below sand/GAC unless there is relatively rapid mixing of GAC down to 0.5 ft. due to bioturbation and/or deposition of clean sediments above the mono-layer cap. Thus, for these areas, the depth of sampling and compliance for a specific event may be less than 0.5 ft. based on observation of the cap material and overlying sediment thicknesses at that time, as detailed in Appendix D. No sample will be collected if, after multiple sample attempts, the thickness of the mono-layer cap and any overlying accumulated sediment is less than 3 inches thick. Samples will be collected for analysis in these areas during subsequent sampling events after sufficient mixing and deposition have occurred. Details on how cap sample results will be compared to the chemical-specific performance criteria are provided in Section 6.2.3.

6.2.3 Comparison of Sample Results to Cap Performance Criteria

Analytical results from cap material and cap porewater samples collected from the habitat layer will be compared to the cap performance criteria to verify that the cap is performing as expected (or better than expected). The performance criteria for chemicals that are included in the calculation of the mean PECQ are based on cap solid phase concentrations, while the performance criteria for contaminants based on the NYSDEC sediment screening criteria (i.e., benzene, toluene, and phenol) are based on cap porewater concentrations. As detailed below in Section 6.3, cap sampling will include both solid phase and porewater sampling and analysis. Therefore, cap habitat layer and mono-layer cap sampling results will be compared to performance criteria as detailed below:

- Cap solid phase sample results will be compared directly to the solid phase performance criterion for chemicals that are included in the calculation of the mean PECQ
- Cap solid phase sample results for benzene, toluene, and phenol will be compared to the porewater performance criteria that are based on the NYSDEC sediment screening criteria by converting the solid phase concentrations to porewater concentrations based on partitioning calculations using the equilibrium partitioning coefficients used in the Final Design (and listed in Appendix D) and sample-specific fraction organic carbon (f_{oc}) values.
- Cap porewater concentrations will be compared to the solid phase performance criteria for chemicals that are included in the calculation of the mean PECQ by converting the porewater concentrations to solid phase concentrations based on partitioning calculations using the equilibrium partitioning coefficients listed in Appendix D. The f_{oc} values used for calculating solid phase concentrations will be based on the following:
  - For cap areas with fine gravel, coarse gravel, or gravelly cobble in the habitat and/or erosion protection layer (i.e., Zones 2 and 3 as described in Section 6.3) where solid phase samples will not be collected, f_{oc} values consistent with those assumed during the Final Design for cap modeling will be used. The solid phase concentrations will be calculated based on an assumed f_{oc} of 4.56 percent within the 6-inch gravel or cobble bioturbation zone (i.e., upper compliance sample) and an assumed f_{oc} of 0.022 percent at the bottom of the gravel or cobble habitat/erosion protection layer (i.e., lower compliance sample).
  - For mono-layer caps where porewater samples will be collected but the presence of GAC prevents direct measurement of sample-specific f_{oc} values in solid phase samples, the solid phase concentrations will be calculated f using f_{oc} values measured in samples collected from the bioturbation zone as part of the compliance monitoring in adjacent multi-layer caps.
- Cap porewater sample results for benzene, toluene and phenol will be compared directly to the porewater performance criteria that are based on the NYSDEC sediment screening criteria.

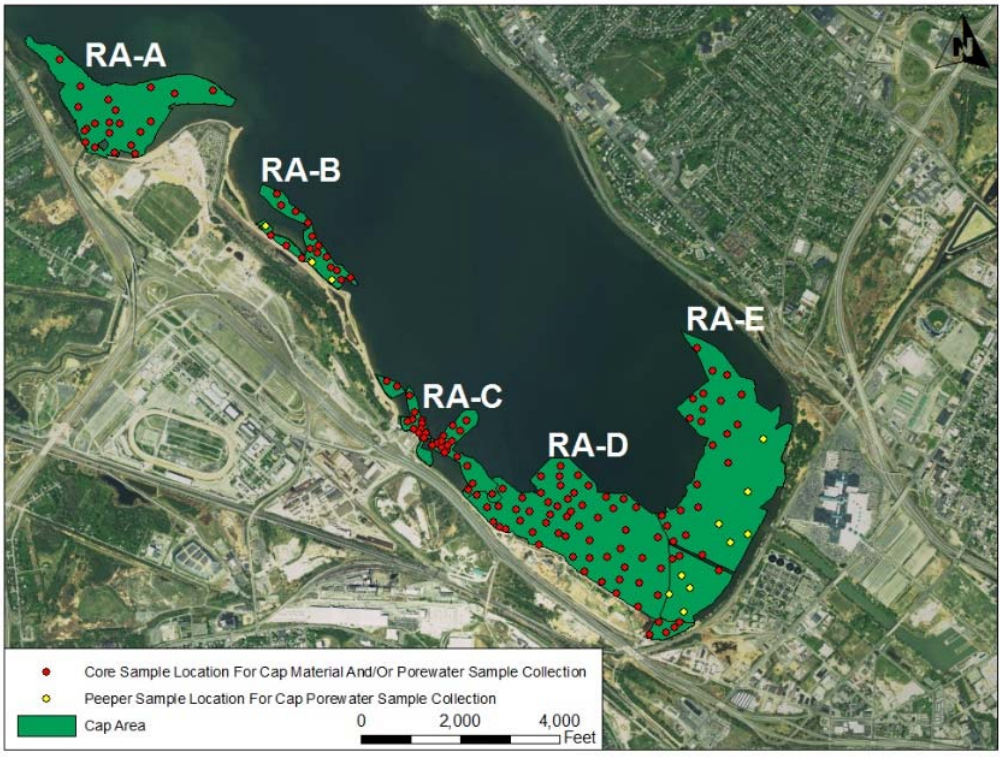
This approach addresses the requirements in the Onondaga Lake ROD and provides for consistency with modeling used to develop protective cap designs in the final design and subsequent design revisions.

6.2.4 Thin Layer Caps in SMU 8

Thin Layer Caps (TLCs) were specified for those portions of SMU 8 that exceeded a mean PECQ of 1. The objective of the TLC is to provide an immediate decrease in surface sediment concentrations by introducing clean substrate. Some of the TLCs were amended to include GAC to improve chemical isolation. Consistent with the design criteria, the long-term performance criteria for amended and un-amended TLCs will be to meet the mean PECQ criterion of 1 and mercury PEC criterion of 2.2 mg/kg within the top 4 cm (approximately 2 inches), which is the compliance depth specified for SMU 8 in the Final Design.

6.3 MONITORING SUMMARY

The sediment cap is designed to provide long-term chemical isolation of contaminants and maintain physical stability while providing a suitable habitat substrate. USEPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (2005) recommends that the physical cap integrity be monitored both routinely and after certain episodic events; therefore, a long-term



Cap Monitoring Sample Locations.

field monitoring program was developed to monitor the effectiveness of the cap in meeting the objectives described in Section 6 which includes the following:

- Routine monitoring of capped areas
- Event-based monitoring of capped areas
- Additional cap monitoring and/or sampling based on the results of routine and event-based monitoring, if appropriate

This section describes the routine, event-based, and additional follow-on monitoring (if warranted) of the sediment caps. Section 6.6 describes response actions or maintenance activities that would be performed if necessary based on the results of the monitoring program.

Long-term monitoring will include both physical and chemical monitoring. Physical monitoring will be conducted to verify that the habitat/erosion protection layer, underlying chemical isolation layer, and mono-layer caps remain in place. Chemical monitoring will be conducted to verify that the chemical isolation layers and mono-layer caps are performing consistent with expectations. Chemical monitoring will include sampling within each of the primary cap modeling areas and will include collection of porewater and cap material samples.

The selection of the physical and chemical monitoring methods used will be influenced by the substrate present in various areas within the habitat and erosion protection layers, which varies from sand or topsoil to cobbles, with the coarser materials occurring closer to shore. Sampling considerations associated with each of the various substrates are detailed below. Figures 6.1 through 6.6 show the different cap designs and delineate the different zones discussed below, inclusive of MPCs.

- Zone 1: Sand – There are no restrictions on coring for thickness verification or sample collection of the cap media or porewater in these areas. As part of the future long-term monitoring program, cap material samples will be collected from the bottom of the bioturbation zone and from the bottom of the habitat/erosion protection layer in these areas and compared to the cap performance criteria. Cap material or porewater samples will also be collected from the underlying chemical isolation layer as an indicator of cap performance. Porewater rather than cap material samples will be collected from the chemical isolation layer and mono-layer caps in areas where GAC is present since the presence of the GAC could interfere with interpretation of bulk chemistry results.

  Although physical samples (cores) will be collected in these areas, it will be very difficult or impossible to differentiate between the habitat/erosion protection and chemical isolation layers because they consist of the same material (sand). Therefore, for purposes of determining sampling intervals, it will be assumed that the habitat/erosion protection layer thickness is equal to the required design minimum and that any cap material beneath this is part of the chemical isolation layer. Cores will be advanced through the full thickness of the cap into the underlying sediment. This information will be used to verify that the full thickness of the cap is present.

- Zone 2: Fine gravel – As part of the quality control sampling during cap construction, it was demonstrated that coring through fine gravel is achievable. However, this material is too coarse to collect a solid sample for laboratory analysis. Based on sampling field demonstrations, porewater samples can be collected from the fine gravel and underlying sand chemical isolation layer in this area through extraction of porewater directly from cores, or by using a peeper (porewater sampling device) that can be pushed through this substrate. Chemical isolation in these areas will be verified based on:
    - Sampling of the porewater from the bottom of the bioturbation zone,
    - Sampling of the porewater from the bottom of the habitat/erosion protection layer,
    - Sampling of the porewater from the underlying chemical isolation layer in GAC-amended caps,
    - Sampling of cap material (via coring) in the underlying chemical isolation layer in unamended caps, and
    - Consideration of sample results in adjacent areas.

  For purposes of determining sampling intervals, it will typically be assumed that the habitat/erosion protection layer thickness is equal to the required design minimum and that any cap material beneath this is part of the chemical isolation layer. This will provide consistency with the sampling in Zones 1 and 3. Physical observation of collected cores will be used to verify the thickness of the various cap layers.
- Zone 3: Coarse gravel or gravely-cobble - This material is too coarse to push a core through in order to determine the cap profile. Therefore, manual probing will be used to verify the presence of coarse gravel- or gravelly cobble-sized armor stone (erosion protection) materials for caps. Probing results, in combination with bathymetric survey results, will be used to evaluate for potential significant changes in habitat/erosion protection layer thicknesses in these areas. Manual probing consists of pushing a steel rod through the water column and into the sediment cap to identify the presence of the hard armor stone. This approach has been used successfully at other sites in New York, including the St. Lawrence River in Massena, New York.

  Based on sampling field demonstrations, a peeper can be pushed through this substrate in order to collect a porewater sample within the habitat/erosion protection layer and underlying chemical isolation layer. For determining the correct intervals for porewater sampling, it will typically be assumed that the habitat/erosion protection layer thickness is consistent with the design minimum, and that any cap material beneath this is part of the chemical isolation layer. The exception to this are the peepers located in RA-B where the habitat/erosion protection layer consists of a minimum of 1 ft. of coarse gravel which meets erosion protection goals overlain by a 1-ft. fine gravel habitat layer. Since the fine gravel is subject to movement and potential loss due to wind/wave energy, it will be assumed for sampling purposes that the habitat/erosion protection layer is 1 ft. Chemical isolation in Zone 3 will be verified based on:
    - Sampling of the porewater from the bottom of the bioturbation zone,
    - Sampling of the porewater from the bottom of the habitat/erosion protection layer,

- Sampling of porewater from the underlying chemical isolation layer,
- Sampling of the cap material (via coring) from the overlying finer habitat substrate in areas where this is part of the cap design, and
- Consideration of sample results in adjacent areas.

In addition, sampling in the areas of coarse substrate will be performed in six dedicated sampling "ports" in RA-D. A sampling port is a rectangular concrete "manhole" riser section that was placed above the chemical isolation layer and filled with a finer-grained material (sand) in place of the larger armor stone. The concrete manhole will protect the finer-grained cap material from erosion. The sampling ports will facilitate collection of core and porewater samples within the habitat/erosion protection and chemical isolation layers for verification of chemical isolation. Sampling port locations are shown in Appendix D figures. Additional sampling port details are provided in the Cap Sampling Port Design Addendum (Parsons and Anchor QEA, 2013) and in Appendix D.

6.3.1 Routine Monitoring of the Sediment Cap

The long-term monitoring of the sediment cap areas will include routine physical and chemical monitoring. Physical monitoring will be performed to verify the presence and stability of the habitat/erosion protection layer and underlying chemical isolation layer and mono-layer caps. Chemical monitoring will be performed to verify that CPOIs are sufficiently isolated from the lake habitat. Routine physical and chemical monitoring during the first 10 years post construction (2017 through 2026) will occur consistent with the schedule shown in Table 6.2, unless otherwise approved by NYSDEC. Discussion pertaining to the physical and chemical monitoring events shown in the schedule is provided in Sections 6.3.1.1 and 6.3.1.2 below.

The physical and chemical monitoring frequency after 2026 will be determined based on the results of prior monitoring events, and will be subject to NYSDEC approval. In addition, the data will be evaluated after each monitoring event to determine if modifications to the monitoring program and/or schedule are warranted. The frequency of routine monitoring will be greater initially and will be reduced over time once the monitoring is able to establish a consistent pattern of cap performance. The monitoring program is intended to be a dynamic monitoring program with the flexibility to be modified based on a review of the results from the monitoring.

The following sections describe the routine monitoring that will be performed in the sediment cap areas. Additional details are provided in the Work Plan included as Appendix D.

6.3.1.1 Routine Physical Monitoring

The routine physical monitoring of the cap shown in Table 6.2 will involve verification that the habitat/erosion protection layer, underlying chemical isolation layer, and mono-layer caps are stable. Routine physical monitoring will be implemented for capped areas in RAs A through F, adjacent wetland areas, and thin layer and amended areas of SMU 8. If the caps show physical stability over time, the frequency of monitoring may be reduced as part of the flexible monitoring program.

The primary purpose of the physical monitoring is to verify that the chemical isolation and habitat/erosion protection layers of the cap and the mono-layer and thin layer caps remain in place. In areas where the sediment cap habitat/erosion protection layer consists of coarse gravel- and cobble-sized material that prevent coring, the monitoring program will consist of verifying the presence of the overlaying habitat/erosion protection layer. Probing results, in combination with bathymetric survey results, will be used to evaluate for potential significant changes in habitat/erosion protection layer thicknesses in these areas. An intact habitat/erosion protection layer will confirm the integrity of the underlying chemical isolation layer. In areas where the cap consists entirely of sand-sized materials or a combination of sand and fine gravel, physical monitoring will include verification, via coring, that the thickness of both the habitat/erosion protection layer and chemical isolation layer is maintained. Methods for sampling in sand and fine gravel areas are discussed in Section 6.3.

The monitoring of the cap will include both bathymetric surveys (including conventional survey methods in shallow areas) as well as coring and/or probing throughout the entire cap area, including thin-layer and amended cap areas in SMU 8. Additional probing is included to focus more intensely on areas of the highest erosion potential (such as in the surf zone areas of the cap, at the mouths of the tributaries, and around utilities). A bathymetric survey will be performed to measure the elevation of the sediment cap. The elevation of the top of the cap collected as part of the monitoring survey will be compared with the previous post-construction survey elevations collected as part of the Quality Assurance/Quality Control (QA/QC) program, or subsequent prior monitoring survey elevations as the monitoring program progresses. The results of the bathymetric survey comparison will be used in conjunction with the probing and cap thickness measurements collected as part of the chemical monitoring coring to determine if additional bathymetric surveying, coring, and/or manual probing is required, as detailed in Section 6.6.

The integrity of the shoreline areas where remedial activities were implemented will also be monitored as part of the long-term cap monitoring program. As shown in Table 6.2, an annual shoreline visual inspection will be completed for the first five years following completion of construction (2017 through 2021). An inspection and photo documentation will be performed by boat and from the shoreline of the shoreline capping areas in RAs A, B, C, D, and E, the Outboard Area (including the berms), the WBs 1-8 connected wetland (including the berms), the Ninemile spits, the WBs 1-8 shoreline stabilization area, and the capped cultural resources located in the shallow areas of RA-E. The inspection and photo documentation will be taken in the spring shortly after ice out in order to identify any impacts due to ice scour. Any signs of potential erosion will be photographed and noted during the inspection. Any other signs of potential impacts to the cap, such as seeps or disturbances, will also be noted. Shoreline conditions within the areas discussed above will also be documented to the extent possible, considering any no-fly restrictions, using aerial photography from a small unmanned aerial system (“drone”). Following the 2017 shoreline inspection and photo documentation, subject to NYSDEC approval, subsequent events may instead consist of drone aerial photography documentation and a shoreline inspection and identification/photo documentation of any noted anomalies in conjunction with NYSDEC.

The specific physical monitoring locations and methods are provided in the detailed monitoring Work Plan included as Appendix D. Alternate methods to verify the physical integrity of the caps (e.g., geophysical methods) may be used, if necessary, subject to approval from NYSDEC as part of dynamic and flexible monitoring program.

6.3.1.2 Routine Chemical Monitoring

The primary purpose of the chemical monitoring is to measure the concentration of CPOIs within the placed cap materials to verify that the performance criteria continue to be met, and are not increasing at a rate greater than expected, and thus confirm the chemical isolation layer is performing consistent with expectations.

Scientists will collect hundreds of sediment cores from the lake cap to verify that it is performing as expected.

The chemical monitoring will include sampling within each of the primary cap modeling areas developed in the design as well as within each MPC area. These modeling areas were developed based on consideration of the most significant parameters impacting the cap design, including porewater contaminant concentrations and groundwater upwelling velocity. Routine comprehensive chemical monitoring will include collection of over 350 samples from over 150 sample locations, as shown in Figure 6.7 and in the detailed sampling plan included in Appendix D. Sample densities for the comprehensive monitoring events range from two to eleven locations in each of the primary cap modeling areas, with higher sampling densities in the MPC areas. Sampling densities take into consideration numerous factors such as cap design, model area size, and contamination levels. Focused chemical monitoring events will include at least 50 percent of the locations of the comprehensive monitoring events except in MPC areas, where no reductions in the number of monitoring locations will occur, unless approved by NYSDEC. The locations of samples in subsequent monitoring events may be modified based on the results from prior monitoring events and will be detailed in addenda to the detailed monitoring Work Plan included as Appendix D.

The chemical monitoring program involves collecting porewater and cap material samples from the cap. Analytical results from samples collected from the habitat/erosion protection layer of multi-layer caps and from the bioturbation zone of mono-layer caps will be compared with the cap performance criteria and porewater-equivalent cap performance criteria, as listed in Table 6.1. These samples are referred to as "compliance samples." The cap habitat/erosion protection layer performance criteria include the PECs for those chemicals that are included in the calculation of the mean PECQ plus the NYSDEC

sediment screening criteria for benzene, toluene, and phenol. Habitat/erosion protection layer concentration measurements below the performance criteria for each chemical will be considered an indication that the cap is effectively isolating chemicals from entering the benthic habitat. In addition to habitat/erosion protection layer sampling, core (cap material) and/or porewater samples collected from the chemical isolation layer will be analyzed as a supporting indicator of cap performance (known as "supporting samples"). An example cap conceptual cross-section depicting compliance and supporting sampling locations is shown in Figure 6.8. Additional details related to compliance and supporting sampling locations for the various cap designs are presented in Appendix D. The specific chemical monitoring locations, analytical parameters, sampling methods, and frequencies are included in the detailed monitoring Work Plan included as Appendix D.

Chemical monitoring will focus on those chemicals, referred to herein as indicator chemicals, which were determined during the design to represent the most significant potential for migration through the cap and which therefore dictated cap design, including GAC application rates. Analysis for indicator chemicals will be completed during each cap chemical monitoring event (i.e., both "comprehensive" and "focused" events). All chemical groups not identified as indicator chemical groups are identified as additional chemical groups and will be analyzed for in the habitat layer to verify long-term compliance. Additional chemical groups will be analyzed for during the first comprehensive monitoring event and each subsequent comprehensive monitoring event unless agreed to otherwise by NYSDEC. The additional chemical groups would not be analyzed during the focused events unless warranted as a response action based on the data from the comprehensive event or other OLMMP monitoring.

Table 6.3 presents the indicator chemicals for chemical monitoring in each cap modeling area, which represent the chemical constituents that dictate the chemical isolation layer design in each area, plus mercury and pH. As an initial design step in the cap modeling process, very conservative screening-level modeling was completed for all contaminants using maximum contaminant porewater concentrations and assuming no biological decay was occurring and no GAC was present. This screening-level modeling was also conservatively based on steady-state conditions rather than the 1,000-year design life assumed for subsequent transient modeling. Contaminants eliminated from further consideration at this stage are much less mobile than other contaminants and/or are present at relatively low concentrations and thus will not migrate significantly within the cap. Contaminants that did not meet cap criteria based on this conservative screening step were then subject to additional transient modeling, resulting in determining the final chemical isolation layer design, including GAC application rate. Table 6.3 includes as indicator chemicals all contaminants that were not eliminated from further consideration during the initial conservative screening-level modeling.

During cap design for RA-A, sediment concentrations in the Ninemile Creek spits were compared to the Ninemile Creek ROD criteria in Attachment 5 to Appendix B of the Final Design. A screening of sample results collected from the Ninemile Creek spits indicated that there are no exceedances of the Ninemile Creek criteria in the spits for hexachlorobenzene, benzo(a)pyrene, total PAHs, or lead. There was one exceedance of the Ninemile Creek ROD criterion for phenol

and two minor exceedances for both arsenic and PCBs. However, elevated VOCs and phenols are present in lake sediments/porewater outboard of the Ninemile Creek spits, and the cap design and supporting model for the Ninemile spits were based on the adjacent cap Model Area A2. VOCs, phenol, and pH will be included as indicator chemicals for the Ninemile Creek spits. Exceedances for the Ninemile Creek mercury criterion of 0.15 mg/kg were present in numerous locations in the spits, therefore long-term cap monitoring of the spits will also include mercury as an indicator chemical.

Cap chemical measurements will be conducted over time to confirm that the cap is chemically protective as designed. Similar to the physical monitoring, the frequency of chemical sampling events (or density of measurements) may be reduced over time if the data indicate consistent and satisfactory cap performance trends.

Data from these monitoring events will be evaluated to identify general patterns and trends of cap performance within all of the remediation areas. If evaluation of monitoring results shows that the cap is not performing consistent with expectations, then additional monitoring and evaluations may be conducted. These details are included in Section 6.6.

6.3.2 Event-based Monitoring of the Sediment Cap

USEPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (2005) recommends that the physical cap integrity be monitored both routinely and after events with certain recurrence intervals. Therefore, in addition to routine monitoring described above, physical monitoring will be performed after extreme events to verify the integrity of the cap. The three extreme event conditions that will be used to trigger a monitoring event are as follows:

- A 50-year or greater wind-generated wave event. The occurrence of a wind-generated wave event of this magnitude may warrant monitoring in certain remediation areas, depending on the wave direction (e.g., from the northwest). Since wave measurements are not collected in Onondaga Lake, wind data reported on an hourly basis from the meteorological station located at Hancock International Airport (located approximately five miles east of Onondaga Lake) will be retrieved from the National Climatic Data Center (NCDC; https://www.ncdc.noaa.gov). These data will be reviewed and analyzed after strong wind events to determine if a 50-year wind event may have occurred in the direction of any of the remediation areas. This analysis will be based on wind speed, assuming that a 50-year wind event corresponds to a 50-year wave event. The monitoring would be performed over the remediation area or areas where the wave events may have the potential to negatively impact the cap. Wave height is determined by longer-term sustained wind speeds, therefore hourly measurements will be used; reported short-term wind gust data will not be used in the analysis.
- A 50-year or greater tributary flow event. During periods of high precipitation and/or snowmelt, the tributaries to the lake can produce erosive forces on the cap at the mouths of the tributaries due to increased flow velocity. Specifically, these are Ninemile Creek, which discharges into RA-A; Harbor Brook, which discharges through the Outboard Area into RAs D and E; and Onondaga Creek, which discharges into RA-E. Flows are measured by

the USGS at each of these tributaries. Daily-averaged flow data will be downloaded from the following websites maintained by USGS:

- USGS 04240300 NINEMILE CREEK AT LAKELAND NY (http://waterdata.usgs.gov/nwis/uv?site_no=04240300)
- USGS 04240010 ONONDAGA CREEK AT SPENCER STREET, SYRACUSE NY (http://waterdata.usgs.gov/nwis/uv?site_no=04240010)
- USGS 04240100 HARBOR BROOK AT SYRACUSE NY (http://waterdata.usgs.gov/nwis/uv?site_no=04240100)

These data will be reviewed and analyzed after significant rainfall runoff or snowmelt events to determine if a 50-year return interval flow event may have occurred. If the 50-year flow event or greater occurs in these tributaries, the cap in the corresponding remediation area that is influenced by the associated flow will be monitored. For Harbor Brook, this will include portions of RA-D, RA-E and Outboard Area.

- A seismic event measuring 5.5 or larger within 30 miles of Onondaga Lake as measured by the USGS and reported on the USGS Seismic Hazard Page (http://earthquake.usgs.gov). While a significant earthquake in Central New York State is not common, a large magnitude occurrence could disrupt the cap stability and potentially damage the integrity of the cap layers. An earthquake could also cause settlement of the armor layer and layer mixing, resulting in lost integrity of the chemical isolation layer. Physical monitoring will determine if any disruption has occurred. After a seismic event has been reported to occur, data on the magnitude and epicenter of the seismic event will be retrieved from the USGS Seismic Hazard Page (http://earthquake.usgs.gov/). These data will be analyzed to determine if the triggering event has occurred.

NYSDEC will be notified within one week of the determination that one of these events has occurred. The wind speeds and directions and tributary flows corresponding to 50-year and 100-year events are provided in Table 6.4a and 6.4b. The event-based monitoring methods will be consistent with those discussed in Section 6.3.1.1. However, the scope of the monitoring will be developed subsequent to the event trigger based on the nature of the trigger and potential impacted cap areas.

If physical monitoring determines that the cap layers were not eroded or disturbed after the occurrence of a 50-year wind-generated wave or flood flow event, then the trigger for future event-based monitoring will be a 100-year return-interval event (the basis of design for erosion protection layer in the Final Design), subject to NYSDEC approval. However, the potential need for an event-based trigger following a second 50-year event will be evaluated in consultation with NYSDEC based on factors such as the intensity and duration of the first 50-year event compared to the second 50-year event.

Identification of specific conditions that would present significant potential for ice scour would be difficult. Therefore, the routine monitoring program includes visual inspection of all shoreline capped areas for evidence of significant ice scour each spring following ice out, as

discussed in Section 6.3.1.1. If significant ice scour is identified within the initial 5-year monitoring period, annual monitoring for ice scour may be extended, to be determined in consultation with NYSDEC.

6.4 CSX SHORELINE MONITORING

Revisions to the nearshore capping and dredging design in RA-E in the vicinity of the active rail lines along the southeastern shoreline were developed based on rail line stability considerations (Parsons and Anchor QEA, 2014a). Three active rail lines are located immediately adjacent to the shoreline in the area south and immediately north of Onondaga Creek. Geotechnical analysis indicated that dredging along the shoreline could result in an unacceptable factor of safety for the shoreline and rail line stability, which could result in movement of the rail lines. Due to the shallow water in this area, placement of a sediment cap without prior dredging would result in loss of lake surface area. Therefore, a dredging and capping off-set from the shoreline was developed along with wave damper structures installed to reduce wave energy within the off-set area (Parsons and Anchor QEA, 2014a). This offset ranges from approximately 130 ft. to 200 ft. from the shoreline, and impacts an area of approximately 10.1 acres (Figure 6.5).

The monitoring program in this area includes baseline surface sediment sampling at approximately the same density as sampled during the pre-design investigation for the full list of mean PECQ parameters plus benzene, toluene and phenol; total organic carbon (TOC); and grain size, and post-remedy surface sediment sampling at/near baseline locations to confirm natural recovery.

Baseline sampling in this area was completed in autumn 2016. Post-remedy sampling will be completed in 2019 and 2024 and the data may be incorporated into the second and third USEPA five-year reviews. If the results from the 2019 event show a significant increase in concentration relative to the 2016 baseline sampling event, an additional event may be necessary before the 2024 sampling event. The need, scope, and timing for subsequent monitoring in this area will be determined based on the results of the 2024 sampling event and in coordination with NYSDEC.

6.5 SHORELINE HYDRAULIC CONTROL SYSTEM MONITORING

As part of the IRMs associated with adjacent contaminated sites, shoreline subsurface barrier walls and/or groundwater collection systems have been installed directly adjacent to several capped areas within the lake and adjacent wetlands. This includes:

- A groundwater collection system which has been implemented as part of the WBs 1-8 IRM and is currently in long-term operation (O'Brien & Gere, 2013).
- Shoreline barrier walls and groundwater collection systems which have been implemented as part of the Willis/Semet and WB B IRMs and are currently in long-term operation (Parsons, 2014).

Successful hydraulic containment by these systems will limit groundwater upwelling velocities in adjacent lake and wetland areas, and therefore is an important factor in ensuring the caps achieve their established performance criteria. Operational and monitoring data from the

hydraulic containment systems will be used to demonstrate that groundwater from the shallow and intermediate zones is being successfully captured, and thus the only potential source of groundwater upwelling through the cap is from the deep zone through the underlying clay layer. This is the design basis used to generate the groundwater upwelling velocities used in the cap modeling for the Final Design. Monitoring, maintenance and reporting details associated with these systems are provided in the applicable IRM documentation. Summaries of the performance of these systems will be included in future cap monitoring reports that document the routine cap monitoring results.

6.6 DECISION FRAMEWORK SUMMARY AND RESPONSE ACTIONS

The purpose of post-construction cap maintenance, if required, is to preserve the long-term permanence and protectiveness of the cap. As discussed in the previous sections, monitoring of the capping areas will primarily involve routine evaluation of the cap's physical and chemical integrity, as well as periodic event-based monitoring in cap areas, if necessary, based on storm or seismic events. The results of the monitoring and subsequent discussions with NYSDEC will determine if a response action is necessary. In the event that the monitoring discussed above identifies areas where the cap is significantly physically compromised or is not performing consistent with performance criteria specified in the ROD, the monitoring data will be further evaluated and additional monitoring will be conducted to help determine whether maintenance activities will be necessary. Potential triggers and response actions for multi-layer caps, mono-layer caps, and thin layer caps are provided below.

As a result of stability considerations based on soft sediments underlying the cap on relatively steep slopes in some areas, specific procedures and limitations on cap thickness and placement methods such as lift thickness, wait times between lift placement, and placement sequencing were developed as part of the Final Design, MPC Design Revisions, and placement operations program. These were developed based on extensive site-specific data and detailed geotechnical evaluations. These same considerations will need to be evaluated in detail as part of any response action that includes placement of additional cap material.

6.6.1 Multi-Layer Caps

6.6.1.1 Physical Monitoring and Maintenance Framework

This section presents the framework for response actions for multi-layer cap areas based on the results of physical monitoring. If the initial physical monitoring data (i.e., bathymetric surveying, probing, and coring results) indicate that the cap armor layer remains intact, as discussed below, maintenance actions will not be required. Given natural hydrodynamic fluctuations, small, localized disturbances to the cap would be expected to "self-heal," meaning they will level over time such that the cap armor material will sustain minor disturbances without requiring maintenance. Potential changes to the physical integrity of the cap will be considered in conjunction with chemical monitoring data and evaluations using as-built information to evaluate whether the cap is functioning as expected. If data collection from either the routine or event-based monitoring show evidence of significant loss of material such that the potential protectiveness of

the cap may be impacted, additional data collection will be initiated. Potential physical monitoring results that would trigger additional data collection and evaluation include:

- A bathymetric survey that, when compared to the prior bathymetric survey, indicates a decrease in cap elevation greater than 0.5 ft. over a contiguous area greater than 5,000 $ft.^2$ that cannot be reliably accounted for based on settlement or loss of finer-grained habitat layer material, to be evaluated in consultation with NYSDEC. Typical repeatability for single beam bathymetry measurements is +/- 0.5 ft. or less, and therefore bathymetry measurements will be able to detect relatively minor changes to the elevation of the cap. Additional cores to provide visual evidence of cap layer thicknesses may be needed in the areas where the bathymetric survey suggests a loss of 0.5 ft. or more. Relevant information that will be considered in interpreting the bathymetry measurement results and determining if, or where, additional data collection is required in the event of a bathymetric cap elevation decrease of 0.5 ft. or more includes:
  - Uniformity of the bathymetry change. For example, uniform bathymetry change over a large area may be more indicative of settlement rather than erosion, while smaller localized areas of bathymetry change may be more indicative of material loss.
  - Results from the probing completed as part of the routine physical monitoring.
  - Results from cap thickness measurements collected as part of the chemical monitoring coring.
  - Anticipated magnitude and rate of settlement of underlying sediment, as documented in the Final Design.
  - Location of bathymetric change versus anticipated high erosional energy areas, such as shallow water locations which are subject to greater wave action, or at the mouths of tributaries or other surface water discharges.
  - Long-term trends based on prior monitoring events.
  - Cap surface substrate. In some areas, the cap includes an upper habitat substrate that is finer than the underlying erosion protection substrate. Some movement of this finer habitat material is anticipated, as documented in the Final Design.
- A core thickness measurement from one or more cores indicating a habitat/erosion protection layer of less than 0.75 ft. or total cap thickness less than 1.75 ft.
- Probing results indicating total loss of the coarse habitat/erosion substrate in any area, regardless of size.

Additional verification and delineation of the affected cap areas will be implemented if any of these conditions occur. Activities may include underwater video surveying, additional bathymetric measurement, geophysical surveying, additional core sampling and/or additional probing.

If significant cap erosion is confirmed by the additional data collection, an evaluation will be completed to determine whether the protectiveness of the cap has been or could be significantly compromised to determine whether additional response actions are required. This evaluation will

include a comprehensive review of all available data considering multiple lines of evidence including spatial and temporal trends in data, rather than isolated data points. The evaluation will include:

- Review prior physical and chemical monitoring data.
- Review information pertaining to the as-built conditions of the cap (e.g., construction verification data).
- Define extent of potential impacts and the significance on cap performance and protection of human health and the environment.
- Determine likely cause(s) of physical changes to cap.
- Evaluate potential for additional cap material losses.
- Evaluate potential impacts of physical response action, such as cap repair, on existing habitat (may be particularly relevant in adjacent wetland areas).
- Determine if further action is required.

There are several factors to consider when evaluating whether changes to the physical integrity of the constructed cap will affect the long-term performance of the cap. In evaluating the physical monitoring data, considerations will be given to:

- Influence of the conservative cap design and cap modeling assumptions serving as the basis of design.
- Cap material type (e.g., sand, gravel, cobble) in habitat and erosion protection layers.
- Cap material over-placement and granular activated carbon (GAC) over-dosage during construction (e.g., as-built information).

The primary factors in determining whether a response action involving physical repair or upgrade of the cap is appropriate are:

- Whether additional significant loss of cap material is anticipated
- Whether the documented loss of material would have a significant impact on the long-term chemical isolation effectiveness of the cap

Chemical isolation design in multi-layer cap areas was based on the assumption that the habitat/erosion protection layer is a minimum of 1 ft. However, the habitat/erosion protection layer design ranged from a minimum of 1 ft. to 2 ft. depending on post-capping water depth. In addition, capping operations resulted in significant overplacement as documented in Appendix D, resulting in placed habitat/erosion protection layers that were thicker than the design minimum in the vast majority of areas. Therefore, loss of up to 1 ft. or more of material in some areas would not impact long-term chemical isolation performance. To further assess the potential implications of theoretical loss of habitat/erosion protection material within the lake, a sensitivity analysis was completed (Appendix D) evaluating the potential impacts on chemical isolation if the minimum thickness of the habitat/erosion protection layer of the multi-layer caps was reduced from 1 ft. to

0.5 ft. The sensitivity analysis considered the potential impacts on the cap minimum design life of 1,000 years based on compliance at the bottom of the habitat/erosion protection layer. Results of this analysis indicate:

- In cap areas in less than 20 ft. of water that did not include GAC (Cap Model Areas A1 and E1), modeling indicates that the design life of 1,000 years based on compliance at the bottom of the habitat layer will be met even if the habitat/erosion protection material on top of the chemical isolation layer is reduced to 0.5 ft.
- In GAC-amended cap areas, cap modeling based on the field-measured (as-built) average GAC doses indicates that the design life of 1,000 years based on compliance at the bottom of the habitat layer will be met even if the habitat/erosion protection material on top of the chemical isolation layer is reduced to 0.5 ft. Cap modeling also indicates that even assuming the GAC application rate is the minimum specified in the design, the chemical isolation design life of the cap exceeds 500 years.

Based on this evaluation, thinning of the habitat/erosion protection layer to 0.5 ft. would not significantly compromise the chemical protectiveness of the cap. Although response actions will be triggered when one or more cores show loss of material (i.e., habitat/erosion protection layer less than 0.75 ft., total cap thickness less than 1.75 ft. or bathymetry measurements indicate a decrease in cap elevation greater than 0.5 ft.), the purpose of this sensitivity analysis was to demonstrate that from a chemical isolation standpoint, the cap would remain protective in the remaining top 0.5 ft. bioturbation zone even in the event of a loss of some habitat/erosion protection layer. Any specific response actions would depend on location, observations of the physical integrity of the cap, and other factors such as those noted above. If, after consideration of the design and as-built cap details, it is determined that the loss of capping material in a particular area may have significantly compromised the protectiveness of the cap, additional response actions will be considered. Appropriate response actions to repair degraded cap areas will only be performed after the cause of cap degradation has been determined so that repairs are appropriate to prevent recurring degradation unless unacceptable risks over large areas require a more rapid response. Possible response actions include the following:

- Placing additional or coarser habitat/erosion protection layer materials or otherwise repairing the cap within the identified area of erosion (e.g., re-establish cap thickness).
- Enacting managerial or institutional controls to help control any further cap erosion if it is due to sources such as boat traffic or outfall discharges.

The need for physical repair of the cap will be determined on a case-by-case basis taking into consideration all relevant factors and will be subject to NYSDEC approval.

6.6.1.2 Chemical Monitoring and Maintenance Framework

This section presents the framework for response actions for multi-layer caps based on the results of chemical monitoring. Chemical sampling results will be compared to the performance criteria. As with the physical monitoring and maintenance framework, the response actions will be based on an overall review of the data collected considering multiple lines of evidence including

spatial and temporal trends in data, rather than isolated data points. Response action(s) will be implemented subject to NYSDEC approval.

Exceedances of performance criteria or multiple successive measurements that indicate a consistent trend toward possible short-term exceedance of criteria may indicate that maintenance response actions are necessary. Therefore, triggers have been set up for multi-layer caps as follows:

- Exceedances of performance criteria within the habitat/erosion protection layer at one or more sampling locations (compliance data; see Figure 6.8) and
- Concentrations within the habitat/erosion protection layer (compliance data) and/or chemical isolation layer (supporting data; see Figure 6.8) significantly above anticipated concentrations, based on cap modeling results included in Appendix D which provide short-term predicted chemical concentrations within the habitat/erosion protection and chemical isolation layers.

These potential occurrences would trigger the following responses:

- Review physical monitoring data to verify presence of expected cap layer thicknesses.
- Review construction-related information including as-built layer thickness and GAC dose.
- Evaluate chemical and other data to determine reason for exceedance. This may include evaluation of shoreline hydraulic containment system performance and/or evaluation of groundwater upwelling velocities to verify that the groundwater upwelling velocities through the cap have been reduced as predicted.
- Collect additional data, which may include some, or all, of the following:
  - Resample same location
  - Include measurement of contaminant concentrations within the underlying sediment
  - Delineate extent of cap area that exceeds performance criteria or is above anticipated concentrations
  - Continue monitoring to assess temporal trends
  - Measurement of in-situ GAC content
  - Assess groundwater upwelling velocities

Additional data may be collected as part of the following routine monitoring event or as a separate event. After sufficient data are evaluated (e.g., multiple rounds of data), additional response actions (e.g., cap repair or upgrade) will be evaluated if compliance data exceed the performance criteria considering the extent and severity of exceedance.

6.6.2 Mono-Layer Caps

As discussed in Section 6.2, mono-layer caps include MERCs and a subset of the MPCs, including GAC direct application areas. Mono-layer cap thickness and chemical monitoring results, presence of GAC, and mixing depth will be used to verify mono-layer cap effectiveness. Numerous mono-layer cap configurations have been designed with varying thicknesses; therefore, quantitative triggers have not been developed. The need for additional evaluation, data collection

and/or physical repair or upgrade will be determined in consultation with and subject to approval by NYSDEC, and will take into consideration all available information, including:

- Any evidence of significant and unexpected loss of sand/GAC, considering the thickness goal of the mono-layer caps is specified as an average rather than a minimum. In general, the post-construction verification samples indicate that the mono-layer cap thicknesses are greater than the design thicknesses (Appendix D). In addition, coring completed as part of the 2016 cap sampling field demonstration indicated a significant visible sand layer is present even in GAC direct application areas, as discussed in Section 6.2.
- Mono-layer cap thickness, including thickness of overlying sediment that is expected to accumulate over time and evidence of mixing with underlying sediment due to bioturbation, considering that a bioturbation depth of 6 in. was assumed during cap modeling
- Chemical monitoring results
- Design-related results for mercury indicating the need for sediment deposition to meet mercury criteria in the future
- Potential impacts of ongoing deposition in the 6 to 9-meter zone
- Construction-related data

6.6.3 Thin Layer Caps (TLCs) in SMU 8

TLCs were placed in SMU 8 adjacent to RA-C, RA-D and RA-E. Measured chemical concentrations within the top 4 cm of the TLC will be compared to the mean PECQ of 1 and the mercury PEC of 2.2 mg/kg. TLC thickness, presence of GAC, and mixing depth may also be used to evaluate TLC effectiveness. Should sample concentrations exceed the anticipated concentrations, the above listed response actions for a multi-layer cap may be triggered, taking into consideration the anticipated impacts of ongoing deposition in SMU 8.

6.7 REPORTING

Following completion of annual physical monitoring and sample collection, processing, laboratory analyses and validation are completed, a data summary report will be prepared and submitted to NYSDEC that describes the results from the physical and chemical monitoring effort. The annual report for each year will include:

- Description of any deviations from the Work Plan.
- Presentations of data.
- Confirmation that data are consistent with expectations.
- Recommendations for any revisions to the monitoring program and/or other response actions, including backup documentation, based on the need for decisions points, or as a result of unexpected data.

- Summaries of the performance of the shoreline hydraulic containment systems, which contribute to the chemical isolation capacity of the cap by minimizing groundwater upwelling velocities in near shore areas.
- A DUSR for the laboratory analyses results from cap chemical monitoring.

SECTION 7

HABITAT REESTABLISHMENT AND BIOLOGICAL RESPONSE

This section describes the overall monitoring and maintenance related to habitat reestablishment and enhancement activities. As stated in Section 1, the ROD calls for, among other things, a combination of dredging and capping in the littoral zone. These activities will necessarily disturb existing habitats. The ROD specifies, "*The littoral zone in the vicinity of the dredging/capping will be restored to reestablish appropriate habitat and function following removal of contaminated sediments"*. Therefore, following dredging and capping, habitat monitoring and maintenance (if needed) of remediated areas will commence.

The habitat monitoring is based on the goals and objectives stated in the draft *Remedial Design Elements for Habitat Restoration* (Habitat Plan, Parsons, 2012). The Habitat Plan was developed with the guidance of the Habitat Technical Working Group (Habitat TWG) with input from multiple organizations that use the lake on a regular basis. The Habitat TWG included representatives from the NYSDEC, USEPA, United States Fish and Wildlife Services (USFWS), and Honeywell and its team from SUNY-ESF, Mississippi State University, Terrestrial Environmental Specialists, Anchor QEA, O'Brien & Gere, and Parsons. The Habitat TWG developed the Habitat Plan with the intent that if habitat areas were constructed as described in that plan, by definition, the goal of habitat reestablishment set forth in the ROD and listed above would be met. The goals listed in Section 1.1 of the Habitat Plan provide the focus of the monitoring program. Those goals, broadly stated, are to maintain or improve the:

- size, diversity, and ecological function of wetlands
- ecological function of the littoral zone
- ecological function of the shoreline habitat
- habitat conditions of the profundal zone

The approach developed by the Habitat TWG to assist in meeting the goals and objectives set forth in the Habitat Plan and ROD focused on establishing "habitat modules" within remediation areas. These habitat modules are based on water depth, substrate and energy and focus on the representative species identified in the Habitat Plan. The habitat modules are summarized in the following table.

HABITAT MODULES

Module	Water Depth (ft.)	Substrate/Energy
1 – Deep water	20 to 30	Sand Low to medium energy
2A – Mid water depth	7 to 20	Sand/fine gravel Low to medium energy
2B – Mid water depth	7 to 20	Coarse gravel/gravelly cobble High energy
3A – Shallow water	2 to 7	Sand/fine gravel Low energy
3B – Shallow water	2 to 7	Coarse gravel/gravelly cobble High energy
4A – Floating aquatics wetland	1 to 3	Organics/fines/sand Very low energy
5A – Non-persistent emergent wetland	0.5 to 2	Organics/fines/sand Low energy
5B – Shoreline shallows/limited emergent wetland	0.5 to 2	Gravel/gravelly cobble High energy
6A – Persistent emergent wetland or salt marsh	1 ft. above water to 1 ft. deep	Organics/fines/sand. Low energy
6B – On shore to shallows/limited emergent wetland or salt marsh	1 ft. above water to 1 ft. deep	Coarse gravel/gravelly cobble/sand High energy
8A – Shoreline/riparian areas/ successional fields	> 1 ft. above water	Topsoil/sand
8B – Shoreline/riparian areas	> 1 ft. above water	Coarse gravel/gravelly cobble with topsoil in select areas
9A – Inland wetlands not associated with the lake/wet meadow and persistent emergent wetland	Varies	Topsoil/sand Low energy
9B – Inland wetland not associated with the lake/Forested and scrub-shrub wetland	Varies	Topsoil/sand Low energy

Two types of criteria have been developed to assist with the assessment of habitat reestablishment: Stage 1 and Stage 2. Stage 1 criteria are design level criteria that are used to verify that the modules were constructed as designed, and Stage 2 are used to determine if the criteria for vegetation establishment have been met and to document effects on other biological communities.

Stage 1 criteria (Table 7.1) were met based on compliance with contract drawings and specifications once remediation (dredging and/or capping) and habitat reestablishment work for a specific area was completed. The primary design parameters associated with Stage 1 criteria for all modules include:

- Elevation
- Habitat layer substrate
- Habitat layer thickness

For areas designed as planted wetland modules there are two additional design criteria:

- Organic content of sediment
- Planting specifications (density, species composition, etc.)

In addition to the criteria above, there is an overall wetland acreage design criteria for mitigation wetlands. The mitigation wetlands included under the lake design and construction scope are:

- WBB/HB Outboard area (NYSDEC designated wetland SYW-19)
- Connected Wetland at WB 1-8[5]
- Spits at the mouth of Ninemile Creek (part of NYSDEC designated wetland SYW-10)

Overall wetland mitigation requirements include these areas as well as wetlands impacted by other shoreline remediation activities, which are detailed in Section 7.1.2.

There are no associated response actions for non-compliance of the Stage 1 criteria since they must be met for the work to be approved. As such, Stage 1 success criteria are not discussed further in this document but will be addressed through the construction quality assurance process.

The Stage 2 criteria (Tables 7.2 and 7.3) include specific habitat and biological community parameters that will be used to evaluate the establishment and expansion of native wetland vegetation communities within planted areas, and the presence and use of reestablished and surrounding areas by fish, benthic macroinvertebrates, birds, mammals, reptiles, and amphibians. Additional details regarding success criteria for the restoration component of the connected and perched wetlands at WB 1-8 can be found in Appendix H of the Wastebeds 1-8 IRM Design (O'Brien & Gere, 2013). Areas with planted vegetation will be compared to a set of specific success criteria related to plant cover and invasive species that are intended to facilitate the

[5] The creation of the Wastebeds 1-8 Connected Wetlands (removals and capping) were included in the lake design. Details on the restoration (planting and structure) and Success Criteria of both the connected wetland and perched (inland) wetlands are addressed in the *Integrated IRM, Mitigation Wetlands, and Remediation Area Hydraulic Control System 100 % Design Report Wastebeds 1-8.* (O'Brien and Gere Rev Ed. 2013).

establishment of diverse native plant communities. If the vegetation success criteria are not being met, or do not show a trend towards being met, a set of response actions, such as targeted plantings, can be implemented in an attempt to bring planted areas into agreement with the criteria.

Although there are no specific success criteria for the biological communities, the Stage 2 criteria focus on monitoring and documenting the use of remediated areas by various organisms. The biological data will be compared to baseline (where available) or reference data to document any changes in use of the areas and verify that the habitat in remediated areas is consistent with similar habitats in Onondaga Lake. Some structural response actions may be considered based on interpretation and discussion of monitoring results for specified elements. However, as discussed below, any response actions would only be expected to have an influence at a small scale.

7.1 SUCCESS CRITERIA

Significant components of the monitoring program are associated with planted vegetation establishment and biological community response. Monitoring of vegetation recovery in non-planted capped areas is a component of this program, as well as monitoring of other parameters such as hydrologic regimes. Establishment of vegetation is the key factor for maintaining or improving ecological function of restored wetlands, shallow littoral, and shoreline habitats and is the only component with success criteria. Monitoring data will be evaluated against the success criteria for planted vegetation to determine if the goals are being met or, if necessary, whether response actions are warranted. Other biological components such as the fish and wildlife community, and natural colonization of non-planted areas by aquatic vegetation have been agreed to be monitored to provide information regarding how these communities respond to habitat improvements. The establishment or restoration of biological communities is a significant part of maintaining or improving the ecological functions of the Onondaga Lake area. An evaluation of achievement of the success criteria and habitat quality will be performed after the five-year monitoring period is completed and a revised monitoring and maintenance plan will be developed, if necessary, in coordination with the NYSDEC. Response actions to be implemented if the success criteria below are not achieved are detailed in Section 7.4. Response actions will be determined based on consultation with and approval by NYSDEC.

7.1.1 Vegetation

The success criteria for vegetated areas differ depending on the type of habitat: planted wetlands, in-lake planting, planted uplands, and the naturally colonized littoral zone. In wetland, upland, and shallow water lake habitats vegetation plays an important functional role by providing cover, foraging opportunities, and reproductive and nursery habitat for wide range of species. As such, establishment of a diverse native vegetation community is the primary component of the success criteria in these planted areas.

7.1.1.1 Wetland Areas

The success criteria in planted wetland areas (Spits at the mouth of Ninemile Creek and the WBB/HB Outboard area wetlands) consist of goals for minimum areal percent cover, and maximum percent of invasive species. The forested wetland area in the WBB/HB Outboard area also has goals for woody species. The threshold success criteria goals are provided in Table 7.3a. Monitoring for success criteria will begin the first growing season following planting and will continue for five consecutive years.

The final (5th year) success criteria for percent cover of planted wetland areas is 85 percent or greater, with percent cover of invasive species not to exceed five percent. There are also interim goals for years one through five that are shown in Table 7.3a, including zero percent invasive cover of species in years one through four. The zero percent invasive species interim goal assures that any invasive species observed on site will be managed regardless of the percentage at which they are found, and provides the maximum chance of successfully achieving the five percent goal after five years. A list of invasive plant species that will be managed for is provided in Table 7.4.

As a part of an extensive wetland monitoring program, biologists evaluate native plant establishment in a newly restored wetland along the shoreline of Onondaga Lake.

The goal for installed large trees (i.e., container class No. 20 or larger) in the WBB/HB Outboard area forested wetland is 90 percent survival from year one through to year five. Large trees needing replacement will be replaced once with a comparable species, of the same size, which has been observed to be performing well at the site. Any replacement tree which does not survive the five-year period will be substituted with two smaller trees (No. 7 to 10 container) of a species that has been observed performing well at the site or, after consultation with NYSDEC, with a species that is judged to be a suitable for the site-specific conditions. Substitute trees that do not survive will be replaced with #7 to #10 sized trees as needed to maintain the original number of trees installed as part of the design. Large trees needing replacement in areas where access with equipment is difficult and/or poses a risk to established vegetation (e.g., forested wetland areas) may be substituted with smaller potted trees (No. 7 to 10 container). The specific planting location of replacement trees may also be adjusted based on field conditions and site observations. Any replanting of large trees, or replacement trees, would take place in the next appropriate planting period (spring or fall), which may occur in the same year as the observation or in the following year.

7.1.1.2 Upland Vegetation

The vegetation monitoring component for upland modules 8A/B, which are only located in the WBB/HB Outboard area, will include percent survival of woody species, overall percent cover, and percent cover of invasive species.

The final success criteria for these areas are that, within five years, at least 90 percent of the area will be covered with vegetation, and there will be no more than 5 percent of invasive species present. There are also interim goals for years one through five that are shown in Table 7.3b, including zero percent invasive cover of species in years one through four. Criteria and response actions regarding the establishment of large trees are the same as stated in Section 7.1.1.1, except the annual large tree survival goal is 100 percent.

7.1.1.3 In-lake Vegetation

In-lake vegetation refers to habitat modules 4A, 5A, and 6A off the mouth of Ninemile Creek (excluding the Ninemile Creek spits) that were planted with emergent, floating aquatic, and submerged aquatic wetland species. The interim and final annual goals for these areas are reflected in Table 7.3c and, like other planted areas, includes goals for minimum percent cover of vegetation and maximum cover of invasive species. Specifically, the goal for percent plant cover is to reach at least 75 percent cover by year five, with no more than five percent of invasive species present (including water chestnut). The 75 percent cover goal for this area is slightly less than in other planted areas due to the challenges associated with establishing plants in a deeper lake setting. The percentage of invasive species documented will be included in each monitoring report. Any additional information related to invasive species collected by the OCDWEP Ambient Monitoring Program will also be included.

7.1.1.4 Non-planted Aquatic Vegetation

Although there are no specific success criteria for aquatic vegetation that naturally recolonizes shallow non-planted areas, this component of the program will document the species composition and distribution where colonization occurs within remediated areas such that a determination can be made that these areas are developing aquatic vegetation consistent with other comparable locations in Onondaga Lake. Aquatic vegetation is expected to colonize the littoral zone within the remediation areas in a manner similar to the expansion throughout the lake documented over the past 10 years by Onondaga County as part of their Ambient Monitoring Program (OCDWEP, 2012). Their data indicate that expansion into previously unvegetated areas occurred rapidly and that the proportion of invasive species remained relatively unchanged. As such, this monitoring program is similar to Onondaga County's Annual Report on the Onondaga Lake Ambient Monitoring Program. The results of the monitoring program will be periodically reviewed and reported to determine if any revisions to the program are needed or if management activities are warranted.

7.1.2 Wetland Acreage

Remedial activities along the shoreline of Onondaga Lake, including the construction of the IRM barrier wall along the lake shoreline near WBB/HB, has both temporary and permanent impacts to the habitat at the site. The wall alignment bisects the site and creates two separate areas — the "inboard" area is the portion on the landward side of the wall, and the "outboard" area lies between the wall and the lake. The wall and associated remedial activities altered some wetland and open water areas along the shoreline. Figure 7.1 illustrates the conditions near the WBB/HB site as they existed prior to remedial action, and reflects how the wall bisects this area and altered the distribution of the existing habitats. As shown in Figure 7.1, there were approximately 12.2 acres of wetlands and 2.3 acres of open water (East Flume and the Harbor Brook channel) before remediation. In addition, 2.3 acres of open water was lost inboard of Willis/Semet IRM barrier wall.

Wetlands and open water impacted at the WBB/HB site and behind the Willis/Semet IRM barrier wall due to remediation will be restored onsite to the maximum extent practicable, as shown in Tables 7.5A through 7.5C and Figures 7.2 and 7.3. This includes wetlands and open water to be created outboard of the barrier wall (Parsons and Anchor QEA, 2016), and wetlands to be created inboard of the barrier wall (design in progress). The impacted wetlands inboard of the WBB/HB barrier wall will be mitigated at a 2:1 ratio. Based on the anticipated loss of wetland that cannot be restored onsite, designs were developed for creating similar habitat along the shore of WB 1-8. The design for this mitigation has been integrated with the remedy for the WB 1-8 site and other mitigation wetlands proposed in that area (O'Brien & Gere, 2013). The Onondaga Lake Final Design (Parsons & Anchor QEA, 2012d) also included remediation and restoration of wetlands associated with the Ninemile Creek spits. Pre-remediation and designed wetland and open water acreages for these areas are tabulated in Tables 7.5A, 7.5B, and 7.5C. The 2.3 acres associated with the WB 1-8 connected wetlands that mitigates the 2.3 acres of lake surface area lost due to the installation of the Willis/Semet IRM barrier wall is included in Table 7.5B. As shown in Tables 7.5A and 7.5C, the total required wetland area is 19.5 acres. The designed wetland area of 22 acres, which includes the anticipated designed wetland area of 0.9 acres inboard of the barrier wall, exceeds the required wetland area by approximately 2.5 acres.

As shown in Figure 7.2, berms were installed along the WBB/HB Outboard area shoreline that extend into open water areas off of the WBB/HB Outboard area to be protective of the shoreline wetlands. The area occupied by the berms within the lake is approximately 1.2 acres, of which approximately 0.6 acres were constructed above a lake level of 362.5 ft. However, settlement of the berms and movement of berm material from ice is anticipated and may reduce the area of berms above lake elevation. As documented in the design addendum (Parsons and AQEA, 2016d), following successful completion of the multi-year Honeywell wetland monitoring and maintenance program, a determination will be made in conjunction with NYSDEC regarding whether the wetlands would be self-sustaining in the absence of the berms. Established wetlands in the area were stable prior to remediation. If it is determined that the berms are no longer required, they will be cut down to a lower elevation as determined appropriate. The berm material would be spread into the surrounding area outside of the berm alignment. In addition, an interim assessment

of the effectiveness and need for the berms, including assessment of the amount of settlement, will be conducted following year two of the monitoring period.

Final achievement of the total wetland area requirement will be determined based on wetland delineation to be completed as part of the long-term monitoring program.

7.1.3 Fish Community

Although there are no specific success criteria for fish community, the fish community composition (both adult and juvenile), including the number of species and diversity, will be compared to a representative warm water/cool water fish community (based on the literature) and baseline data. The fish community will be assessed both within remediated areas as well as lakewide to evaluate the overall species composition. The number of species present will also be compared to representative community data (based on the literature) as well as with the number of species reported by the baseline monitoring program. These results will provide a semi-quantitative comparison of the fish communities at various locations within the lake. In addition, the WBB/HB Outboard area wetland is designed to provide habitat for wetland spawning species such as Northern Pike. The monitoring program for the WBB/HB Outboard area wetland is focused on documenting that the area is used by Northern Pike or other wetland dependent fish species.

7.1.4 Macroinvertebrate Community

The macroinvertebrate community will be monitored to document recolonization of the remediated area and changes that may occur to community composition following the completion of capping such that a determination can be made that these areas are developing a macroinvertebrate community consistent with other comparable locations in Onondaga Lake. Additionally, the community will be monitored in reference areas of the lake, as well as in the CSX area. The CSX area covers approximately 10 acres in the southwest corner of RA-E, and was unable to be dredged and capped as part of the remedy, as described in the 2014 ESD (USEPA and NYSDEC, 2014). Appropriate and representative community metrics will be calculated for the sampling techniques to be utilized as part of the program. Further details can be found in Appendix E. The NYSDEC Biological Assessment Profile (BAP) (NYSDEC, 2014c) will be calculated from the benthic macroinvertebrate data collected at stations within the lake to document the levels of impact (e.g., none, slight, moderate, severe) for comparison to those documented during the baseline monitoring program. However, changes have occurred in the substrate and lake bathymetry as a result of dredging and capping, and sampling locations and methods are different than historical locations, which would make direct point-to-point comparisons between 2010 (and older data) and the data to be collected post-remediation impractical.

7.1.5 Wildlife

Although there are no specific success criteria for the wildlife community, the monitoring program will document functional use of the remediation areas by taxa associated with the representative species such that a determination can be made that these areas are developing a wildlife community consistent with other comparable habitat locations around Onondaga Lake.

Monitoring will occur multiple times per month during the field season to observe wildlife that regularly utilize the sites, as well as will include targeted monitoring events during breeding and migrations. Targeted monitoring events will include specialized methods such as call surveys. Further details can be found in Appendix E. The number and types of wildlife species using the remediated portions of the lake should be similar to those recorded by other organizations or as a part of other project components (e.g., natural resource damage assessment). Any comparisons will take into account seasonality and other circumstances, as appropriate. However, the similarity of wildlife species present in remediated areas of the lake versus unremediated areas is dependent on a wide variety of factors including the type and size of modules present in each area, as well as the potential wildlife corridors in each area.

7.2 MONITORING SUMMARY

Biological monitoring data[6] will be collected from within remediation areas and in-lake reference areas as summarized below. Additional details associated with the habitat monitoring data collection are provided in Appendix E.

Post remediation monitoring of habitat and biological communities in Onondaga Lake will begin in 2017 following completion of capping in 2016, though not all components are monitored in all areas in all years. In general, some level of monitoring is scheduled to occur until at least five years after planting in the last area is completed.

7.2.1 Wetland and Upland Vegetation

Annual observations of hydrologic conditions and qualitative vegetation evaluations will be completed to document the establishment and expansion of planted vegetation. In addition to a formal wetland delineation during Year 5 as noted in Table 7.2, a formal wetland survey will be completed during Year 3 to delineate the margins of the wetland based on vegetation and hydrology. Vegetation monitoring within planted wetland and upland habitats will be based on methods approved for other sites within the Onondaga Lake portfolio (e.g., LCP-OU1, Geddes Brook, and Ninemile Creek). Vegetation will be quantitatively monitored within planted habitat types consisting of modules 4A, 5A, 6A, 8A, 8B, and 9A/9B. The monitoring schedule for these areas is staggered because restoration is directly associated with completion of discrete sections of the cap (specifically topsoil placement) and therefore dependent on the capping and habitat restoration timeline. In addition, there is a distinct five year monitoring window for vegetation success criteria to be achieved, meaning that individual capped and planted sections will be at various stages of monitoring simultaneously. Monitoring will begin the first full growing season after planting has been completed. For example, the first area planted was RA-A, which was capped in late 2015 and early 2016, and planted during the spring/summer of 2016, therefore monitoring will begin in 2017 and end in 2021. The last area to be planted was the WBB/HB Outboard area that was planted in 2017, with monitoring beginning in 2018 and ending in 2022. This means that vegetation monitoring will be occurring in some areas from 2017 to 2022. An

6 Chemical and physical monitoring of the habitat layer will be conducted in conjunction with the cap and erosion protection layer monitoring as described in the Cap Monitoring and Maintenance section.

evaluation of achievement of the performance goals for forested wetlands and other areas with significant woody material will be performed after the five-year monitoring period is completed. Given the time needed for a mature forest to be established is longer than the five-year period covered in this plan, further monitoring efforts will be developed for these areas in coordination with NYSDEC following the initial five-year monitoring period.

Conditions for plant growth throughout the Onondaga Lake shoreline where monitoring is planned to occur are notably diverse in nature, and plant composition and density are expected to vary spatially. To better capture the heterogeneity of conditions throughout the different planting zones, data collection will be conducted within permanent 50 square foot sampling plots, at a minimum density of two plots per acre. In addition, for the large trees planted within forested wetland or upland areas, each tree shall be visually inspected and overall condition will be recorded. Details for wetland and upland vegetation monitoring are provided in Appendix E.

7.2.2 Aquatic Vegetation

Monitoring will be completed to document the natural colonization of the reestablished littoral zone by aquatic vegetation species. Littoral zone vegetation sampling will be based on the point sampling methods and locations approved for use during the PDI phase. The sample points will be sampled within remediation areas annually beginning in 2017, the first full growing season after capping is complete. A comparable number of control sites located in proximity to, but outside remediation area boundaries will also be sampled. Overall species composition and relative abundance of each species will be collected. In addition to the formal sampling effort, two qualitative boat surveys (one in the spring and another in the same general timeframe as the point sampling) of the capped area from the shoreline to approximately 20 ft. of water depth will be completed to provide a broader perspective on vegetation distribution. If available, Onondaga County's annual areal littoral zone macrophyte photography and five year field surveys will also be reviewed.

7.2.3 Fish Community

Fish community data will be collected to document the use of the remediation areas and will include sampling in remediation areas and other areas of the lake for both adult and juvenile fish. Monitoring began during baseline sampling, and has continued throughout construction. Post-construction monitoring will occur annually beginning in 2017 and its continuation or need for modification reviewed at five year intervals, with the first review in 2021. Sampling will be completed using essentially the same methods and locations as those used during the approved baseline monitoring program. Adult fish will be sampled using trap and gill nets, while juvenile fish will be sampled using seines. Trap net and gillnet locations will be the same as used during baseline as they are representative of fish use in and adjacent to each remediation area. Since juvenile fish tend to use a smaller area, sampling sites may be modified from baseline if a specific remediation area was not sampled during baseline. Northern Pike sampling will include at least one station within and one station adjacent to the WBB/HB Outboard area, and may use multiple sampling techniques, to increase the chances of collecting juvenile Northern Pike, or other species that utilize wetland habitats. This sampling will be limited to catch and release, as practicable, to

minimize potential impacts on Northern Pike reestablishment. Data to be collected at each site include the number of individuals of each species, life history stage, and length and weight of the first 30 individuals per species.

7.2.4 Macroinvertebrates

Benthic community data will be collected to document recolonization of the new substrate placed as part of remediation. Benthic macroinvertebrate samples will be collected from representative areas within remediation areas, three locations within the CSX area, as well as from the unremediated areas of the lake. Additionally, locations were added within Remediation Areas that were not sampled during baseline per Appendix E. Sampling procedures will follow NYSDEC sampling procedures; in areas of soft sediment, ponars will be utilized while in areas of coarse substrate, multiplates will be utilized. A subsample of up to 100 organisms will be identified to the lowest possible taxon with those data being used to calculate community metrics. Further information on methods and sample locations can be found in Appendix E. Post remediation monitoring will occur twice in the first five years following completion of capping. The first event will be in 2018 with a decision regarding whether to complete the second sampling event in 2019 or 2020 based on the 2018 sample results. Results will be reviewed and discussed with NYSDEC subsequent to the second sampling event to determine if additional monitoring is necessary.

Examples of species commonly observed in wetlands.

7.2.5 Wildlife

It is anticipated that the remediation areas will be used by a variety of wildlife species for cover, foraging, and/or reproduction. Wildlife data will be used to document the use of remediated areas. Wildlife use (e.g., nesting, feeding) will be assessed using two primary methods: standard field observations (e.g., visual observation, tracks, scat, nests) conducted as part of other activities within and around restored areas (e.g., vegetation sampling, routine site visits, other monitoring activities) and acquisition of available external data (e.g., Audubon bird counts and assessments completed for other project components). Monitoring will occur multiple times per month during the field season to observe wildlife that regularly utilize the sites, as well as will include targeted monitoring events during breeding and migrations. Targeted monitoring events will include specialized methods such as call surveys. Further details can be found in Appendix E. Monitoring in each capped area will occur annually

during the same five year period as vegetation monitoring and then evaluated after year five to determine if additional monitoring is necessary.

7.3 CRITERIA ATTAINMENT DETERMINATION

The data collected from this monitoring program for planted vegetation and wetland establishment will be evaluated against the success criteria to determine if the habitat reestablishment and enhancement activities are meeting the stated goals and objectives. Monitored elements without specific success criteria will be compared to baseline and/or in-lake reference locations to better understand community level changes in the lake. The scale of these comparisons will vary depending on the specific data being evaluated. For example, wetland and submerged aquatic vegetation may vary within each module due to differences in water depth and substrate, but are more specific to the module "boundaries" than other more mobile members of the biological community. Therefore, while collection of monitoring data may be completed within a specific module, assessment may occur at larger scales such as within remediation/restoration areas or in some cases, the lake as a whole. For example, modules 1 and 2 are deeper water habitats and predominantly unvegetated, and there are no physical, chemical, or biological barriers to prevent organisms (e.g., fish, diving birds) from moving freely between the two modules. Therefore, data collected from within these two modules could be combined for evaluation.

In a dynamic monitoring program, the process of adaptive management is used with the goal of achieving a desired range of habitat characteristics by applying site-specific habitat information in an iterative framework of measurement and response (Holling, 1978; Thom, 1997). In this framework, no single result determines the ultimate project outcome. Rather, if certain goals are not being met, additional monitoring is conducted and decisions are made regarding the need for, and approach, to particular adaptive responses. An illustration of the decision framework, through which data are obtained, and evaluated, and decisions and response actions are determined is provided in Figure 7.4.

The data collected from this monitoring program will be evaluated to determine if the habitat reestablishment and enhancement activities are meeting the goals and objectives. These evaluations can include analysis of trends over time, direct comparisons of vegetation results to success criteria goals and thresholds, or comparisons of the post-re-establishment data to similar data collected during baseline and/or from in-lake reference areas (Table 7.6).

7.3.1 Wetland and Upland Vegetation

Attainment of the success criteria for areas planted with wetland and upland vegetation is supported by a series of specific criteria based on certain parameters (specifically overall percent cover and abundance of invasive species) at certain specified years after completion of planting. The annual target goals (Table 7.3) associated with these parameters are primarily to ensure that vegetation planted (or recruited) in specific modules remains viable and increases in coverage. The success criteria will be met when the average percent cover is greater than or equal to the thresholds for overall percent cover and less than the goal for maximum percent cover of invasive species.

7.3.2 Aquatic Vegetation

Habitat module 3A has been specifically designed to provide the water depth and substrate needed for colonization of aquatic macrophytes. Aquatic vegetation will be monitored so that the progression of natural colonization in module 3A areas can be documented. Monitoring in all other areas will be documented and reported accordingly.

7.3.3 Wetland Acreage

After Year 5, planted wetland areas will meet the definition of a wetland using the three parameter rule (i.e., presence of hydric soils, hydrophytic vegetation, and hydrology) and, as discussed in the *Remedial Design Elements for Habitat Restoration* (Habitat Plan, Parsons 2012), the total acreage of wetlands created will meet the total required to mitigate wetlands lost during the lake remedy (Table 7.5C).

7.3.4 Fish Community

The fish community will be monitored by documenting the species richness and diversity of the warm water/cool water fish community present the lake. For adults, this assessment will be qualitatively compared with the baseline community to gain a better understanding of community level changes, with the understanding that the lake is a dynamic system and variability in the presence and abundance of some species is natural. In addition, a semi-quantitative comparison with baseline data will be conducted. Finally, capture of juvenile Northern Pike and/or other wetland spawning/rearing fish species in or near the WBB/HB Outboard area will be used to indicate the successful establishment of habitat suitable for Northern Pike spawning and rearing in the newly created wetland. In order to minimize impacts on establishing populations, sampling will be limited to catch and release and once Northern Pike spawning and/or juveniles have been documented, reductions in sampling will be discussed with NYSDEC.

7.3.5 Macroinvertebrates

The overarching goal is to maintain or improve the ecological function of the Onondaga Lake area. While there are no specific criteria, it is expected that the benthic macroinvertebrate community will be improved following the completion of the lake remedy relative to the pre-remediation condition. The NYSDEC BAP (NYSDEC, 2014c) will be used to characterize the benthic macroinvertebrate community in littoral areas. The BAP results in a numeric score that is associated with one of four impact determinations: none, slight, moderate, or severe. The BAP results of the post-remediation benthic macroinvertebrate community will be compared with the baseline BAP results (Parsons, 2011) to document potential changes in the benthic community.

7.3.6 Wildlife

The wildlife community will be monitored by documenting the species using each remediation area and the how the habitat is being used (e.g., nesting, feeding etc.).

7.4 HABITAT RESPONSE ACTIONS

Response actions are implemented to correct observed deficiencies in meeting success criteria or in an attempt to understand why success criteria were not met as expected. If response actions do not provide a measurable effect, then the utility of continually implementing responses must be considered. As previously discussed, Onondaga Lake is a large, complex, open system containing ecological communities structured over time by a combination of biotic and abiotic factors. Remedial actions and habitat re-establishment/enhancement will not influence large-scale factors such as climate/weather, certain physical site characteristics (e.g., fetch, proximity to tributaries), eutrophication, water clarity, emigration and immigration, inter and intra-specific competition, disease, and natural reproductive variability. Similarly, response actions that might be implemented if certain criteria are not being met will not influence those large-scale factors. Accordingly, response actions will be focused on those activities that may have an influence on the biological community at a smaller scale.

There are two types of response actions: structural (or physical) and programmatic. Structural responses are those actions that physically change the area being evaluated with the intent that the changes will result in an increased likelihood of attaining success criteria, and include, for example, planting, seeding, invasive species control, and placement of additional structure. As such, only monitoring elements that have success criteria have associated structural response actions. Programmatic responses include enhanced data evaluation, additional data collection, special studies, and/or changes to the monitoring program or success criteria. Additional potential response actions not identified herein, if appropriate and feasible, may be evaluated in consultation with NYSDEC. The dynamic monitoring strategy necessitates that the response actions remain flexible and are therefore subject to change based on the results obtained from the monitoring program and after consultation with agencies.

To facilitate the decision making process and ability to efficiently implement response actions, the criteria for planted vegetation are straightforward comparisons of the data collected from planted areas with a specified percentage. If the planted material does not show sufficient survival and expansion to cover the remediated areas, these areas potentially may be colonized by invasive species. Therefore, in addition to criteria for plant survival and percent cover, the response actions include criteria relating to invasive species. While monitoring and response actions will be implemented to minimize the potential for establishment of invasive species, elimination of invasive species from within the modules and remediation areas is not an ultimate project goal and is not a requirement for meeting the success criteria.

7.4.1 Vegetation

7.4.1.1 Wetland, Upland, and In-lake Planted Areas

Response actions for planted and seeded areas may include additional data collection to facilitate evaluation of poor plant performance, or replanting/seeding areas with species shown to be performing well at the site. Response actions also include treatment/removal of invasive species based on the success criteria provided in Table 7.3. If monitoring data indicate compliance with

annual target success criteria, no structural response actions will be implemented and routine monitoring will continue as planned.

7.4.1.2 Aquatic Vegetation

Recent expansion of aquatic vegetation in the littoral zone indicates that natural colonization can occur very rapidly in Onondaga Lake. Response actions may include additional data collection and analysis to better understand how natural colonization of remediation areas is occurring.

7.4.2 Wetland Acreage

Wetland acreages will need to be assessed holistically across the respective sites that comprise the mitigation areas in Table 7.5A to determine if mitigation acreages have been attained. If after five years the total acreage of delineated wetlands does not meet the total required to mitigate wetlands lost during the remedy, the need for and the scope of potential response actions will be developed in consultation with NYSDEC to resolve the discrepancy. If data and/or observations of hydrology, soil conditions, and/or vegetation prior to the delineations suggest wetland conditions (including hydrology) are not being established or maintained, then potential response actions may be considered sooner than Year 5.

7.4.3 Fish Community

As previously discussed, Onondaga Lake is a large, complex, open system containing an ecological community that has been structured over time by a combination of biotic and abiotic factors. For the remediation areas in general, the response actions include additional evaluation of collected data, potential additional data collection and evaluation, and placement of additional structure, if supported by the results of the additional data collection.

Due to the number of variables needed for Norther Pike to effectively spawn, the time until Northern Pike begin to utilize the WBB/HB Outboard area is unknown; therefore, at least four spawning seasons are needed to collect post-restoration data prior to the implementation of response actions. If Northern Pike spawning is not observed or juvenile Northern Pike or other wetland spawning/rearing species are not documented in the WBB/HB Outboard area by the end of the fourth season following restoration, then response actions could include further assessment of the fish community data for both adults and juveniles. If Northern Pike juveniles are not collected in or adjacent to the WBB/HB Outboard area wetland, but adult Northern Pike are collected and/or observed in this area of the lake, then additional sampling for juveniles may be conducted in the following year to evaluate if spawning is occurring. Prior to sampling for juveniles, water level data will be evaluated to determine if water levels were suitable for providing access to the wetland areas. In addition, the habitat suitability index (HSI) for Northern Pike will be calculated for the area to evaluate the suitability of the wetland for Northern Pike spawning. Planting additional vegetation will be considered based on the results of the HSI calculations and wetland vegetation monitoring results.

7.4.4 Macroinvertebrate Community

Similar to the fish community, the macroinvertebrate community is structured by a combination of biotic and abiotic factors, most of which are unrelated to the remedy. If the results of the macroinvertebrate community indices indicate greater impairment than the baseline or in-lake reference indices, then additional analysis may be conducted or additional data collection may occur such as; an evaluation of Onondaga County water quality data from the lake and/or, sampling of surficial sediments and porewater for CPOIs or other parameters, should it be deemed necessary. Those data will be used to determine if the macroinvertebrate community is consistent with those parameters based on literature. Response actions do not include altering cap material.

7.4.5 Wildlife

Similar to the fish community and benthic macroinvertebrate communities, there are multiple biotic and abiotic factors that influence the types and number of wildlife species that will use Onondaga Lake for certain portions (or all) of their life cycle. The response actions are similarly focused on additional data collection and evaluation if wildlife use of the remediated areas is not observed. Placement of additional structure such as basking logs or rocks for amphibians will be considered based on the results of the data evaluations.

Bald Eagles are now a common sight over Onondaga Lake.

7.5 INVASIVE SPECIES MANAGEMENT

As previously stated, if the planted areas designed to support native plant species do not show sufficient survival and expansion of planted material, or natural recolonization, these areas potentially may be colonized by invasive species. Therefore, best management practices are utilized as part of the standard maintenance program and the response actions include control of invasive species. While monitoring and response actions will be implemented to minimize the potential for establishment of invasive species, elimination of invasive species from within the modules and remediation areas is not an ultimate project goal and is not a requirement for meeting the success criteria. In addition to control of invasive species during the establishment period, the habitat construction specifications include specific requirements to minimize the potential for introducing invasive species as part of seeding and planting operations.

7.6 REPORTING

Habitat components have a five-year monitoring period for each restored area that begins the first full growing season following restoration. This is contingent on achievement of the specified goals being met by the end of five years. Following completion of annual habitat monitoring, a data summary report will be prepared and submitted to NYSDEC that describes the results from

the monitoring activities. An annual data summary report will be submitted for the first four monitoring years and will include:

- Description of any deviations from the Work Plan
- Summaries of results from information collected for the various monitoring components, as detailed below
- Confirmation that data is consistent with expectations and that interim goals are being met, as specified in Table 7.3
- Recommendations for any revisions to the monitoring program and/or other response actions, including backup documentation, based on the need for decisions points, or as a result of unexpected data.

The fifth-year annual report for each area (i.e. 2021 for unplanted remediated areas and for the planted areas in RA-A and the Ninemile Creek spits, 2022 for the WBB/HB Outboard Area wetlands) will be expanded to provide a discussion of whether success criteria goals are met, how the restored habitats are being functionally utilized by fish and wildlife, and whether existing conditions are likely to be sustained in the future. The results of the wetland delineation carried out during the fifth monitoring year will also be included, as well as an accounting of overall wetland mitigation acreage. The report will also make recommendations regarding modifications to the program such as whether monitoring can be discontinued as anticipated, or whether additional monitoring or other response actions are required.

As discussed in Sections 1.1 and 10.1, a comprehensive report covering all monitoring components will be issued approximately every five years starting in 2019. The habitat fifth-year reports will be submitted between the submittal of the first and second comprehensive report. Therefore, it is anticipated that the first comprehensive report will provide a summary of progress towards meeting habitat goals, and the second comprehensive report will discuss any approved decisions resulting from previous fifth-year report(s).

The annual data summary reports will include the following sections and associated data summaries:

7.6.1 Wetland, Upland, and In-lake Planted Areas

The annual report will include the relative percent cover of each plant species in each planted area, overall percent cover in each individual sampling plot (those plots with woody plants will include counts of woody species), and average aerial percent cover of vegetation in each wetland, upland, and in-lake planted area. The condition of large trees (#20 or above) installed during restoration will be summarized by species and planted area (i.e. upland, forested wetland). Maps showing vegetation cover types will be provided. Photographs taken at each of the photograph locations will be included as an attachment. An overall qualitative description of the success of the planted areas and recommendations to correct issues within the restoration areas, if necessary. In the 2018 report, a map of the shoreline survey to be conducted that year will be included.

7.6.2 Aquatic Vegetation

The annual report will include plant community composition from each quantitative sample location and in each Remediation Area as well as reference areas. Frequency of occurrence of each species in each Remediation Area as well as reference areas will also be presented.

7.6.3 Fish and Wildlife

For fish, the annual reports will include species richness and abundance of each species at each of the monitoring stations (i.e. by remediation area and reference locations). Community metrics will be compared with similar metrics from the baseline monitoring program to allow for a semi-quantitative comparison of fish communities at various locations around the lake, as practical given changes in monitoring locations.

All wildlife species documented in each remediation area will be presented in the annual reports as well as how those species were using the restored habitats.

7.6.4 Benthic Macroinvertebrates

For the year in which sampling is conducted, the annual report will include the results of the relevant NYSDEC BAP score for the given method (multiplate or ponar) (NYSDEC, 2014c) calculated from the community data. The BAP results of the post-remediation benthic macroinvertebrate community will be compared with baseline BAP results (Parsons et al., 2011) to document potential changes in the benthic community. Additionally, recommendations regarding future sampling will be made as applicable.

SECTION 8

WASTEBEDS 1-8 SHORELINE STABILIZATION

The ROD identified two specific locations where habitat enhancement activities would be applied along an estimated 1.5 miles (2.4 km) of shoreline (SMU 3) and over approximately 23 acres (SMU 5) to stabilize calcite deposits and oncolites. The shoreline stabilization was expanded to include shoreline areas in SMU 4 as part of the Final Design. This section describes the success criteria, monitoring and response actions related to the habitat enhancement activities implemented to stabilize the SMU 3 and SMU 4 shoreline adjacent to WB 1-8. The habitat enhancement was designed to reduce sediment resuspension and turbidity along the shoreline of SMUs 3 and 4 and was integrated with the remedy for WB 1-8 and the capping in RAs A and B. As described in the Final Design, two approaches were used for the habitat enhancement along WB 1-8 (hereafter, WB 1-8 shoreline stabilization). From elevation 360 ft. – 362.5 ft. (the area below average lake level), six inches of graded gravel was placed to stabilize the substrate. From elevation 362.5 ft. to 365 ft. (the area above average lake level), the shoreline was stabilized with bank run material and planted and seeded with native vegetation. Further details of the WB 1-8 shoreline stabilization are included in Section 4.3.7.1 of the Final Design (Parsons and Anchor QEA, 2012d) and Section 6 of the Habitat Addendum to the Final Design (Parsons and Anchor QEA, 2016e).

A benefit of shoreline stabilization has been the colonization of lake areas by native wetland plant species.

In the time since the ROD, coverage by aquatic macrophytes has increased significantly, well beyond the acreage that would have resulted from the implementation of the 23 acres of habitat enhancement. Therefore, the goals outlined in the ROD for habitat enhancement in SMU 5 have already been met and habitat enhancement is no longer required in that area.

As the revegetation design and goals for shoreline stabilization are similar to those for the adjacent WB 1-8 upland habitat restoration, long-term goals and maintenance and monitoring activities for this aspect of the shoreline stabilization are included in Appendix H (Tables H-2 and H-3) of the Wastebeds 1-8 IRM Design (O'Brien & Gere, 2013).

8.1 SUCCESS CRITERIA

The success criteria for the WB 1-8 shoreline stabilization are:

- Reduce from baseline levels near-shore turbidity associated with wind / wave events in the area where graded gravel is placed
- Increase stability to reduce erosion of the shoreline

8.2 MONITORING SUMMARY

The monitoring program for WB 1-8 shoreline stabilization included collection of baseline turbidity data in SMU 3 prior to the placement of the graded gravel. Turbidity measurements were collected using three different methods: 1) data sondes at three locations that provided turbidity measurements every 15 minutes over approximately three months; 2) a portable turbidity meter used weekly along five transects; and 3) turbidity measurements made at 46 locations during a single-day wind event. Of the three methods, the data sondes were most effective in identifying elevated turbidity levels during high wind/wave events, as documented in the Wastebeds 1-8 Baseline Turbidity Monitoring Report (Parsons and UFI, 2014b). Turbidity levels measured using the portable turbidity meters were uniformly low, therefore future compliance monitoring will include sonde deployment only. The potential use of portable turbidity meters will be considered in the event that monitoring of additional locations or transects is needed. One year post completion of the shoreline stabilization and RA-B capping, turbidity data will be collected using data sondes at the same locations and over approximately the same three-month time period as the baseline monitoring program. Prior to the deployment of data sondes, the macrophyte coverage will be visually assessed and documented along the Wastebeds 1-8 Shoreline Stabilization area to ensure that sonde locations are representative of the condition of the shoreline. Results of the survey will be discussed with NYSDEC to determine if any of the locations need to be adjusted. Monitoring is anticipated to begin in 2017. If storm/wind/wave events comparable to those that occurred during baseline monitoring do not occur during compliance monitoring, additional monitoring may be appropriate and will be determined in consultation with NYSDEC.

Additionally, an annual physical inspection and photo documentation of this area will be completed as part of the long-term cap physical monitoring program, as detailed in Appendix D. Any signs of potential erosion will be photographed and noted during the inspection. Any other signs of potential impacts, such as seeps or disturbances, will also be noted. Physical inspections will occur annually for a minimum of five years. Additional physical monitoring may be appropriate based on the results of the first five years of monitoring. In addition, physical inspection and photo documentation will be completed after the first 10-year wind-generated wave event[7] occurs, which was the basis for determining size of the substrate used for the shoreline stabilization. The construction completion date for the WB 1-8 shoreline stabilization area was November 2014. Wind records from the same station used in the design (NOAA WBAN 14771 at Syracuse Hancock International Airport) were obtained for November 2014 through mid-May

[7] Wind speeds greater than 38 mph from the north, northeast or east. Further details can be found in Table 9.1 in Appendix D of the Final Design.

2017. Within that time frame, one wind event occurred that exceeded the 10-year event wind speed from the directions of interest. On 5/29/2016, the hourly reported wind speed was 40 mph (just slightly higher than the 10-year wind speed) and came from a direction of 350° (from the North). Winds gust were as high as 60 mph. In reviewing the weather records for that date (from www.weatherunderground.com), it appears a strong thunderstorm and front moved through the area in the afternoon which produced a wind speed that exceeded the 10-year event. Therefore, monitoring beginning 2017 will be reflective of conditions subsequent to a wind-wave event that exceeded the design basis.

If significant loss of stabilization material is noted as part of the physical inspection, additional turbidity monitoring may be appropriate and will be evaluated in consultation with NYSDEC.

8.3 CRITERIA ATTAINMENT DETERMINATION

Attainment of the success criteria for shoreline stabilization will be met when turbidity levels are lower than the baseline levels based on the results from one post-construction three-month turbidity monitoring program. The following metrics will be evaluated, as described in Appendix A of the Baseline Monitoring Report (Parsons and UFI, 2014):

- Changes in peak turbidity events between the baseline and compliance monitoring (smaller peaks and/or shorter durations than baseline)
- Shifts in median turbidity at specified wind intervals between the baseline and compliance monitoring (lower median turbidity at wind intervals)
- Changes in slope of wind speed versus turbidity regression between the baseline and compliance monitoring (lower slopes)

If turbidity data collected post placement verify the reduction of turbidity from baseline levels, then turbidity monitoring will conclude. However, as discussed in Section 8.2 above, additional turbidity monitoring may be appropriate based on the results of the annual and/or event based visual inspections and/or the initial post-remediation turbidity monitoring to be conducted in 2017. In the case that comparable storm/wind/wave events do occur during 2017 compliance monitoring but criteria are not attained, an additional round of turbidity monitoring will be carried out in 2018. In the unlikely event that compliance is still not achieved after 2018, the scope of any further monitoring or response actions will be determined in consultation with NYSDEC.

8.4 RESPONSE ACTIONS

Response actions for the offshore stabilization area includes collection of additional data to determine presence of placed material, and/or increased turbidity monitoring. The substrate in this area was selected to be resistive to erosional forces up to a 10-year, wind-generated wave event rather than a 100-year event as was used for the design of the cap erosion-protection layer. In addition, ice scour may occur due to the shallow water along this shoreline. Based on these considerations, some movement of the substrate is expected due to ice and/or under events larger than a 10-year event and would not necessarily indicate that response actions are required.

Additional turbidity monitoring will be completed at the closest downwind location monitored during baseline monitoring should significant material losses be observed during physical monitoring to verify that turbidity remains lower than baseline levels. The scope of this additional turbidity monitoring will be developed in consultation with NYSDEC. If turbidity monitoring indicates that turbidity levels are not lower than baseline levels, additional quantitative turbidity monitoring or placement of material will be evaluated.

8.5 REPORTING

Field data will be downloaded or entered into a database that includes turbidity, and specific conductance measurements. Data will be managed by UFI throughout the monitoring period and final data sets will be stored by Parsons. Data summaries, assessments, and recommendations will be discussed with NYSDEC and summarized in report form following sampling completion. Data reporting will include evaluations of criteria attainment described in Section 8.3 above.

SECTION 9

INSTITUTIONAL CONTROLS

Institutional controls are included as part of the long-term monitoring and maintenance program for the lake to protect the integrity of the cap and ensure long-term protectiveness of human health and the environment. As defined in USEPA's Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (2005), institutional controls are non-engineered instruments, such as administrative and legal controls, that may be included as part of a remedial action to minimize the potential for human health or ecological exposure to sediment contamination and ensure the long-term integrity of the remedy. Specifically, institutional controls will be implemented to:

- Prevent unacceptable exposure to residual contamination within the lake
- Prevent recreational boaters from accidently hitting any navigational hazards created by capping and restoration components of the remedy
- Prevent damage to the cap from activities such as navigational dredging

Each of these categories of institutional controls are discussed below. Consistent with NYSDEC requirements, certification that institutional controls are in place and that remedy-related Operations, Monitoring and Maintenance (OM&M) is being performed will be submitted to NYSDEC as a component of the cap monitoring section of the annual reports.

9.1 PREVENTION OF CONTAMINATION EXPOSURE

As documented in the ROD, even prior to remediation there were no unacceptable risks associated with human contact with lake sediments based on the baseline human health risk assessment completed prior to implementation of the remedy (TAMS, 2002c). This included potential recreational exposure pathways (e.g., swimming, wading, boating) and potential exposure by future construction workers. Excess cancer risks for these exposure pathways were within or below the acceptable range of one in one million to one in ten thousand and the hazard index (HI) for non-cancer risks did not exceed 1.0. Therefore, no institutional controls are required associated with potential exposure by future construction workers, or recreational use of the lake, other than fish consumption as discussed below. As discussed in Section 9.3, any activity or use which may damage the cap or disturb underlying materials is prohibited. These provisions will provide additional assurance that there will be no unacceptable risks associated with direct human exposure to sediments within the lake.

Onondaga Lake was closed to fishing in 1970, and subsequently reopened with consumption advisories in 1986. Fish consumption advisories have been and will continue to be maintained by the NYSDOH. All fresh waters in New York State are under a NYSDOH fish consumption advisory specifying humans should consume no more than one meal (one-half pound) per week.

Specific to Onondaga Lake at the time of preparation of this report, the NYSDOH fish consumption advisory is:

- Children age 15 and younger and women under age 50, all species and sizes: do not eat.
- Men over age 15 and women over age 50:
  - Walleye, Carp, Channel Catfish, White Perch of all sizes; Largemouth Bass and Smallmouth Bass greater than 15 inches: do not eat.
  - Largemouth Bass and Smallmouth Bass less than 15 inches: eat up to one meal/month.
  - Brown Bullhead and Pumpkinseed: eat up to four meals/month
  - For all other fish: eat up to one meal/month.

Advisories are typically updated by the NYSDOH yearly based on new information as it becomes available. The most up to date information can be found on the NYSDOH website, by contacting the NYSDOH directly, or by contacting the NYSDEC. It is expected that consumption advisories for all relevant species will be maintained by the NYSDOH until acceptable levels are met. Details regarding the scope of fish tissue monitoring to be conducted by Honeywell that can be used by NYSDOH while setting consumption advisories are provided in Section 4.

9.2 RECREATIONAL BOATING

The New York State Office of Parks, Recreation and Historic Preservation currently maintains navigational buoys in Onondaga Lake to warn boaters of hazards in water less than 4 ft. in depth and beyond 100 ft. from shore. Permanent demarcations were deployed in RA-A in the shallow water area in early June 2016 by the construction team under the directive of NYS Office of Parks, Recreation and Historic Preservation. Honeywell will coordinate with this agency to place any additional buoys. All markers will be placed and maintained by NYS Office of Parks, Recreation and Historic Preservation. The NYS Office of Parks, Recreation and Historic Preservation has been contacted to verify the process which will be implemented to provide them with the necessary information to allow them to place any required buoys.

In addition, updated (post-capping) bathymetric survey data will be provided to the National Oceanic and Atmospheric Administration (NOAA) to allow them to update the Navigational Chart for Onondaga Lake (currently included as Chart Number 14786 for the Small-Craft Book Chart for the New York State Canal System). NOAA has been contacted to verify the process which will be implemented to provide them with the necessary information to allow them to update the navigational charts.

9.3 CAP PROTECTION

As discussed below, both the U.S. Army Corps of Engineers (USACE) and the NYSDEC have the authority and responsibility to enforce prohibitions on activities that would threaten the integrity of the cap. Examples of regulated activities include but are not limited to: building structures such as bulkheads, piers, catwalks, boathouses and pilings; excavation, dredging, filling

and depositing dredged or fill material in waters and wetlands such as marshes, swamps, bogs, forested wetlands, some isolated wetlands, and in lakes and waterways; construction of overhead and underwater transmission lines, cables and pipes; and, construction of breakwaters, jetties, groins and stone revetments. Any individual, company, corporation or government body planning these types of activities would be regulated and required to apply for permits with both the USACE and the NYSDEC. The permit application process would trigger both the USACE and NYSDEC to deny approval for activities which could detrimentally impact the integrity of the sediment cap. The USACE and NYSDEC have been contacted to verify the process which will be implemented to provide them with the necessary information to allow them to appropriately regulate future activities within the areas specified below. Honeywell will send a notification, including relevant information relating to the location of remedial elements, to the specific permitting offices with the USACE and the NYSDEC. This notification will be repeated every five years. As detailed in Section 6, Honeywell will implement a long-term cap monitoring program which will include shoreline inspections, bathymetric surveys, and other monitoring activities which will provide information which will assist in documenting that the institutional controls are effective and that the cap has not been disturbed.

"No Dredge" areas will be established over the following:

- All capped areas except for the New York State Canal Corporation Navigational Channel leading to Onondaga Creek and the Syracuse Inner Harbor. The channel depth leading to Onondaga Creek within the dredging and capping area was developed to be deep enough to accommodate commercial boat traffic that uses Onondaga Creek and the Inner Harbor. The New York State Canal Corporation (NYSCC), which is responsible for navigational dredging within the lake, requested that the remedy include creating post-capping bathymetry that is consistent with the original 1915 canal design, for which they provided design drawings. To allow for future potential navigational dredging in this area if the channel accumulates significant sediment over time, the remedy included dredging to a sufficient depth such that the final cap surface is 2 ft. below the navigational depth to prevent dredge-induced damage to the cap during future navigational dredging (Parsons and Anchor QEA, 2014). The detailed design for this area has been provided to the NYSCC.
- The profundal zone, which is currently undergoing MNR as prescribed in the ROD. As contaminated sediments are slowly being buried by cleaner sediments, dredging or similar disturbances could disrupt the MNR process and potentially redistribute contaminated sediments into the lake system.
- The approximately 200-ft. area along the RA-E (southeastern) shoreline, including the navigation channel within the site limits, where it was determined that dredging and capping could not be performed based on shoreline stability considerations (EPA and NYSDEC, 2014).

The cap was designed to be resistant to potential scour resulting from boat propellers and wakes. Anchoring of recreational boating would result in minor disturbances of the cap that would not impact its overall effectiveness. The MPCs which did not include a separate erosion protection layer (i.e., monolayer sand caps, exclusive of GAC direct application areas) are all located in deep water areas (greater than 10 ft.) where sand was determined to be resistant to anticipated erosive forces as specified in the design, including boat propellers and wakes, therefore boating restrictions such as no wake areas are not required for these areas. The majority of the small areas that included GAC direct application are in water depths greater than 10 ft. where there will be minimal erosive forces due to wind/wave action or boating activities. In shallower areas, the erosive forces due to wind/wave action will likely exceed those related to boating activity and therefore restrictions such as reduced speeds and no wake areas would not provide significant benefit. In addition, as discussed in Section 6, more frequent monitoring will be conducted in these MPC areas to monitor the presence and effectiveness of the GAC. Therefore, there are no restrictions required on recreational boating associated with protecting the integrity of the cap.

9.3.1 USACE

The USACE has been involved in regulating certain activities in the nation's waters since 1890. Until 1968, the primary thrust of the Corps' regulatory program was the protection of navigation. As a result of several subsequent laws and judicial decisions, the program has evolved to one involving the consideration of the full public interest by balancing the favorable impacts against the detrimental impacts. This is known as the "public interest review." Any individual, company, corporation or government body planning construction or fill activities in waters of the United States, including wetlands, must obtain a permit from the Corps of Engineers. In general, the Corps of Engineers has jurisdiction over all construction activities in tidal and/or navigable waters, including adjacent wetlands, shoreward to the mean high-water line. In other areas, such as nontribal waterways, adjacent wetlands, some isolated wetlands, forested wetlands, and lakes, the Corps has regulatory authority over the discharge of dredged or fill material. The program is one which reflects the national concerns for both the protection and utilization of important resources. The regulatory authorities and responsibilities of the Corps are based on the following laws:

Section 10 of the Rivers and Harbors Act approved March 3, 1899, (33 U.S.C. 403) (referred to as Section 10), prohibits the unauthorized obstruction or alteration of any navigable water of the United States. The construction of any structure in or over any navigable water of the United States, the excavating from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army.

Section 404 of the Clean Water Act (33 U.S.C. 1344) (referred to as Section 404), authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearing, for the discharge of dredged or fill material into the waters of the United States at specified disposal sites.

Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (33 U.S.C.1413) (referred to as Section 103), authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearing, for the transportation of dredged material for the purpose of disposal in the ocean where it is determined that the disposal will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities.

9.3.2 NYSDEC

NYSDEC was established in 1970 to form a comprehensive agency that encompasses all state programs intended to protect and enhance the environment. The programs are authorized under the Environmental Conservation Law (ECL) and work in coordination with local and federal programs. Regulations pertaining to activities which could potentially impact the integrity of the cap as well as permit application details are detailed in 6NYCRR Part 608 Use and Protection of Waterways. Statutory authority for enforcement of these regulations is also documented within the Part 608 regulations.

SECTION 10

PROGRAM SCHEDULE, ANTICIPATED DELIVERABLES, AND MONITORING AND MAINTENANCE STAFFING REQUIREMENTS

10.1 PROGRAM SCHEDULE AND ANTICIPATED DELIVERABLES

Routine data collection efforts related to Honeywell's Onondaga Lake remedy will formally transition to long-term monitoring in 2017. The monitoring and reporting schedules for the various monitoring elements are provided in the respective sections of this OLMMP and are summarized in Table ES.1. Work plans for element(s) to be monitored are included in this document as appendices. Any changes to scope will be submitted to NYSDEC for approval prior to the commencement of sampling. Detailed standard operating procedures (SOPs) are presented in the QAPP. Monitoring elements scheduled for data collection as part of the long-term monitoring program include:

- SMU 8 MNR
- Biota Tissue
- Surface Water
- Cap Maintenance and Monitoring
- Habitat Reestablishment and Biological Response
- WB1-8 Shoreline Stabilization Turbidity Monitoring
- Institutional Controls

The work plans, which are included as appendices to this document, are based primarily on approved work plans used in previous sampling efforts, where applicable. Future revisions or updates will be discussed and coordinated with NYSDEC in advance.

An annual summary report will be submitted to NYSDEC that will include the results for each monitoring element for which monitoring occurred for a given year. The details of what will be included in annual reports for each element is discussed in the respective sections of this document. Reports will typically be issued by June 15 of the year following sampling, unless otherwise discussed with NYSDEC. In addition, analytical results will be submitted to the agencies within 30 days of completion of data validation according to procedures set forth in the QAPP and in the work plans for the various monitoring elements.

In addition to the information included in annual reports, a comprehensive report will be issued approximately every five years starting in 2019. The comprehensive report will summarize the preceding five years of monitoring data, and will include evaluations of trends over time, which is particularly applicable for components for which changes are more gradual, such as fish tissue mercury concentrations, MNR progress and wetland vegetation establishment. The comprehensive report will also include a discussion of potential response actions, as appropriate. Additional

analysis and/or reporting will be included in the five-year comprehensive report, and would be available for the USEPA Five-Year reviews. The first USEPA Five-Year Review occurred in 2015; the second Five-Year Review is scheduled to occur in 2020. The ROD states that "*...a statutory review will be conducted within five years after initiation of remedial action. The five-year review will evaluate the results from monitoring programs established as part of this remedy to ensure that the remedy remains protective of human health and the environment."* The comprehensive reports will be issued during the fall of the year preceding the EPA review, with the specific schedule for submittal to be discussed with NYSDEC in advance.

As discussed in Section 9.3, U.S. Army Corps of Engineers and the NYSDEC will enforce prohibitions on activities that would threaten the integrity of the cap through their permitting processes. Honeywell will send a notification, including relevant information relating to the location of remedial elements, to the specific permitting offices with the USACE and the NYSDEC. This notification will be repeated every five years timed coincident with and documented within the five-year review reports.

10.2 MONITORING & MAINTENANCE (M&M) STAFFING REQUIREMENTS

10.2.1 Staffing Requirements

Honeywell's Contractor is responsible for providing sufficient staffing for executing this plan. Honeywell will have a representative that can communicate between the Contractor and NYSDEC in terms of documentation, reviews, and agency inspections. Honeywell and/or its contractor will notify NYSDEC in advance of conducting any repairs to the cap or other components of the remedy (e.g., berms, wave breaks).

10.2.2 Responsibilities and Duties

Honeywell's Contractor

Honeywell's Contractor will be responsible for conducting any necessary site inspections, maintenance/repairs, sampling, field documentation of M&M activities, and report preparation. Honeywell's Contractor is responsible for site health and safety during M&M activities. In the case that a subcontractor is secured to carry out a portion of the work, Honeywell's Contractor is responsible for ensuring that the work is carried out in accordance with the Plan, as well as for ensuring proper QA/QC documentation.

Honeywell

Honeywell is ultimately responsible for implementing the M&M program in accordance with the OLMMP. Honeywell is financially responsible for the M&M program and must contract for M&M services, as applicable. Honeywell will submit required documentation to NYSDEC and participate in five-year review meetings, if requested by NYSDEC.

NYSDEC

The NYSDEC is responsible for ensuring that the OLMMP is carried out as approved. The NYSDEC will review and approve monitoring reports for each component of the monitoring program and will participate in the five-year review meeting, as needed, to make decisions regarding the long-term M&M program.

USEPA

The USEPA, in conjunction with NYSDEC, is responsible for generating the Five-Year Review, and thereby documenting the ongoing protectiveness of the remedy**.**

10.2.3 Qualifications and Training

Qualifications and training for laboratory and field sampling personnel will be provided in the QAPP that will be submitted to the NYSDEC both initially and upon future modification. A health and safety plan will be submitted to NYSDEC for informational purposes.

10.2.4 Citizen Participation

Honeywell is committed to cooperating with NYSDEC to inform the public during the M&M period. Honeywell will conduct the M&M program with NYSDEC oversight, review, and approval. NYSDEC will implement the citizen participation activities with Honeywell's assistance as needed.

For additional information, the public is encouraged to contact any of the following project staff:

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SECTION 11

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TABLES

TABLE ES.1
SCHEDULE FOR ONONDAGA LAKE MONITORING AND MAINTENANCE

Monitoring Component	Sub-component	Post-Construction Monitoring Period					Long-term Period
		2017	2018	2019	2020[1]	2021	2022+
MNR[2]	Mercury PEC, Mercury BSQV, and microbead markers	X			X		2023 & 2026
	Sediment traps	X	X	X	X	X	
Tissue[3]	Fish and zooplankton tissue	X	X	X	X	X	⇨
Surface Water	Mid-lake routine sampling (nitrate program)	X	X	X	X	X	⇨
	Compliance sampling	X	X	⇨			
Cap Effectiveness	Routine physical monitoring	X	X	X	X	X	2022, 2024, 2026 ⇨
	Event based physical: thickness, integrity, and stability[4]						
	Routine chemical monitoring	X		X			2022, 2024 ⇨
Habitat[3]	Wetland vegetation[5]	X	X	X	X	X	2022 ⇨
	Aquatic vegetation	X	X	X	X	X	2022 ⇨
	Fish community	X	X	X	X	X	⇨
	Wildlife community (mammals, birds, reptiles and amphibians)	X	X	X	X	X	⇨
	Macroinvertebrate community		X		X		⇨
WB 1-8 Shoreline Stabilization	Nearshore turbidity	X	⇨				
	Physical inspection[6]	X	X	X	X	X	

⇨ Hatched arrows indicate the need for and/or schedule for continued monitoring is dependent on evaluation of prior results.

[1] The EPA Second Five-Year Review is anticipated to occur in 2020, with the Third Five-Year Review to occur in 2025.

[2] Schedule for routine monitoring shown. MNR sampling may be terminated prior to ten years if compliance verification monitoring (two consecutive events) indicates that goals have been achieved and NYSDEC approves of such a change.

[3] Includes adult sport fish fillets, whole body composites, whole body prey fish, and zooplankton annually. Some sub-components that are currently scoped to be single sampling events to establish a post remediation baseline condition or sampling events that fall under other subcomponents have not been included in this table. Specific details regarding scopes of work are included in the individual sections and respective work plans.

[4] Monitoring will be completed if specific event triggers are exceeded.

[5] The monitoring schedule for re-established wetland vegetation has staggered start and finish times that are a function of both capping and planting schedules. Monitoring begins within individual areas the first growing season after planting is completed and then continues for five consecutive years. Planting of re-established areas began in 2016 (following capping). Depending on the individual area, the five year monitoring period will begin between 2017 and 2018 and end between 2021 and 2022. Note, a wetland survey will be conducted in Year 3 and a formal wetland delineation will occur in year 5 for each area.

[6] Physical inspection and photo documentation will be completed after the first 10-year wind-generated wave event occurs, which was the basis for determining size of the new substrate used for the shoreline stabilization.

TABLE 3.1
SCHEDULE FOR IMPLEMENTING MNR IN ONONDAGA LAKE

		Planned Sampling		Data Eval. and Decisions		Conduct Responses[e]		
Project Phase	**Year**	**Number of Routine Surface Sediment Locations[a]**	**Sampling to Assess Sedimentation Rate and Mixing[b]**	**Track MNR[c]**	**Evaluate Response Actions[d]**	**Monitoring or Modeling**	**Thin-Layer Capping or Other Construction**	**Implementation Notes**
Design	2007	26						
	2008	7	High-Resolution Cores					
	2009		Markers Deployed					
	2010	70	Cores	Yes	Yes			
	2011	10	Cores	Yes	Yes			
Construction	2012		Cores					Dredging/Capping started
	2013							
	2014	20	Cores	Yes	Yes			
	2015		Cores	Yes	Yes			
	2016							Cap+TLC construction completed
MNR Period[f]	2017	22	Cores	Yes	Yes			MNR Baseline
	2018					If Needed		
	2019					If Needed	If Needed	
	2020	22	Cores	Yes	Yes			
	2021					If Needed		
	2022					If Needed	If Needed	
	2023	22	Cores	Yes	Yes			
	2024					If Needed		
	2025					If Needed	If Needed	
	2026	22	Cores	Yes	Yes			
	2027					If Needed	If Needed	TLC any remainder

Notes:

[a] The number of sample locations during the MNR period is for the "routine monitoring" in uncapped areas of SMU 8. Additional samples will be collected in SMU 8 and the littoral zone to assess compliance with the PEC and BSQV, See Appendix A.

[b] Sampling may include high resolution cores as well as marker cores.

[c] Tracking MNR will involve updating the MNR model and other projections as warranted based on new data.

[d] Response actions may include additional monitoring, modeling, and/or additional thin layer-capping (TLC).

[e] To date, natural recovery has been progressing faster than predicted and no additional modeling or response actions have been necessary.

[f] Routine monitoring is scheduled to occur every three years until goals are met as determined by compliance monitoring or until 2027. Additional compliance monitoring events may occur as needed based on monitoring data being collected (events will be within one to three years of one another). See Sections 3.2 through 3.4 for additional information.

TABLE 4.1

SUMMARY OF LONG-TERM MONITORING OF FISH

Objective	Species	Prep	Number	Analytes[1]
Human Health				
Sport Fish	Walleye, Smallmouth Bass, Carp, Pumpkinseed	NYS Standard Fillet	25/species (evenly distributed among 8 locations)	Hg, PCBs, hexachlorobenzene, lipids, percent moisture and dioxin/furans (12/species) annually
Ecological				
Large prey[2]	White Sucker	Whole body	24 (evenly distributed among 8 locations)	Hg, PCBs, hexachlorobenzene, DDT+metabolites, lipids, and percent moisture annually
Small prey	Killifish/ Minnows	Whole body composites of 10-15 individuals	24 (3 at each of 8 locations)	Hg, PCBs, hexachlorobenzene DDT+metabolites, lipids, and percent moisture annually

Notes:

1 Annual sampling, Hg and organics analysis through at least 2019. Following review of data annually and in 2020, reduction of sampling and/or analysis by species and analyte will be considered, subject to NYSDEC approval.

2 Sport fish data can also be used to calculate concentrations in large prey fish consumed by ecological receptors after the fillet concentrations are converted to whole-body concentrations.

TABLE 5.1
ONONDAGA LAKE SURFACE WATER STANDARDS AND GUIDANCE VALUES

		Class B/C							
		Human Consumption of Fish		Fish Propagation		Fish Survival		Wildlife Protection	Aesthetic
Parameter[1]	Units	H(FC)	Basis code	A (C)		A (A)		W	E
Mercury	ug/L								
Dissolved Mercury	ug/L	0.0007	B	0.77		1.4		0.0026	
Methylmercury	ug/L								
Benzene	ug/L	10	A	210	(G)	760	(G)		
Chlorobenzene	ug/L	400	B	5					
1,2-Dichlorobenzene	ug/L			5	**				
1,3-Dichlorobenzene	ug/L			5	**				
1,4-Dichlorobenzene	ug/L			5	**				
Ethylbenzene	ug/L			17	(G)	150	(G)		
Toluene	ug/L	6000	B	100	(G)	480	(G)		
1,2,3-Trichlorobenzene	ug/L			5	**				
1,2,4-Trichlorobenzene	ug/L			5	**				
1,3,5-Trichlorobenzene	ug/L			5	**				
o-Xylene	ug/L			65	(G)**	590	(G)**		
m,p-Xylene	ug/L			65	(G)**	590	(G)**		
Xylenes, Total	ug/L			65	(G)	590	(G)		
Acenaphthene	ug/L			5.3	(G)	48	(G)		
Anthracene	ug/L			3.8	(G)	35	(G)		
Benzo(a)anthracene	ug/L			0.03	(G)	0.23	(G)		
Benzo(a)pyrene	ug/L	0.0012	(G)						
Fluorene	ug/L			0.54	(G)	4.8	(G)		
Naphthalene	ug/L			13	(G)	110	(G)		
Phenanthrene	ug/L			5	(G)	45	(G)		
Pyrene	ug/L			4.6	(G)	42	(G)		
Phenol	ug/L								1
PCB Congeners	ng/L	0.001						0.12	

Notes:

[1] PAHs being analyzed in surface water are consistent with the CPOIs in the cap monitoring program and have relevant surface water quality standards or guidance values.

H(FC)- Human consumption of fish
A(C)- Fish propagation
A(A)- Fish survival
W- Wildlife protection
E- Aesthetic
** - standard refers to the sum of the isomers
(G) - indicates a guidance value
A - Oncogenic, Human Health Basis code
B - Non-oncogenic Human Health Basis code
Source: NYSDEC Ambient Water Quality Standards and Guidance Values, 1998

TABLE 6.1
HABITAT LAYER CHEMICAL PERFORMANCE STANDARDS

Chemical	Performance Standard[1]	
Benzene	760	µg/L
Chlorobenzene	428	µg/kg
Dichlorobenzenes	239	µg/kg
Ethylbenzene	176	µg/kg
Naphthalene	917	µg/kg
Phenol	250	µg/L
Toluene	480	µg/L
Xylene	561	µg/kg
Trichlorobenzenes	347	µg/kg
PCBs	295	µg/kg
Fluorene	264	µg/kg
Phenanthrene	543	µg/kg
Acenaphthene	861	µg/kg
Acenaphthylene	1,301	µg/kg
Anthracene	207	µg/kg
Pyrene	344	µg/kg
Benzo(a)anthracene	192	µg/kg
Benzo(b)fluoranthene	908	µg/kg
Benzo(k)fluoranthene	203	µg/kg
Chrysene	253	µg/kg
Fluoranthene	1,436	µg/kg
Benzo(a)pyrene	146	µg/kg
Dibenz(a,h)anthracene	157	µg/kg
Indeno(1,2,3-cd)pyrene	183	µg/kg
Benzo(g,h,i)perylene	780	µg/kg
Mercury	2,200	µg/kg

1 Includes PECs for chemicals that are used for calculation of the mean PECQ plus the NYSDEC sediment screening criteria for benzene, toluene and phenol.

TABLE 6.2
CAP ROUTINE MONITORING SCHEDULE

Year	Full Thickness Multi-Layer Caps and SMU 8 TLCs Included in Final Design				MPCs, MERCs, and SMU 8 TLCs and Direct Application Areas Included in Design Revisions	
	Chemical		Physical		Chemical	Physical
	Comprehensive	Focused[1]	Comprehensive Bathy Survey & Coring[2]	Probing & Visual Inspection	Comprehensive	Comprehensive Bathy Survey & Coring[2]
2017	X		X	X	X	X
2018			X	X		X
2019		X	X	X	X	X
2020[3]				X		X
2021				X		
2022	X		X[4]		X	X[4]
2023						
2024		X	X[4]		X	X[4]
2025[3]						
2026				X		

[1] Focused chemical monitoring events would include at least 50% of the locations from the comprehensive monitoring events.

[2] Includes coring associated with routine chemical monitoring and additional coring as needed based on bathymetric survey and coring results to verify thickness.

[3] USEPA 5-Year Review.

[4] Full bathymetric survey unless focused bathymetric survey approved by NYSDEC.

Bathymetry measurements and chemical sampling in the CSX shoreline area will be completed in 2019 and 2024.

Additional work plans documenting the cap monitoring schedule after 2026 will be prepared in 2026, subject to NYSDEC review and approval.

Additional monitoring will be implemented as appropriate based on prior results or occurrence of wind/wave or flow events exceeding triggers.

TABLE 6.3
CAP MONITORING CHEMICAL PARAMETERS

REMEDIATION AREA	CAP MODEL AREA (INCLUSIVE OF MPCS)	CHEMICAL GROUPS THAT DETERMINED GAC APPLICATION RATE	INDICATOR CHEMICAL GROUPS	ADDITIONAL CHEMICAL GROUPS
A	A1	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
	A2[1]	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
B	B1	Phenol	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	B2	Phenol	VOCs[4], LPAHs, mercury, pH	PCBs, HPAHs
C	C1	Phenol	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	C2	LPAHs	VOCs, LPAHs, HPAHs, mercury, pH	PCBs
	C3	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
D	SMU 2	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	West	Phenol	VOCs, LPAHs, HPAHs, mercury, pH	PCBs
	Center[2]	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	East	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
E	E1A[3]	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
	E1B[3]	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
	E2	VOCs	VOCs, LPAHs, mercury	PCBs, HPAHs
	E3	VOCs	VOCs, mercury	PCBs, LPAHs, HPAHs
F	F	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
SMU 8 Amended TLCs and GAC Direct Application	SMU 8	Not Applicable	mean PECQ VOCs, PAHs, PCBs, mercury. pH	None
SMU 8 Unamended TLCs	SMU 8	Not Applicable	mean PECQ VOCs, PAHs, PCBs, mercury	None
Wetlands	WB1-8	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	WBB-East	VOCs	VOCs, LPAHs, mercury	PCBs, HPAHs
	WBB-Center	VOCs	VOCs, LPAHs, HPAHs, mercury, pH	PCBs
	WBB-West	VOCs	VOCs, LPAHs, HPAHs, mercury, pH	PCBs

Notes: Naphthalene is included as a VOC.

LPAHs include fluorene, phenanthrene, acenaphthene, acenaphthylene and anthracene. Phenol is not a PAH but is included in the LPAH indicator and additional chemical group for convenience since PAHs and phenol are both analyzed by EPA Method 8270. HPAHs include fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3,-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

[1] Includes Ninemile Creek Spits and Model Area RA-A-40197.

[2] Includes Model Area OL-VC-10138/40.

[3] E1 consists of two separate areas that were modeled as one area.

[4] VOCs are not considered an indicator chemical group for Model Area B2 based on the original cap modeling but are included because they were modeled as part of the design for the MPCs within that area.

TABLE 6.4A
50-YEAR AND 100-YEAR RETURN INTERVAL WIND SPEEDS AND DIRECTIONS

Remediation Area	50-year Wind Speed (in miles per hour)	100-year Wind Speed (in miles per hour)	Directions
A and F1	45	48	North, Northeast, East
B	45	48	North, Northeast, East
C	42	45	North, Northeast, East
D	44	47	North and Northwest
E	56	60	Northwest
F2	55	58	Southeast, South, West

TABLE 6.4B
50-YEAR AND 100-YEAR RETURN INTERVAL FLOW EVENTS[1]

Tributary	50-year Daily-Averaged Flow Rate (in cubic feet per second)	100-year Daily-Averaged Flow Rate (in cubic feet per second)
Ninemile Creek	3,300	3,800
Harbor Brook	800	1,000
Onondaga Creek	4,400	4,900

[1] Source: 100-year flow rates reported in Table 6-2 of Appendix D (Erosion Protection Layer Evaluation) of Parsons and Anchor QEA (2012). The 50-year flow rates were estimated from a flood frequency analysis of historical streamflow data.

TABLE 7.1
STAGE 1 CONSTRUCTION SUCCESS CRITERIA SUMMARY

Goal[1]	Objective(s)	Stage 1 Parameters	Timing	Comparison to[2]	Response Action
Maintain or improve size, diversity, and ecological function of wetlands.	Establish wetland modules: • Module 4A in Remediation Area A and Wastebed B/Harbor Brook Outboard Area (WBB/HB Outboard Area) • Module 5A in Remediation Area A, Connected Wetland at Wastebeds 1-8 (WB 1-8), and WBB/HB Outboard Area • Module 6A in Remediation Area A, Spits at the Mouth of Ninemile Creek, Connected Wetland at WB 1-8, and WBB/HB Outboard Area • Module 9A/B at WBB/HB Outboard Area	• Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content • Planting specifications[3] • Structure placement	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
	Create Connected Wetland at WB 1-8[4] Create wetlands for Northern Pike in WBB/HB Outboard Area Create wetlands on the spits at the mouth of Ninemile Creek	• Acreage • Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content • Planting specifications • Structure placement	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
Maintain or improve connectivity of the lake habitats with adjacent stream and upland habitats. .	Establish modules that transition from the lake to shoreline: • Module 4A in Remediation Areas A, and WBB/HB Outboard Area • Module 5A in Remediation Areas A, B, and WBB/HB Outboard Area • Module 6A in Remediation Area A and WBB/HB Outboard Area • Modules 8A/B at WBB/HB Outboard Area • Module 9A/B at WBB/HB Outboard Area	• Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content • Planting specifications • Structure placement	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met

[1] Goals are from Section 4 of the Habitat Plan and are specific to habitat restoration and do not include measurements related to attainment of Preliminary Remedial Goals (PRGs).
[2] The Stage 1 Parameters will be evaluated by comparing quality control data to design documents, etc., to determine achievement of success criteria (monitoring details provided in CQAP)
[3] Planting specifications include plant density, species, and any contractor warranty for survival.
[4] Success criteria pertaining to planting specifications and structure placement for the Wastebeds 1-8 Connected Wetlands will be conducted and documented under Wastebeds 1-8 Integrated IRM Scope.

TABLE 7.1
STAGE 1 CONSTRUCTION SUCCESS CRITERIA SUMMARY

Goal	Objective(s)	Stage 1 Parameters	Timing	Comparison to	Response Action
Maintain or improve connectivity of the lake habitats with adjacent stream and upland habitats (cont'd.).	Connected Wetland at WB 1-8	• Acreage • Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content • Planting specifications • Structure placement	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
Maintain or improve ecological function of the littoral zone.	Establish a diversity of habitats in the littoral zone: Modules 1, 2, 3, 5B, and 6B	• Elevation • Habitat layer thickness • Grain size and analytical chemistry • Structure placement	During and immediately following construction	Design documents and CQAPs	Design and CQAP requirements must be met
	Modules 4A, 5A, and 6A	• Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content • Planting specifications • Structure placement	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
Maintain or improve ecological function of the shoreline habitat.	Modules 4A, 5A, 6A, and 8A/B	• Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content • Planting specifications • Structure placement	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
	Create Connected Wetland at WB 1-8	• Acreage • Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content (Modules 4A, 5A, and 6A only) • Planting specifications • Structure placement	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
	WB 1-8 Shoreline Stabilization	• Thickness • Grain size and analytical chemistry	Immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met

TABLE 7.1
STAGE 1 CONSTRUCTION SUCCESS CRITERIA SUMMARY

Goal	Objective(s)	Stage 1 Parameters	Timing	Comparison to	Response Action
Maintain or improve habitat conditions of the profundal zone.	Place thin layer cap in specific portions of SMU 8	• Thickness • Grain size and analytical chemistry	During and immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
Conserve and/or create habitats for threatened and/or endangered or rare species[5].	Establish a diversity of habitat types	• Elevation • Habitat layer thickness • Grain size and analytical chemistry • Organic Matter Content • Planting specifications • Structure placement	Immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met
Design conditions that discourage the establishment of invasive species (e.g., avoid creating conditions conducive for invasive plant species) to the extent practicable.	Use native species in seeding and planting plans Use clean material for habitat substrate	• Species identification • Substrate classification	During construction	Design documents and CQAP	Reject any non-compliant species or material
Develop conditions that require minimal maintenance and promote public use.	Use native, robust species in seeding and planting plans	• Species identification	During construction	Design documents and CQAP	Reject any non-compliant species
	Deep water fishing area close to shore along Willis wall	• Elevation (water depth)	Immediately following construction	Design documents and CQAP	Design and CQAP requirements must be met

[5] Restored and conserved areas are expected to provide habitat that could be used by a wide variety of species including many threatened, endangered or species of special concern such as Southern Naiad (Modules 2-4), Osprey (Modules 1-3), Indiana bat (Module 8A), and Lake Sturgeon (Modules 1 and 2).

TABLE 7.2
STAGE 2 (LONG-TERM MONITORING) SUCCESS CRITERIA SUMMARY

Habitat Functional Categories	Habitat Modules/Areas Represented	Monitoring Element	Goals	Measurements	Timing	Possible Programmatic Response Action(s)	Possible Structural Response Action(s)
Planted Wetland Areas	Ninemile Creek Spits, Module 6A. Wastebed B/ Harbor Brook Outboard (WBB/HB Outboard Area); Modules 4A, 5A, 6A, and 9A/B.	Vegetation	Meet or exceed annual target thresholds for overall areal vegetative percent cover and maximum percent cover of invasive species (Table 7.3) Meet portfolio wetland acreage goals (Table 7.5)	• Overall vegetative areal percent cover • Relative percent cover of each species • Percent cover of invasive species • Total number of trees and shrubs • Annual estimates of wetland acreage in years 1 through 4 based on vegetative cover types • Wetland survey in year 3 • Wetland delineation in year 5 • Large tree condition	Annually for five years beginning first growing season after planting	• Continue monitoring if goals can likely be met without structural response actions • Collect additional data/analysis to refine estimate and/or understand why goals are not being met (e.g., sample soil for pH, organic matter, etc.) • Evaluate which plant species specified for planting or seeding are performing well for consideration of replanting • Modify monitoring program if deemed necessary	• Invasive controls • Install additional plants and/or seed as necessary, using species shown to be successful at the site. • Mitigate known disturbances to the extent practical (e.g., adding coir logs to decrease wave energy or installing irrigation in the event of a drought)
		Wildlife	Document wildlife use of restored areas	• Taxa/Species observed • Number of individuals • Location • Habitat utilization (nesting, feeding, etc.)	Annually for five years beginning first growing season after planting	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Fish community	In the WBB/HB Outboard Area wetlands, document Northern Pike juveniles or other species that use wetlands as habitat	• Number of individuals of each species • Life history stage • Size	Annually for five years beginning the year following completion of capping	• Calculate Habitat Suitability Index for Pike in HB wetland • Visual surveys during spring to determine if Pike are using the wetland • Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Install additional plants and/or seed as necessary/practical, using species known to be preferred by Pike and other species that use wetlands as habitat. • Add structure
		Benthic macro-invertebrates	Document colonization of remediation areas	• Number of each taxa present • NYSDEC Biological Assessment Profile	Twice within the first five years following completion of capping	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat

TABLE 7.2
STAGE 2 (LONG-TERM MONITORING) SUCCESS CRITERIA SUMMARY

Habitat Functional Categories	Habitat Modules/Areas Represented	Monitoring Element	Goals	Measurements	Timing	Possible Programmatic Response Action(s)	Possible Structural Response Action(s)
Planted Wetland Areas (Cont'd.)	Ninemile Creek Spits, Module 6A. Wastebed B/ Harbor Brook Outboard (WBB/HB Outboard Area); Modules 4A, 5A, 6A, and 9A/B.	Water Surface	Document that wetland hydrology is being maintained	• Lake water elevation (feet above sea level) • Depth to water table	Elevations regularly for five years beginning first growing season after planting. Water table during delineations or as response action if wetland vegetation is not establishing.	• Continue monitoring • Collect additional data	• Temporary irrigation if low water levels inhibit wetland vegetation establishment.
In-Lake Planting Areas	Remediation Area A; Modules 4A, 5A, 6A	Vegetation	Meet or exceed annual target thresholds for overall areal vegetative percent cover and maximum percent cover of invasive species (Table 7.3)	• Overall vegetative areal percent cover • Relative percent cover of each species • Percent cover of invasive species	Annually for five years beginning first growing season after planting	• Continue monitoring if goals can likely be met without structural response actions • Collect additional data/analysis to refine estimate and/or understand why goals are not being met (e.g., sample soil for pH, organic matter, etc.) • Evaluate which plant species specified for planting or seeding are performing well for consideration if replanting • Modify monitoring program if deemed necessary	• Invasive controls • Install additional plants and/or seed as necessary, using species shown to be successful at the site • Mitigate known disturbances to the extent practical (e.g., adding coir logs to decrease wave energy or installing irrigation in the event of a drought)
		Wildlife	Document wildlife use of restored areas	• Taxa/Species observed • Number of individuals • Location • Habitat utilization (nesting, feeding, etc.)	Annually for five years beginning first growing season after planting	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Benthic macro-invertebrates	Document colonization of remediation areas	• Number of taxa present • NYSDEC Biological Assessment Profile	Twice within the first five years following completion of capping	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Water Surface	Document that wetland hydrology is being maintained	• Lake water elevation (feet above sea level)	Regularly for five years beginning first growing season after planting	• Continue monitoring • Collect additional data	• Temporary irrigation if low water levels inhibit wetland vegetation establishment

TABLE 7.2
STAGE 2 (LONG-TERM MONITORING) SUCCESS CRITERIA SUMMARY

Habitat Functional Categories	Habitat Modules/Areas Represented	Monitoring Element	Goals	Measurements	Timing	Possible Programmatic Response Action(s)	Possible Structural Response Action(s)
Planted Upland Areas	WBB/HB Outboard Area; Module 8A/B	Vegetation	Meet or exceed annual target thresholds for overall areal vegetative percent cover and maximum percent cover of invasive species (Table 7.3)	• Overall vegetative areal percent cover • Relative percent cover of each species • Percent cover of invasive species • Total number of trees and shrubs • Large tree condition	Annually for five years beginning first growing season after planting	• Continue monitoring if goals can likely be met without structural response actions • Collect additional data/analysis to refine estimate and/or understand why goals are not being met (e.g., sample soil for pH, organic matter, etc.) • Evaluate which plant species specified for planting or seeding are performing well for consideration if replanting • Modify monitoring program if deemed necessary	• Invasive controls • Install additional plants and/or seed as necessary, using species shown to be successful at the site • Mitigate known disturbances to the extent practical (e.g., adding coir logs to decrease wave energy or installing irrigation in the event of a drought)
		Wildlife	Document wildlife use of restored areas	• Taxa/Species observed • Number of individuals • Location • Habitat utilization (nesting, feeding, etc.)	Annually for five years beginning first growing season after planting	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat

TABLE 7.2
STAGE 2 (LONG-TERM MONITORING) SUCCESS CRITERIA SUMMARY

Habitat Functional Categories	Habitat Modules/Areas Represented	Monitoring Element	Goals	Measurements	Timing	Possible Programmatic Response Action(s)	Possible Structural Response Action(s)
Non-Planted Shallow Littoral Zone	Remediation Areas A, B, C, D, and E; Modules 3A, 3B, 5A, 5B	Vegetation	Document progression of natural colonization in modules 3A and 3B	• Species composition • Location • Frequency of occurrence of each species	Annually for five years beginning first growing season after capping in each area	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Wildlife	Document wildlife use of restored areas	• Taxa/Species observed • Number of individuals • Location • Habitat utilization (nesting, feeding, etc.)	Annually for five years beginning first growing season after planting	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Fish community	Fish community composition representative of a warm water/coolwater fish community and baseline data	• Number of individuals of each species • Life history stage • Size • Fish community metrics such as richness and diversity	Annually for five years beginning the year following completion of capping	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Benthic macro-invertebrates	Document colonization of remediation areas	• Number of each taxa present • NYSDEC Biological Assessment Profile	Twice within the first five years following completion of capping	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat

TABLE 7.2
STAGE 2 (LONG-TERM MONITORING) SUCCESS CRITERIA SUMMARY

Habitat Functional Categories	Habitat Modules/Areas Represented	Monitoring Element	Goals	Measurements	Timing	Possible Programmatic Response Action(s)	Possible Structural Response Action(s)
Deep Littoral Zone	Modules 1, 2A, 2B	Vegetation	Document natural colonization	• Species composition • Location • Frequency of occurrence of each species • Distribution	Annually for five years beginning first growing season after capping in each area	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Fish community	Fish community composition representative of a warm water/cool water fish community and baseline data	• Number of each species • Life history stage • Size • Fish community metrics such as richness and diversity	Annually for five years beginning the year following completion of capping	• Continue monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat
		Benthic macro-invertebrates	Document colonization of remediation areas	• Number of each taxa present • NYSDEC Biological Assessment Profile	Twice within the first five years following completion of capping	• Continue Monitoring • Collect additional data • Conduct additional analysis • Modify monitoring program	• Adaptive management based on evaluation of the functionality of the habitat

TABLE 7.3A
PLANTED WETLAND VEGETATION THRESHOLD SUCCESS CRITERIA SUMMARY

Habitat Type / Module	Threshold	Immediate Response Action
Planted Wetland Areas – Ninemile Creek Spits, Module 6A. Wastebed B/ Harbor Brook Outboard Area (WBB/HB Outboard Area), Modules 4A, 5A, 6A, and 9A/B[1].	**After the first full growing season following planting:** • The percent cover of wetland plants has increased from the initial planting. • Invasive wetland species are not present. • 80 percent of potted trees and shrubs are present. • 90 percent of large trees are present.	• Seed and/or install additional plant material as needed. Plant species/vegetative types that have shown the highest level of success at the site should be used. • Replace missing or dead potted trees and shrubs to achieve 80 percent presence. • Control invasive species, as practical. • Implement herbivory control, if necessary. • Over the five-year period, any large tree replacement necessary will be carried out once, and all replacement large trees which do not survive will be substituted for two, #7 to #10 sized trees of a species performing well at the site. Substitute trees that do not survive will be replaced with #7 to #10 sized trees as needed to maintain the original number of trees installed as part of the design.
	After 2 years: • Total wetland plant cover is at least 75 percent. • Invasive wetland species are not present. • 90 percent of large trees are present.	• Seed and/or install additional plant material as needed. Plant species/vegetative types that have shown the highest level of success at the site should be used. • Control invasive species, as practical. • Implement herbivory control, if necessary. • Over the five-year period, any large tree replacement necessary will be carried out once, and all replacement large trees which do not survive will be substituted for two, #7 to #10 sized trees of a species performing well at the site. Substitute trees that do not survive will be replaced with #7 to #10 sized trees as needed to maintain the original number of trees installed as part of the design.
	After 3 years: • Total wetland plant cover is at least 80 percent. • Invasive wetland species are not present. • 90 percent of large trees are present.	
	After 4 years: • Total wetland plant cover is at least 85 percent. • Invasive wetland species are not present. • 90 percent of large trees are present.	

TABLE 7.3A
PLANTED WETLAND VEGETATION THRESHOLD SUCCESS CRITERIA SUMMARY

Habitat Type / Module	Threshold	Immediate Response Action
	After 5 years: • Total wetland plant cover is at least 85 percent. • Percent cover of invasive species is less than or equal to 5 percent. • 90 percent of large trees are present.	• Seed and/or install additional plant material, as needed. Plant species and/or vegetative types that have shown the highest level of success at the site should be used. • Control invasive species, as practical. • Over the five-year period, any large tree replacement necessary will be carried out once, and all replacement large trees which do not survive will be substituted for two, #7 to #10 sized trees of a species performing well at the site. Substitute trees that do not survive will be replaced with #7 to #10 sized trees as needed to maintain the original number of trees installed as part of the design.

[1] Some woody plants may take longer than five years to achieve criteria, therefore if the criteria are not met after five years the data will be evaluated to determine what additional monitoring and maintenance is necessary for specific areas or species. Factors to be considered include percent cover, species diversity, and relative effectiveness of continued maintenance.

TABLE 7.3B
PLANTED UPLAND VEGETATION THRESHOLD SUCCESS CRITERIA SUMMARY

Habitat Type / Module	Threshold	Immediate Response Action
Planted Upland Areas – WBB/HB Outboard Area, Modules 8A/B[1]	**After the first full growing season following planting:** • Total plant cover is at least 75 percent. • Invasive species are not present. • 80 percent of potted trees and shrubs are present. • 100 percent of large trees are present.	• Install additional seed and/or plant material as needed. Plant species/vegetative types that have shown the highest level of success at the site should be used. • Replace missing or dead plant material to achieve 80 percent presence. • Control invasive species, as practical. • Implement herbivory control, if necessary. • Over the 5-year period, any large tree replacement necessary will be carried out once, and all replacement large trees which do not survive will be substituted for two, #7 to #10 sized trees of a species performing well at the site. Substitute trees that do not survive will be replaced with #7 to #10 sized trees as needed to maintain the original number of trees installed as part of the design.
	After 2 years: • Total plant cover is at least 80 percent. • Invasive species are not present. • 100 percent of large trees are present.	• Install additional seed and/or plant material as needed. Plant species/vegetative types that have shown the highest level of success at the site should be used. • Control invasive species, as practical. • Implement herbivory control, if necessary. • Over the 5-year period, any large tree replacement necessary will be carried out once, and all replacement large trees which do not survive will be substituted for two, #7 to #10 sized trees of a species performing well at the site. Substitute trees that do not survive will be replaced with #7 to #10 sized trees as needed to maintain the original number of trees installed as part of the design.
	After years 3 & 4: • Total plant cover is at least 85 percent each year. • Invasive species are not present. • 100 percent of large trees are present.	

TABLE 7.3B
PLANTED UPLAND VEGETATION THRESHOLD SUCCESS CRITERIA SUMMARY

Habitat Type / Module	Threshold	Immediate Response Action
	After 5 years: • Total plant cover is at least 90 percent. • Percent cover of invasive species is less than or equal to 5 percent. • 100 percent of large trees are present.	• Install additional seed and/or plant material as needed. Plant species/vegetative types that have shown the highest level of success at the site should be used. • Control invasive species, as practical. • Over the 5-year period, any large tree replacement necessary will be carried out once, and all replacement large trees which do not survive will be substituted for two, #7 to #10 sized trees of a species performing well at the site. Substitute trees that do not survive will be replaced with #7 to #10 sized trees as needed to maintain the original number of trees installed as part of the design.

[1] Some woody plants may take longer than five years to achieve criteria, therefore if the criteria are not met after five years the data will be evaluated to determine what additional monitoring and maintenance is necessary for specific areas or species. Factors to be considered include percent cover, species diversity, and relative effectiveness of continued maintenance.

TABLE 7.3C
PLANTED IN-LAKE VEGETATION THRESHOLD SUCCESS CRITERIA SUMMARY

Habitat Type / Module	Threshold	Immediate Response Action
In-Lake Plantings-Remediation Area A, Modules 4A, 5A, 6A	**After the first full growing season following planting:** • The percent cover of plants has increased from the initial planting. • Invasive wetland species are not present.	• Install additional seed and/or plant material as needed. Plant species/vegetative types that have shown the highest level of success at the site should be used. • Control invasive species, as practical. • Implement herbivory control, as necessary.
	After 2 years: • Total plant cover is at least 60 percent. • Invasive wetland species are not present.	
	After years 3 & 4: • Total plant cover is at least 70 percent. • Invasive wetland species not present.	
	After 5 years: • Total plant cover is at least 75 percent. • Percent cover of invasive species is less than or equal to 5 percent.	• Install additional seed and/or plant material as needed. Plant species/vegetative types that have shown the highest level of success at the site should be used. • Control invasive species, as practical.

TABLE 7.4
INVASIVE VEGETATIVE SPECIES TO BE MANAGED

Type	Common Name	Scientific Name
Wetland	Common reed	*Phragmites australis*
	Purple loosestrife	*Lythrum salicaria*
	Water chestnut	*Trapa nutans*
	Yellow iris	*Iris pseudacorus*
Upland	Garlic mustard	*Alliaria petiolata*
	Giant knotweed	*Fallopia sachalinensis*
	Japanese knotweed	*Fallopia japonica, Polygonum cuspidatum, Reynoutria japonica*
	Swallow-wort	*Cynanchum rossicum and C. nigrum*
	Giant hogweed	*Heracleum mantegazzianum*
	Autumn olive	*Eleagnus umbellata*
	Russian olive	*Elaegnus angustifolia*
	European buckthorn	*Rhamnus cathartica*
	Glossy buckthorn	*Frangula alnus*
	Honeysuckle	*Lonicera tatarica, L. morrowii, L. x bella*

TABLE 7.5A
OVERALL WETLAND ASSESSMENT FOR DESIGNED VS REQUIRED AREAS

DESIGNED WETLANDS:

Wastebed B/Harbor Brook Outboard Area	
Area	**Acreage**
Total Wastebed B/Harbor Brook Outboard Area[1]	14.4
Required Area to Mitigate for Loss of Open Water (See Table 7.5B)	-2.3
Portion of Berms Within Outboard Area[2]	-0.4
Portion of Plateau Protective Edges Within Outboard Area Above 362.5[3]	-0.1
Wetland Area Designed	**11.6**

Other Wetland Areas	
Area	**Acreage**
Wastebed B/Harbor Brook Area Inboard of Barrier Wall (Proposed)[4]	0.9
Perched Wetlands at Wastebeds 1-8	7.6
Ninemile Creek Spits	1.9
Wetland Area Designed[5]	**10.4**

TOTAL Wetland Acreage Designed	**22.0**

REQUIRED WETLANDS:

Area	Acreage
Pre-Remediation Wetland Area Temporarily Lost During Remediation that will Require Restoration	
Total required mitigation area for Wastebed B/Harbor Brook Inboard Area Wetlands to satisfy 2:1 mitigation requirements (See Table 7.5C)	9.4
Pre-Remediation Wastebed B/Harbor Brook Area Outboard of Barrier Wall	7.5
Pre-Remediation Wastebeds 1-8 Area	0.7
Pre-Remediation Ninemile Creek Spits Area	1.9
TOTAL Wetland Acreage required to meet Success Criteria	**19.5**

OVERALL WETLAND ACCOUNTING:

Totals	Acreage
Wetland Acreage Designed	22.0
Wetland Acreage required to meet Success Criteria	19.5
Designed Wetland Acreage Exceeding Mitigation Area Requirement	**2.5**

NOTES:

[1] This area consists of all wetland and open water acreage between the Outboard boundary and the edges of upland planted areas as shown on Figure 7.2

[2] Berm acreage includes the 30' portion of each berm that includes upland plantings

[3] The portion of the plateau protective edges below the mean lake level of 362.5 are included as open water in Table 7.5B

[4] Anticipated. Design in process. Wastebed B/HB inboard wetland will be evaluated under the WBB/HB FS/Proposed Plan/ROD process

[5] The WB 1-8 connected wetland is excluded from this total. As specified in the December 2006 ESD, mitigation for lost open water due to the construction of the Willis Avenue Barrier Wall will be mitigated by construction of 2.3 acres of connected wetland at WB 1-8. Therefore the WB 1-8 connected wetland acreage is included in Table 7.5B

Ninemile Creek Spits are part of NYSDEC Designated Wetland SYW-10. The Wastebed B/Harbor Brook wetlands are NYSDEC Designated Wetland SYW-19.

TABLE 7.5B
OPEN WATER ASSESSMENT WITHIN ADJACENT SHORELINE AREAS

MITIGATION AREA REQUIRED:

Area	Acreage
Inboard of Wastebed B/Harbor Brook Barrier Wall (Pre-Remediation)	1.6
Outboard of Wastebed B/Harbor Brook Barrier Wall (Pre-Remediation)	0.7
Inboard of Willis Avenue Barrier Wall (Pre-Remediation)	2.3
Total Open Water Area Lost Requiring Mitigation	**4.6**
Required Mitigation Area (Mitigation ratio 1:1)	**4.6**

AVAILABLE MITIGATION AREA BASED ON DESIGNS:

Area	Acreage
Outboard of Wastebed B/Harbor Brook Barrier Wall [1, 2]	2.3
WB 1-8 Connected Wetland[3.]	2.3
Total Designed	**4.6**
Available for Mitigation Credit	**4.6**

[1]The Outboard Area Design includes approximately 0.6 acres of open water associated with the new Harbor Brook channel alignment, and 0.6 acres associated with the armored edges of the plateaus that are below the average lake level of 362.5, neither of which will be planted. The remainder of the Outboard Area is designed with wetland plantings with no formal delineation between areas that will develop into wetland vs. those that may develop into open water. However, the entire required 2.3 acres of open water mitigation has been subtracted from the designed wetland acreage in this area, as shown in Table 7.5A.

[2] The acreages shown do not include the approximately 1.2 acres of the berms that are within the lake, as shown on Figure 7.2 and as discussed in Section 7.1.2.

[3]As specified in the December 2006 ESD, mitigation for lost open water due to the construction of the Willis Avenue Barrier Wall will be mitigated by construction of 2.3 acres of connected wetland at WB 1-8. Therefore these wetlands are included under open water mitigation rather than under the wetland mitigation areas shown in Tables 7.5A and 7.5C

TABLE 7.5C

WETLAND ASSESSMENT WITHIN ADJACENT SHORELINE AREAS

MITIGATION AREA REQUIRED:

Wastebed B/Harbor Brook Area Inboard of Barrier Wall	
Area	**Acreage**
WL1 (Pre-Remediation)	1.5
WL2 (Pre-Remediation)	2.0
WL3 (Pre-Remediation)	0.0
WL4 (Pre-Remediation)	0.0
WL5 (Pre-Remediation)	0.3
WL7 (Pre-Remediation)	0.9
Total Pre-Remediation Area Disturbed or Lost Due to Remediation	**4.7**
Total Required Mitigation Area for Wastebed B/Harbor Brook Inboard Area Wetlands (Mitigation ratio 2:1)	**9.4**
Required Additional Mitigation Area	**9.4**

AVAILABLE MITIGATION AREA BASED ON DESIGNS:

Wastebed B/Harbor Brook Area Outboard of Barrier Wall	
Area	**Acreage**
WL1 (Pre-Remediation)	4.5
WL2 (Pre-Remediation)	0.7
WL3 (Pre-Remediation)	1.7
WL4 (Pre-Remediation)	0.5
WL5 (Pre-Remediation)	0.0
WL7 (Pre-Remediation)	0.1
Total Pre-Remediation	**7.5**
Total Designed (see Table 7.5A)	**11.6**
Available for Mitigation Credit	**4.1**

Wastebeds 1-8 Area	
Area	**Acreage**
Perched Wetland 1 (Pre-Remediation)	0.3
Perched Wetland 2 (Pre-Remediation)	0.4
Total Pre-Remediation	**0.7**
Total Designed[1]	**7.6**
Available for Mitigation Credit	**6.9**

Ninemile Creek Spits Area	
Area	**Acreage**
Ninemile Creek Spits (Pre-Remediation)	1.9
Total Pre-Remediation	**1.9**
Total Designed	**1.9**
Available for Mitigation Credit	**0.0**

OVERALL WETLAND ACCOUNTING:

Area	**Acreage**
WB B/HB Area Inboard of Barrier Wall Required Mitigation Area	9.4
WB B/HB Area Outboard of Barrier Wall Available for Mitigation	4.1
WB 1-8 Area Available for Mitigation	6.9
Ninemile Creek Spits Area Available for Mitigation	0.0
Total Planned Mitigation Inboard of Barrier Wall (Proposed)[2]	0.9
Designed Wetland Acreage Exceeding Mitigation Area Requirement[1]	**2.5**

NOTES:

[1]The WB 1-8 connected wetland is excluded from this total. As specified in the December 2006 ESD, mitigation for lost open water due to the construction of the Willis Avenue Barrier Wall will be mitigated by construction of 2.3 acres of connected wetland at WB 1-8. Therefore the WB 1-8 connected wetland acreage is included in Table 7.5B.

[2] Anticipated. Design in process. Will be evaluated under the WBB/HB FS/Proposed Plan/ROD process.

TABLE 7.6
BASELINE BIOLOGICAL DATA AVAILABILITY AND USE SUMMARY

Community	Baseline Data Available	Baseline Timing	Supported Habitat Type/Area	Stage 2 Success Criteria Parameters	Stage 2 Success Criteria Parameters Supported by Baseline Data	Data Gaps
Wetland/Upland Vegetation	• Delineations of shoreline wetlands during various RIS, RIFS, and PDI efforts. • Includes acreages, plant species, hydrology, and soils.	• WB 1-8, 2006 • Lakewide, 2009 • NMC 2003, 2010 • Harbor Brook 2003	Planted wetlands	• Survival • Percent cover • Invasives	None; criteria are compared to threshold values	None
Littoral Vegetation	• Habitat PDI surveys of species composition and distribution at multiple sites within, near, and outside RA boundaries; monthly biomass samples at subset of locations. • OCDWEP[1] lake wide surveys and aerial photographs showing lake wide distribution.	• Habitat PDI: 2008-2009 • OCDWEP surveys: 2000, 2005, 2010 • OCDWEP photos: 2000-2011	Littoral zone	Species composition and distribution	Species composition and distribution	None
Fish	• Baseline surveys of adult littoral fish community - abundance and size of each species at multiple sites within, near, and outside RA boundaries. • OCDWEP surveys of adult littoral community - abundance and size of each species along entire shoreline (shallow areas) and at discrete sites (deeper areas).	• Baseline: 2008-2016 • OCDWEP: 2000-2013	Littoral zone	Adult fish community metrics such as richness and diversity	Multiple adult fish community metrics such as richness and diversity	None
	• Baseline surveys of juvenile fish community - abundance and size of each species at multiple sites within, near, and outside RA boundaries. • OCDWEP surveys of juvenile littoral community - abundance and size of each species at multiple sites within, near, and outside RA boundaries.	• Baseline: 2008-2016 • OCDWEP: 2000-2013	Littoral zone	Juvenile fish community metrics such as richness and diversity	Multiple juvenile fish community metrics such as richness and diversity	None
	• Baseline surveys of juvenile fish community at sites located close to HB outboard area. • OCDWEP surveys of juvenile fish community at sites located close to HB outboard area.	• Baseline: 2008-2011 • OCDWEP: 2000-2011	HB outboard	Northern pike spawning and reproduction in HB outboard.	Presence/absence and abundance of northern pike juveniles	None
Macroinvertebrates	• Baseline benthic macroinvertebrate surveys- lowest possible taxa level ID of 100 individual subsample from multiple sites within, near, and outside RA boundaries. • OCDWEP benthic macroinvertebrate surveys- lowest possible taxa level ID of 100 individual subsample from multiple sites within, near, and outside RA boundaries.	• Baseline: 2008 and 2010 • OCDWEP: 2000, 2005, 2010	Littoral zone 1.0 to 1.5 m water depth	Benthic macroinvertebrate community indices	Benthic macroinvertebrate community indices.	None
Wildlife	• PDI, NRD, and external surveys of wildlife in and around the lake.	• 2007-2016 Audubon Christmas bird survey • 2007/2008 NRD survey • 2007/2008 Breeding Bird Surveys (USFWS) • 2011 Reptile and Amphibian population survey (NYSDEC)	Wetlands, uplands, nearshore littoral zone.	Wildlife occurrence and use (e.g., feeding/nesting)	Wildlife occurrence and use (e.g., feeding/nesting)	None

[1] OCDWEP; Onondaga County Department of Water Environment Protection. Only reports publically available included.

FIGURES

Construction/Operation Monitoring

Construction QA/QC Plan

- **Dredging**
  - Position
  - Depth
  - Volume
- **Capping**
  - Position
  - Volume
  - Thickness
  - Dosage
- **Habitat**
  - Wetland acreage
  - Organic matter
  - Planting
  - Structure

Water Quality M&M Plan

- **Turbidity**
  - Discrete
  - Continuous
- **Chemical**
  - Discrete

Remediation Community Health and Safety Plan

- **SCA, WTP, Lakeshore and Pipeline**
  - Traffic
  - Air quality
  - Noise Abatement
  - Spills
  - Site security
  - Navigation
  - HAZOP/Contingency

Remedial Goal Monitoring

OLMMP

1. **Program Details**
2. **Dynamic Monitoring Framework**
   - a)Decision Criteria
   - b)Criteria Attainment
   - c)Response Actions
3. **Monitoring Components**
   - a)MNR
   - b)Biota Tissue
   - c)Surface Water
   - d)Cap M&M
   - e)Habitat Reestablishment and Biological Response
   - f)WB 1-8 Shoreline Stabilization
   - g)Institutional Controls

M&M Data Collection Workplans

1. **MNR**
   - a)SMU 8 sediments
2. **Biota Tissue**
   - a)Adult sport fish
   - b)Prey fish
   - c)Zooplankton
3. **Surface Water**
   - a)Deep basin
   - b)Littoral zone
4. **Cap M&M**
   - a)Physical
   - b)Chemical
5. **Habitat**
   - a)Vegetation
   - b)Fish
   - c)Macroinvertebrates
   - d)Wildlife
   - e)Wetland acreage
6. **WB 1-8 Shoreline**
   - a)Turbidity

Baseline and PDI

- **MNR**
  - SMU 8 sediment
- **Tissue**
  - Adult sport fish
  - Prey fish
  - Zooplankton
- **Surface Water**
  - Mid-lake
  - Littoral zone
- **Habitat**
  - Wetland Delineations
  - Aquatic vegetation
- **Biology**
  - Fish Community
  - Macroinvertebrates
  - Wildlife

FIGURE 1.1

Honeywell

Onondaga Lake Monitoring Approach

PARSONS
301 Plainfield Road, Suite 350, Syracuse, NY 13212

LEGEND:

DEMARCATION FOR BSQV SUBAREAS (DELINEATION IS APPROXIMATE AND MAY BE MODIFIED BASED ON DEVELOPMENT OF FINAL THIESSEN POLYGONS FOR BSQV EVALUATION)

LITTORAL REMEDIATION AREA BOUNDARY

SMU BOUNDARY

CAPPED AREAS (INCLUDES ALL ISOLATION, THIN LAYER, AND MODIFIED PROTECTIVE CAPS)

NOTES:

1. WATER DEPTH CONTOUR INTERVAL IS 5 FT. (PRE-REMEDY CONTOURS SHOWN)
2. WATER DEPTH BASED ON AVERAGE LAKE ELEVATION OF 362.5 FT.

2000 1000 0 2000 4000

SCALE: 1"=2000'

FIGURE 3.1

Honeywell

ONONDAGA LAKE SUBAREAS FOR EVALUATION OF BSQV COMPLIANCE

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\450102 - 2016 OL REMEDIAL GOAL MONITORING\10 TECHNICAL CATEGORIES\CAD\2016\450102-MNR-015.DWG
PLOT DATE: 10/9/2017 11:52 AM PLOTTED BY: RUSSO, JILL

Cap Model Area A1

0 to 3 ft of water (Cap A)

- Habitat Topsoil 12" min
- Erosion Protection/Habitat Coarse Gravel 12" min
- Chemical Isolation Medium Sand 12" min
- Mixing Medium Sand 3" min

3 to 7 ft of water (Cap B)

- Habitat Fine Gravel 18" min
- Chemical Isolation Medium Sand 12" min
- Mixing Medium Sand 3" min

7 to 10 ft of water (Cap C)

- Habitat Fine Gravel 12" min
- Chemical Isolation Medium Sand 12" min
- Mixing Medium Sand 3" min

10 to 20 ft of water (Cap D)

- Habitat Medium Sand 12" min
- Chemical Isolation Medium Sand 12" min
- Mixing Medium Sand 3" min

20 to 30 ft of water (Cap E)

- Habitat Medium Sand 12" min
- Chemical Isolation Medium Sand 6" min
- Mixing Medium Sand 3" min

Cap Model Area A2

0 to 3 ft of water (Cap F)

- Habitat Topsoil 12" min
- Erosion Protection/Habitat Coarse Gravel 12" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

Nine Mile Spits (Cap U)

- Habitat Topsoil 19.5" min
- Erosion Protection Coarse Gravel 4.5" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

Mouth of Nine Mile (Cap I)

- Habitat Coarse Gravel 18" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

3 to 10 ft of water (Cap H)

- Habitat Fine Gravel 18" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

10 to 20 ft of water (Cap J)

- Habitat Medium Sand 12" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

Note: Cross-Section Profiles Are Not To Scale

N

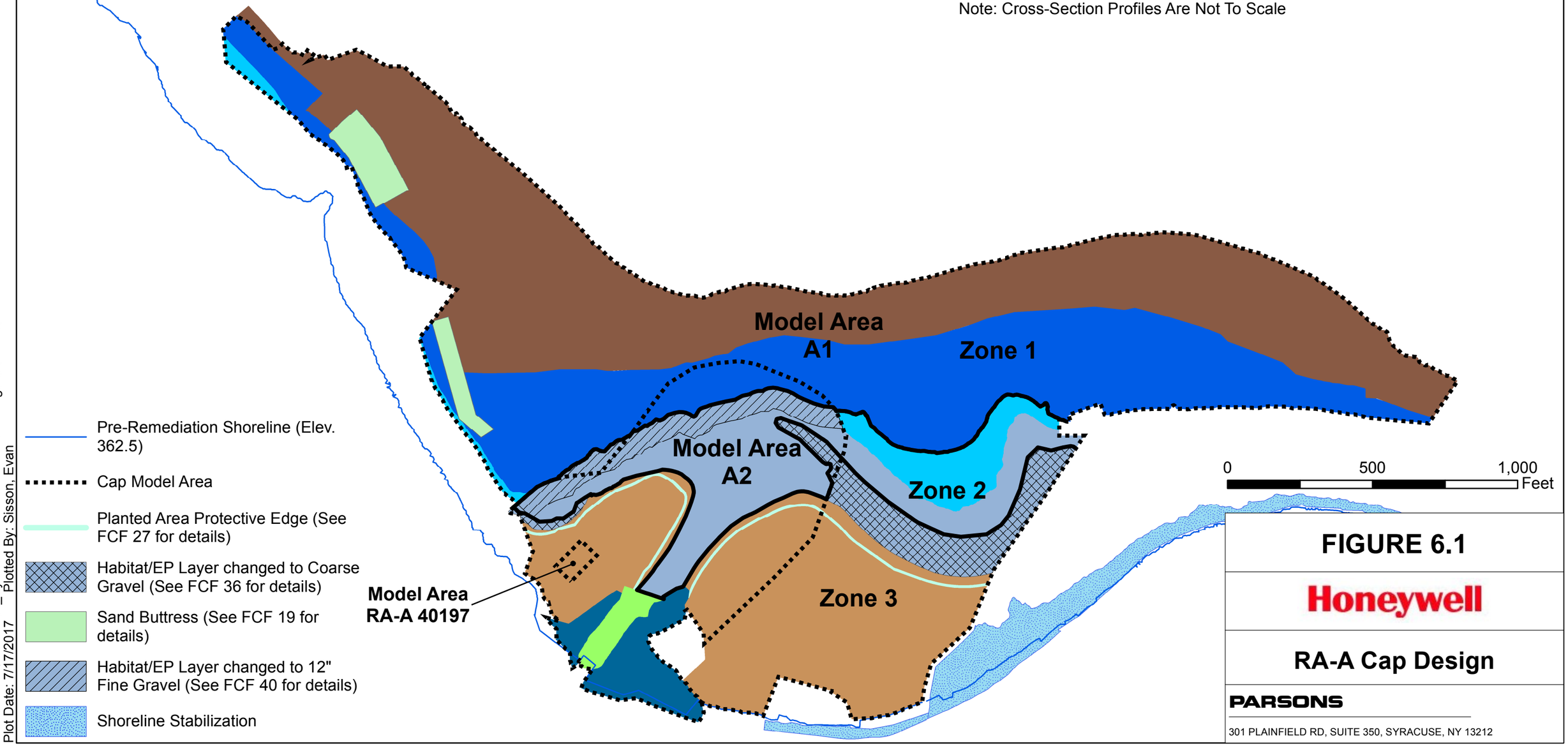


FIGURE 6.1

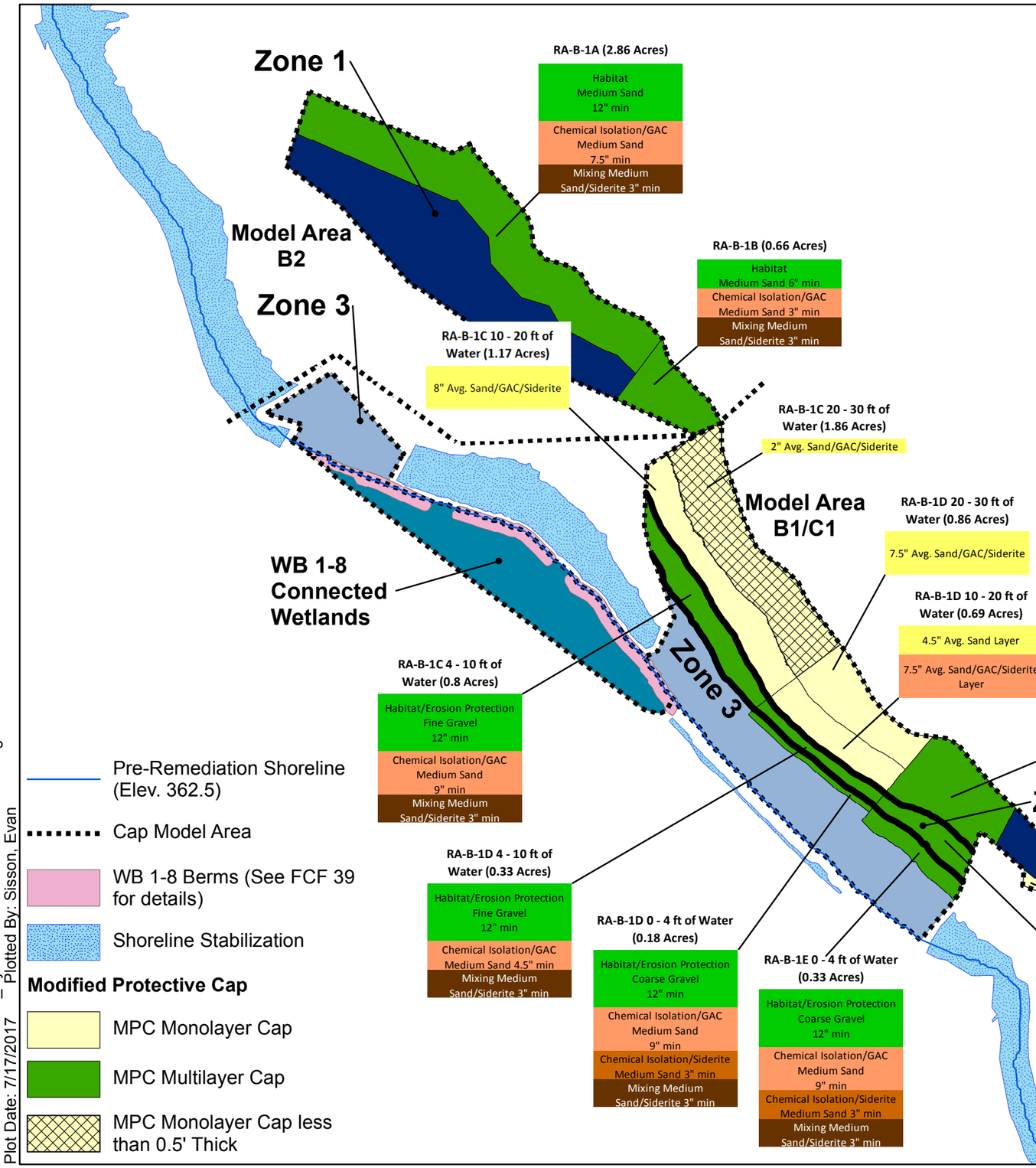
Honeywell

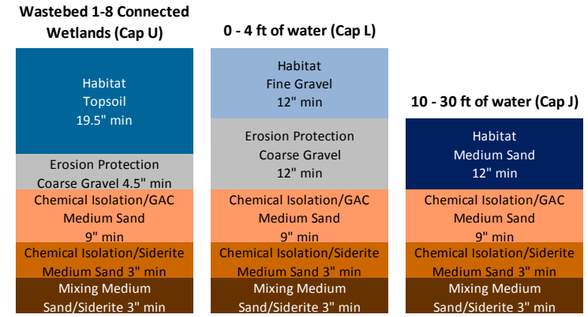
RA-A Cap Design

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\RA-A Figure 6.1.mxd
Plot Date: 7/17/2017 Plotted By: Sisson, Evan





Note: Cross-Section Profiles Are Not To Scale

N

Pre-Remediation Shoreline (Elev. 362.5)

Cap Model Area

WB 1-8 Berms (See FCF 39 for details)

Shoreline Stabilization

Modified Protective Cap

MPC Monolayer Cap

MPC Multilayer Cap

MPC Monolayer Cap less than 0.5' Thick

0 375 750 Feet

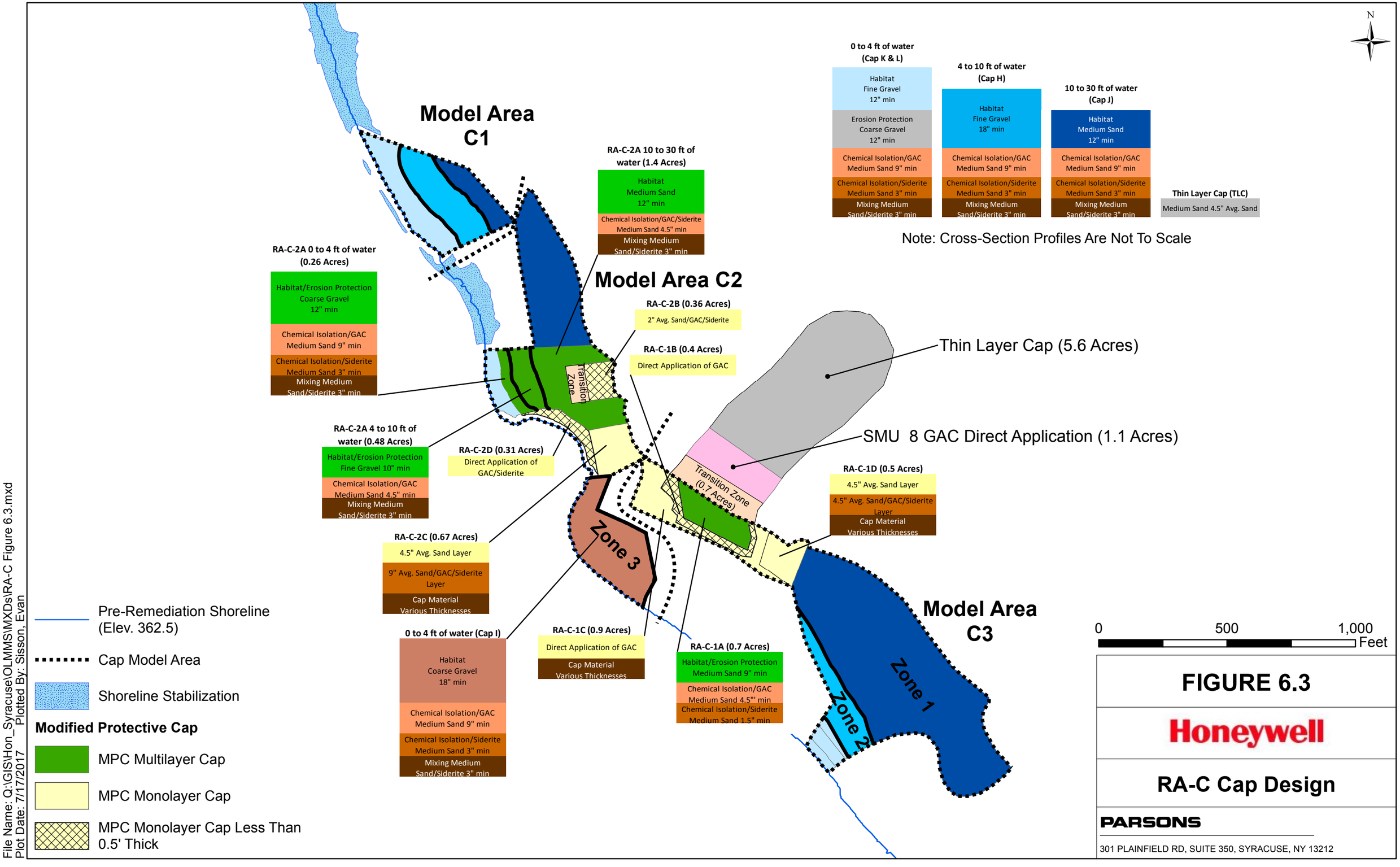
FIGURE 6.2

Honeywell

RA-B Cap Design

PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\RA-B Figure 6.2.mxd
Plot Date: 7/17/2017 Plotted By: Sisson, Evan


N
0 to 4 ft of water (Cap K & L)
Habitat Fine Gravel 12" min
Erosion Protection Coarse Gravel 12" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
4 to 10 ft of water (Cap H)
Habitat Fine Gravel 18" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
10 to 30 ft of water (Cap J)
Habitat Medium Sand 12" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
Thin Layer Cap (TLC)
Medium Sand 4.5" Avg. Sand
Note: Cross-Section Profiles Are Not To Scale
Model Area C1
Model Area C2
Model Area C3
RA-C-2A 10 to 30 ft of water (1.4 Acres)
Habitat Medium Sand 12" min
Chemical Isolation/GAC/Siderite Medium Sand 4.5" min
Mixing Medium Sand/Siderite 3" min
RA-C-2A 0 to 4 ft of water (0.26 Acres)
Habitat/Erosion Protection Coarse Gravel 12" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
RA-C-2B (0.36 Acres)
2" Avg. Sand/GAC/Siderite
RA-C-1B (0.4 Acres)
Direct Application of GAC
Transition Zone
Thin Layer Cap (5.6 Acres)
SMU 8 GAC Direct Application (1.1 Acres)
RA-C-2A 4 to 10 ft of water (0.48 Acres)
Habitat/Erosion Protection Fine Gravel 10" min
Chemical Isolation/GAC Medium Sand 4.5" min
Mixing Medium Sand/Siderite 3" min
RA-C-2D (0.31 Acres)
Direct Application of GAC/Siderite
Transition Zone (0.7 Acres)
RA-C-1D (0.5 Acres)
4.5" Avg. Sand Layer
4.5" Avg. Sand/GAC/Siderite Layer
Cap Material Various Thicknesses
RA-C-2C (0.67 Acres)
4.5" Avg. Sand Layer
9" Avg. Sand/GAC/Siderite Layer
Cap Material Various Thicknesses
Zone 3
Zone 1
Zone 2
0 to 4 ft of water (Cap I)
Habitat Coarse Gravel 18" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
RA-C-1C (0.9 Acres)
Direct Application of GAC
Cap Material Various Thicknesses
RA-C-1A (0.7 Acres)
Habitat/Erosion Protection Medium Sand 9" min
Chemical Isolation/GAC Medium Sand 4.5"' min
Chemical Isolation/Siderite Medium Sand 1.5" min
Pre-Remediation Shoreline (Elev. 362.5)
Cap Model Area
Shoreline Stabilization
Modified Protective Cap
MPC Multilayer Cap
MPC Monolayer Cap
MPC Monolayer Cap Less Than 0.5' Thick
0
500
1,000
Feet
FIGURE 6.3
Honeywell
RA-C Cap Design
PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212
File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\RA-C Figure 6.3.mxd
Plot Date: 7/17/2017 Plotted By: Sisson, Evan

N

Outboard West & Center (Cap U)
- Habitat Topsoil 19.5" min
- Erosion Protection Coarse Gravel 4.5" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

Outboard East (Cap T)
- Habitat Topsoil 19.5" min
- Erosion Protection Coarse Gravel 4.5" min
- Chemical Isolation/GAC Medium Sand 12" min
- Mixing Medium Sand/GAC 3" min

0 to 4 ft of water (Cap F & G)
- Habitat Medium Sand 12" min
- Erosion Protection/Habitat Coarse Gravel 12" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

4 to 7 ft of water (Cap H)
- Habitat Fine Gravel 18" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

7 to 10 ft of water (Cap M)
- Habitat Fine Gravel 12" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

10 to 30 ft of water (Cap J)
- Habitat Medium Sand 12" min
- Chemical Isolation/GAC Medium Sand 9" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

Thin Layer Cap (TLC)
- Medium Sand 2" min

Amended TLC
- Sand/GAC Layer 4.5" Avg.

Note: Cross-Section Profiles Are Not To Scale

1 Extra Foot of Sand Placed Over Former Water Inlet Pipe Valve Structure

RA-D-1B (1.17 Acres)
- 4.5" Avg. Sand/GAC/Siderite

RA-D-1A (7.55 Acres)
- Habitat Medium Sand 12" min
- Chemical Isolation/GAC Medium Sand 6" min
- Mixing Medium Sand/Siderite 3" min

Amended TLC Area B (9.3 Acres)

Amended TLC Area A (7.5 Acres)

RA-D-1A

RA-D-1B

Model Area D-SMU-2

Addendum East

Model Area D-West

Model Area D-Center

Model Area D-East

Model Area OL-VC-10138/40

Model Area Outboard West

Model Area Outboard Center

Model Area Outboard East

Zone 1

Zone 2

Zone 3

RA-D-2 (2.4 Acres)
- Habitat Medium Sand 10.5" min
- Chemical Isolation/GAC Medium Sand 4.5" min
- Chemical Isolation/Siderite Medium Sand 3" min
- Mixing Medium Sand/Siderite 3" min

Cobble Armoring w/Topsoil on 5H:1V Slope Adjacent to Barrier Wall (See FCF 62 for details)

West Naturalized Shoreline (See FCF 57 for details)

East Naturalized Shoreline (See FCF 58 for details)

Berms (See FCF 62 for details)

25 ft Zone of Topsoil Habitat

Plateau Armored Edge (See FCF 62 for details)

Marine Mattress and Adjacent Sand Buttress (See FCF 63 for details)

Harbor Brook Channel

Pre-Remediation Shoreline (Elev. 362.5)

Cap Model Area

Modified Protective Cap

MPC Monolayer Cap Less Than 0.5' Thick

MPC Multilayer Cap

0 500 1,000 Feet

FIGURE 6.4

Honeywell

RA-D Cap Design

PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\RA-D Figure 6.4.mxd
Plot Date: 7/17/2017 Plotted By: Sisson, Evan

Cap Model Area E1

0 to 3 ft of Water (Cap N)
- Habitat Coarse Gravel 12" min
- Erosion Protection Gravelly Cobble 12" min
- Chemical Isolation Gravelly Sand 12" min
- Mixing Gravelly Sand 3"

3 to 7 ft of Water (Cap O)
- Erosion Protection/Habitat Gravelly Cobble 18" min
- Chemical Isolation Gravelly Sand 12" min
- Mixing Gravelly Sand 3"

7 to 10 ft of Water (Cap P)
- Erosion Protection/Habitat Coarse Gravel 12" min
- Chemical Isolation Medium Sand 12" min
- Mixing Medium Sand 3"

10 to 20 ft of Water (Cap C)
- Erosion Protection/Habitat Fine Gravel 12" min
- Chemical Isolation Medium Sand 12" min
- Mixing Medium Sand 3"

20 to 30 ft of water (Cap E)
- Habitat Medium Sand 12" min
- Chemical Isolation Medium Sand 6" min
- Mixing Medium Sand 3"

CRs & Nav Channel (Cap Q)
- Erosion Protection/Habitat Gravelly Cobble 12" min
- Chemical Isolation Gravelly Sand 12" min
- Mixing Gravelly Sand 3"

MERC
- Gravelly Sand/GAC 6" Avg.

Thin Layer Cap (TLC)
- Medium Sand 2" min

Cap Model Areas E2 & E3

0 to 3 ft of Water (Cap NN)
- Habitat Coarse Gravel 12" min
- Erosion Protection Gravelly Cobble 12" min
- Chemical Isolation/GAC Gravelly Sand 12" min
- Mixing Gravelly Sand/GAC 3"

3 to 7 ft of Water (Cap OO)
- Erosion Protection/Habitat Gravelly Cobble 18" min
- Chemical Isolation/GAC Gravelly Sand 12" min
- Mixing Gravelly Sand/GAC 3"

7 to 10 ft of Water (Cap PP)
- Erosion Protection/Habitat Coarse Gravel 12" min
- Chemical Isolation/GAC Medium Sand 12" min
- Mixing Medium Sand/GAC 3"

10 to 20 ft of Water (Cap CC)
- Erosion Protection/Habitat Fine Gravel 12" min
- Chemical Isolation/GAC Medium Sand 12" min
- Mixing Medium Sand/GAC 3"

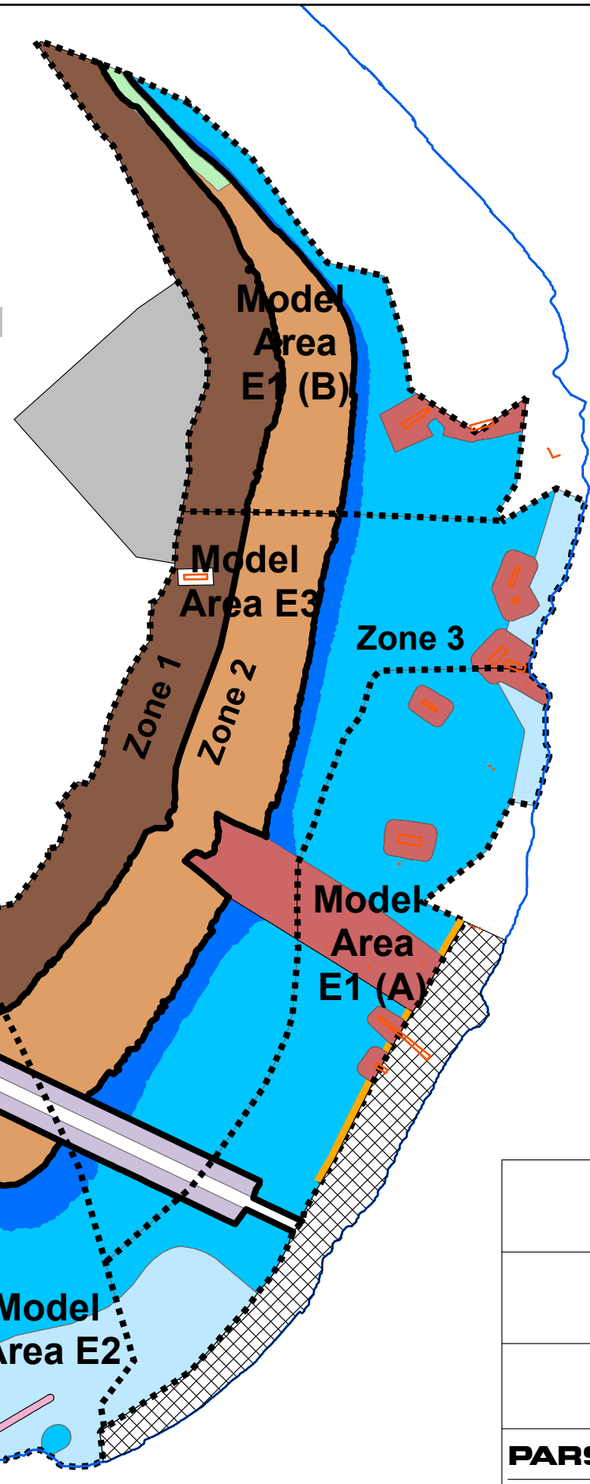
20 to 30 ft of water (Cap S)
- Habitat Medium Sand 12" min
- Chemical Isolation/GAC Medium Sand 6" min
- Mixing Medium Sand/GAC 3"

CRs & Nav Channel (Cap QQ)
- Erosion Protection/Habitat Gravelly Cobble 12" min
- Chemical Isolation/GAC Gravelly Sand 12" min
- Mixing Gravelly Sand/GAC 3"

MERC
- Gravelly Sand/GAC 6" Avg.

Note: Cross-Section Profiles Are Not To Scale

20 to 30 ft of water (Cap R)
- Habitat Medium Sand 12" min
- Chemical Isolation/GAC Medium Sand 12" min
- Mixing Medium Sand/GAC 3"



- Cultural Resources
- Pre-Remediation Shoreline (Elev. 362.5)
- Cap Model Area
- CSX Shoreline
- Wave Dampers
- Berms (See FCF 62 for details)
- Sand Buttress (See FCF 48 for details)

0 1,000 2,000 Feet

FIGURE 6.5

Honeywell

RA-E Cap Design

PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

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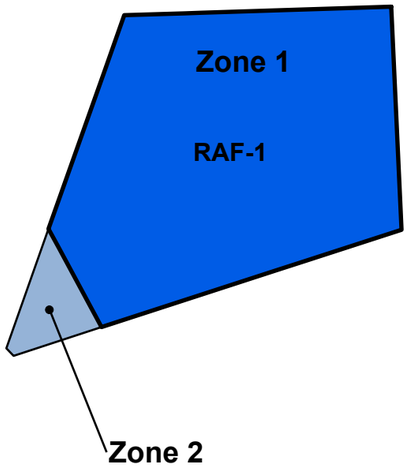
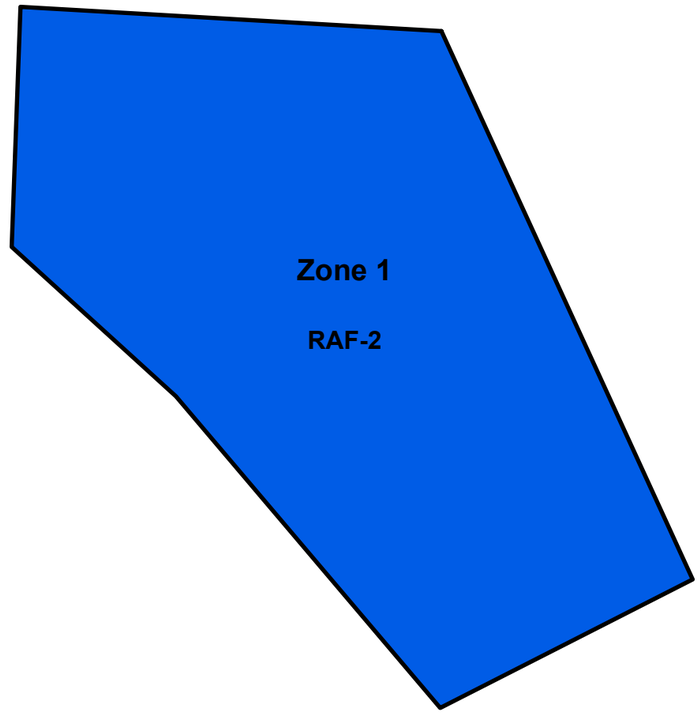
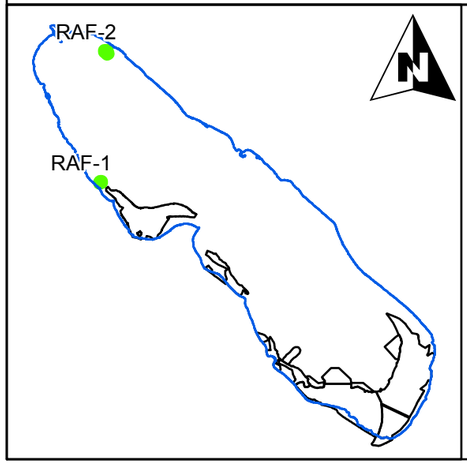
Plot Date: 9/27/2017 Plotted By: Sisson, Evan







7 to 30 ft of water (Cap D)

Habitat
Medium Sand
12" min

Chemical Isolation
Medium Sand
12" min

Mixing Medium Sand
3" min

3 to 7 ft of water (Cap B)

Habitat
Fine Gravel
18" min

Chemical Isolation
Medium Sand
12" min

Mixing Medium Sand
3" min

Note: Cross-Section Profiles
Are Not To Scale

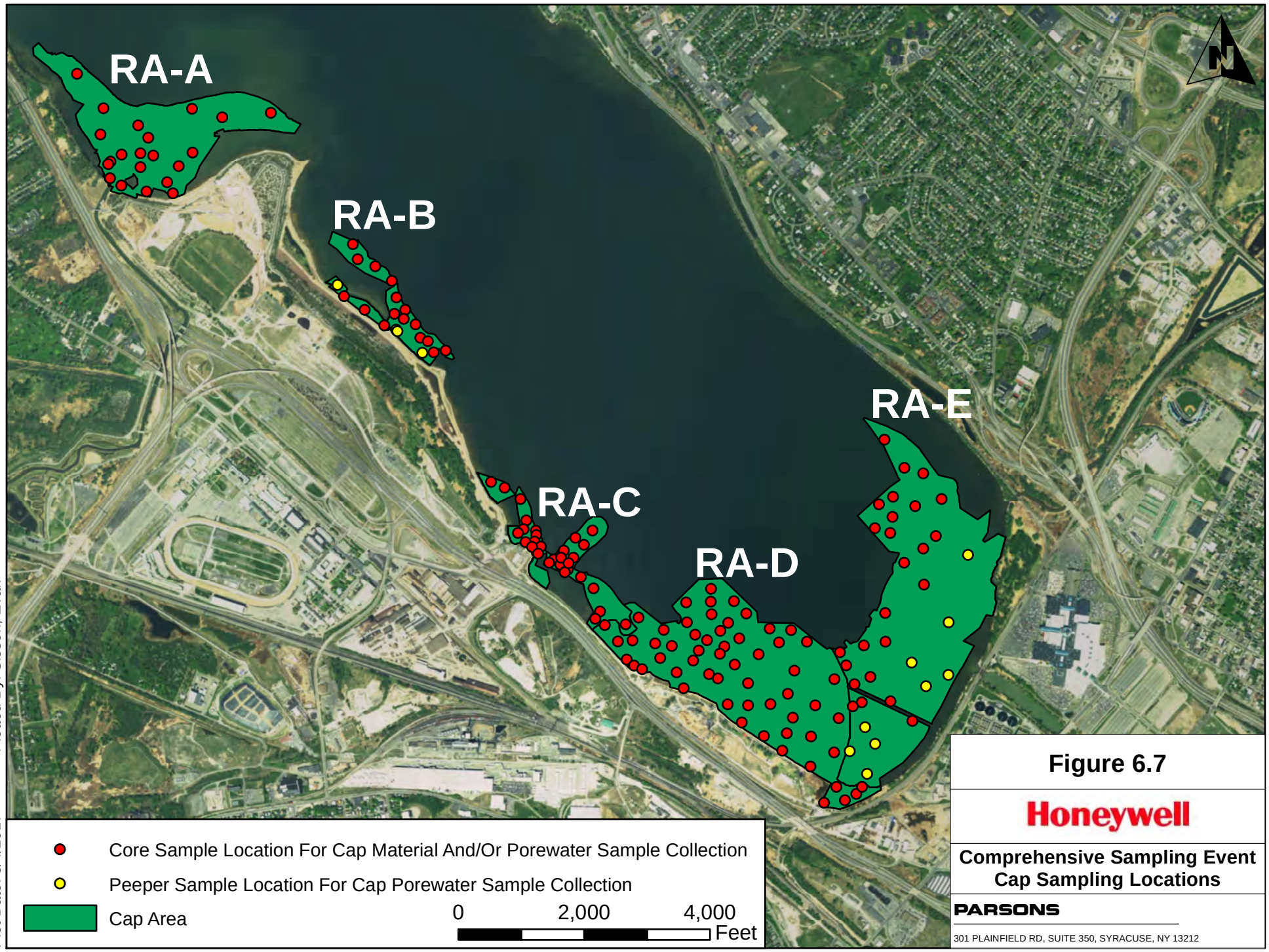
0 50 100 Feet

FIGURE 6.6

Honeywell

RA-F Cap Design

PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212



File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\Cap_Sampling_Locations.mxd
Plot Date: 8/4/2017 Plotted By: Sisson, Evan

Figure 6.7

Honeywell

Comprehensive Sampling Event
Cap Sampling Locations

PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

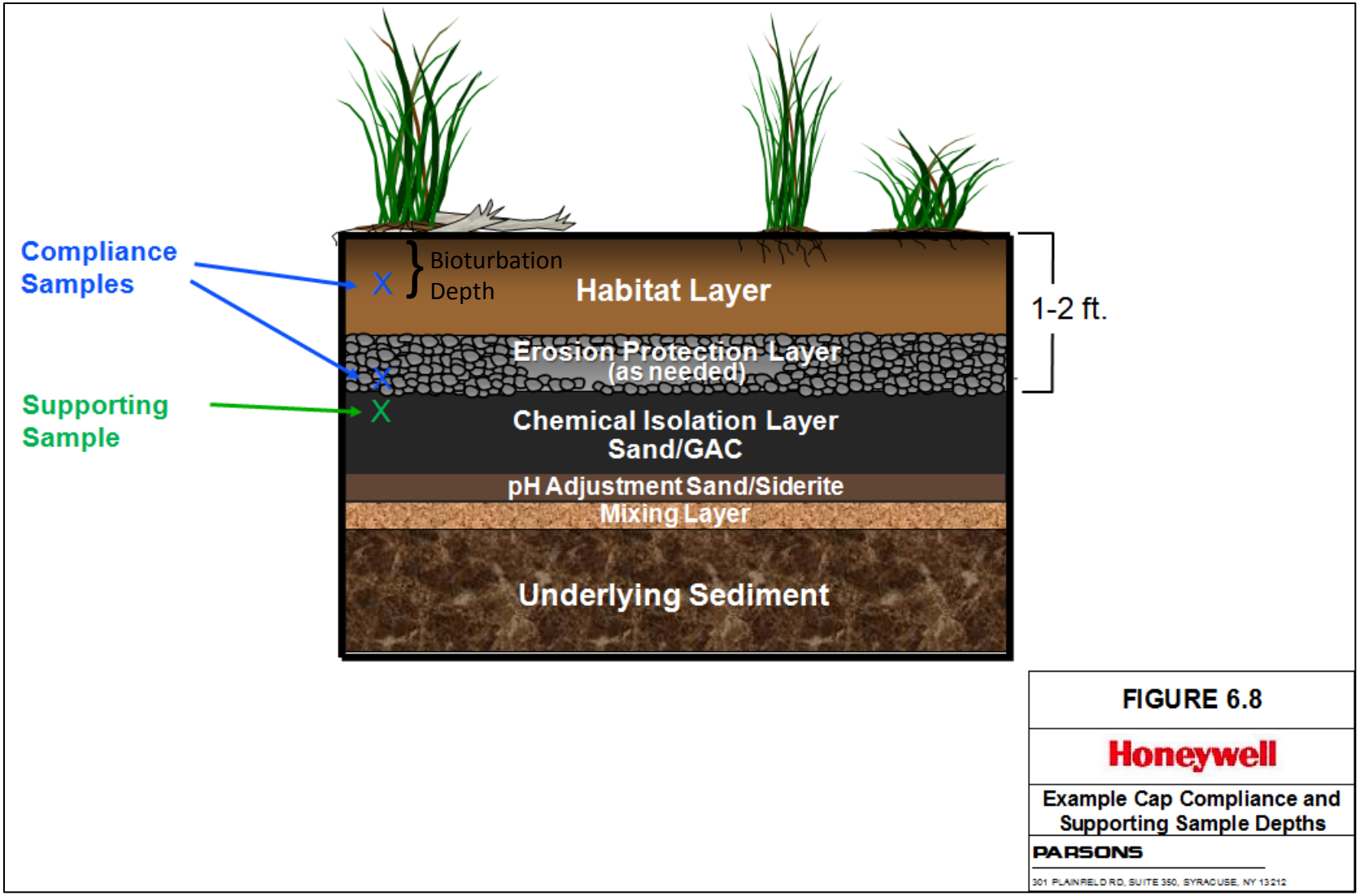


FIGURE 6.8

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Example Cap Compliance and Supporting Sample Depths

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301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\Cap_Sampling_Locations.mxd
Plot Date: 04/20/2017 Plotted By: Sisson, Evan

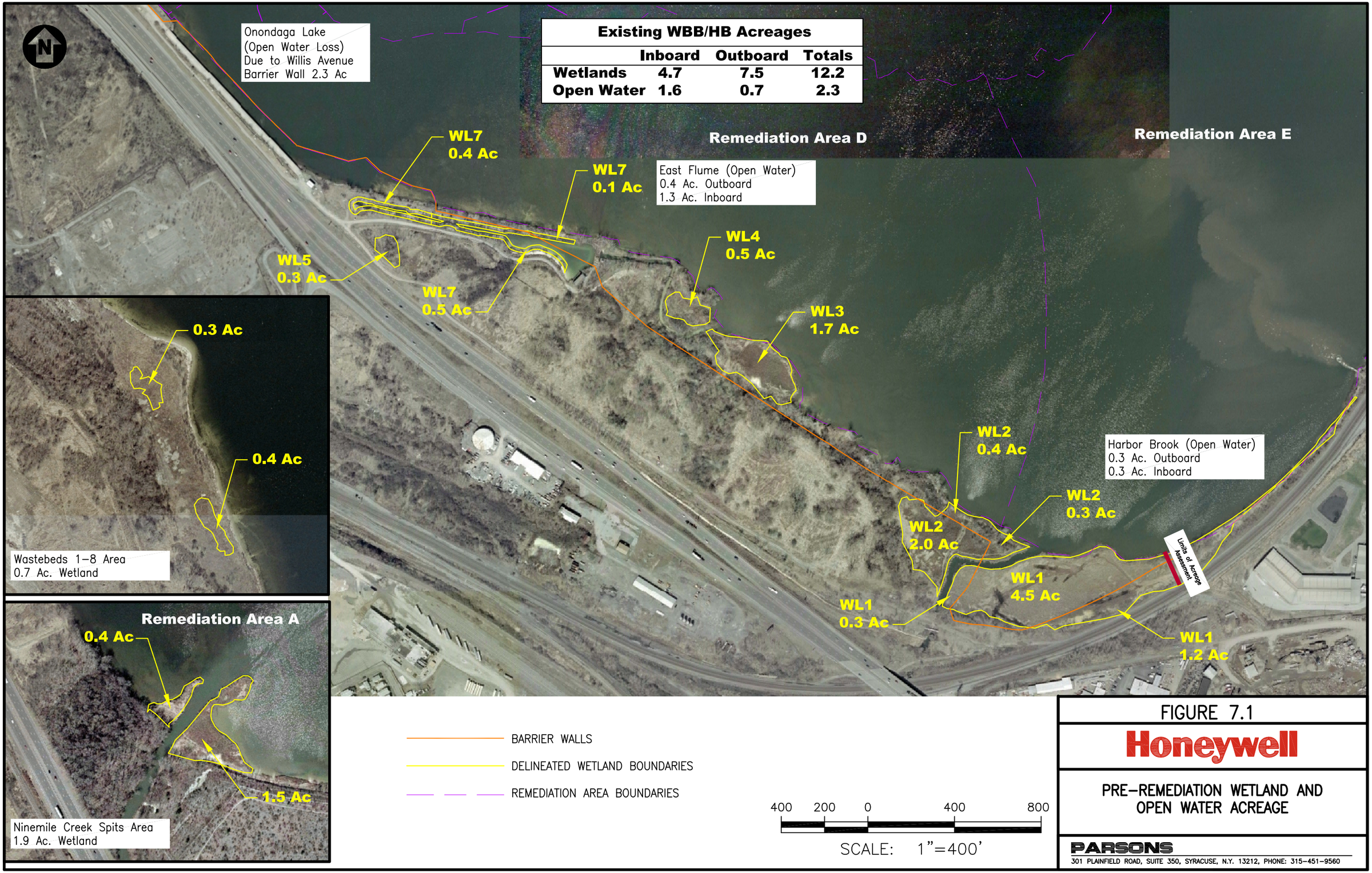

FIGURE 7.1

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PRE–REMEDIATION WETLAND AND OPEN WATER ACREAGE

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315–451–9560

FILE NAME: P:\HONEYWELL –SYR\450102 – 2016 OL REMEDIAL GOAL MONITORING\10 TECHNICAL CATEGORIES\CAD\2017\450102–MNR–2017–01.DWG
PLOT DATE: 10/9/2017 11:57 AM PLOTTED BY: RUSSO, JILL

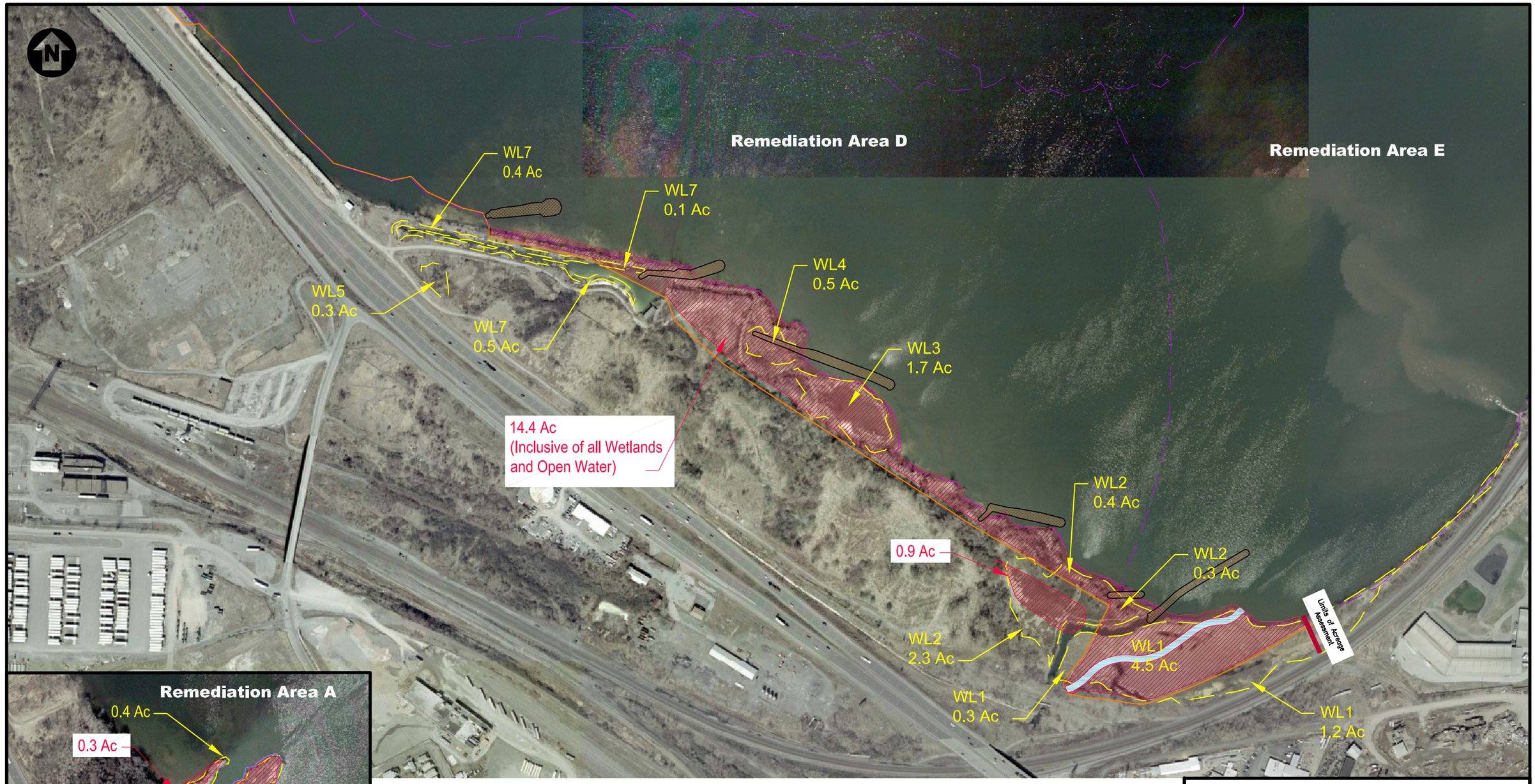

FIGURE 7.2

Honeywell

WASTEBED B/HARBOR BROOK AND NINEMILE CREEK SPITS POST-REMEDIATION WETLAND AND OPEN WATER ACREAGE

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\450102 - 2016 OL REMEDIAL GOAL MONITORING\10 TECHNICAL CATEGORIES\CAD\2017\450102-MNR-2017-02.DWG
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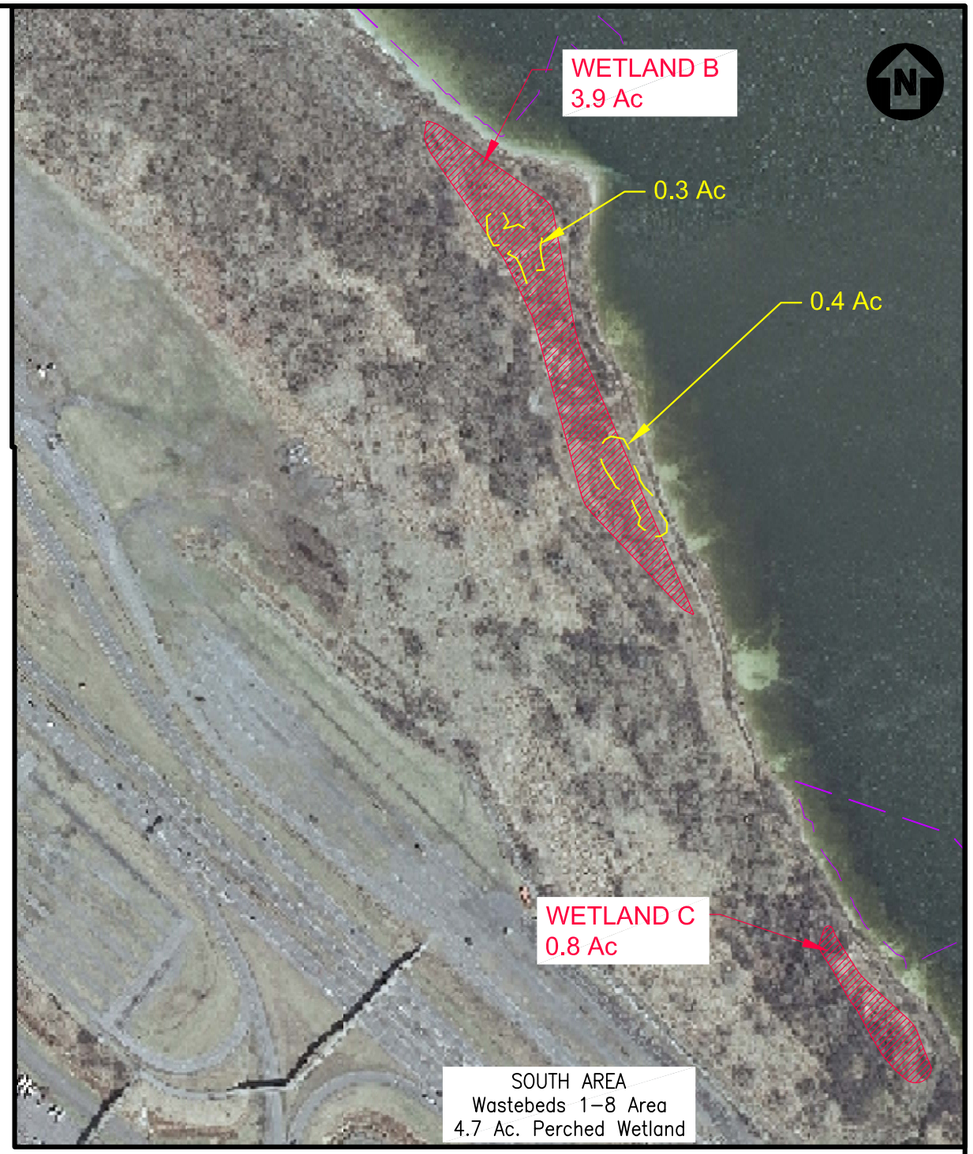
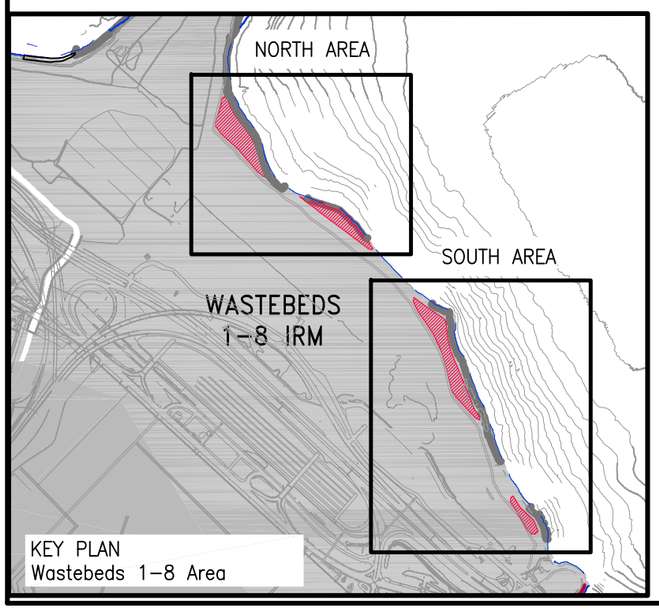




DELINEATED WETLAND BOUNDARIES (NYSDEC) PRE–REMEDIATION

REMEDIATION AREA BOUNDARIES

POST–REMEDIATION WETLAND AREA

400 200 0 400 800

SCALE: 1"=400'

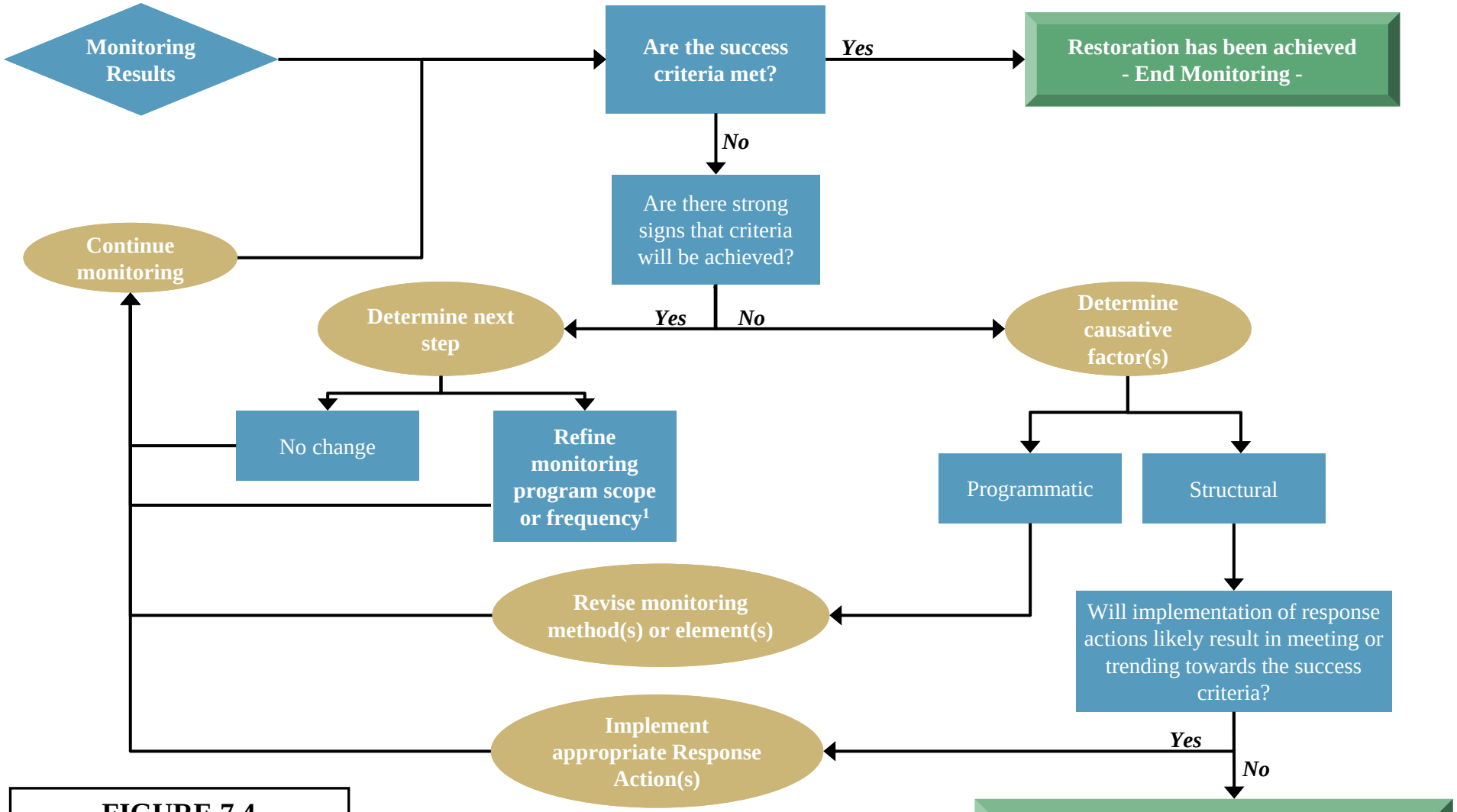
FIGURE 7.3

Honeywell

WASTEBEDS 1–8 POST–REMEDIATION
WETLAND ACREAGE

PARSONS
301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315–451–9560

FILE NAME: P:\HONEYWELL –SYR\450102 – 2016 OL REMEDIAL GOAL MONITORING\10 TECHNICAL CATEGORIES\CAD\2017\450102–MNR–2017–02.DWG
PLOT DATE: 10/9/2017 12:38 PM PLOTTED BY: RUSSO, JILL



*Subject to NYSDEC approval.

FIGURE 7.4

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Habitat Decision Framework Summary

PARSONS

301 Plainfield Road, Suite 350, Syracuse, NY 13212

Note:
1. Refinements to the monitoring program such as reduced sampling frequency or list of parameters being monitored will be evaluated annually if data suggest criteria will be achieved. Proposed modifications will be subject to NYSDEC approval.

ATTACHMENT 1

ONONDAGA LAKE SCA FINAL COVER DESIGN, APPENDIX E: POST CLOSURE CARE PLAN

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau D
625 Broadway, 12th Floor, Albany, NY 12233-7013
P: (518) 402-9676 I F: (518) 402-9773
www.dec.ny.gov

May 18, 2017

Mr. John P. McAuliffe, P.E.
Program Director, Syracuse
Honeywell
301 Plainfield Road, Suite 330
Syracuse, NY 13212

Re: Onondaga Lake Sediment Consolidation Area Final Design, Dated May 2016

Dear Mr. McAuliffe:

As stated in my May 6, 2016 letter to your attention, the Onondaga Lake Sediment Consolidation Area Final Cover Design, dated 2016, was determined to be acceptable and would be approved upon the inclusion and finalization of the SCA Post Closure Care Plan (Appendix E). My April 6, 2017 letter to your attention approved the Post-Closure Care Plan, Onondaga Lake Sediment Consolidation Area (SCA) Final Cover Design Submittal, dated April 2017. Therefore, add the approved Post-Closure Care Plan to the accepted Onondaga Lake Sediment Consolidation Area Final Cover Design, dated 2016, and the resulting document is hereby approved. Please see that copies of the approved document, including this approval letter, are sent to the distribution list selected for this site as well as the document repositories selected for this site.

Sincerely,

Timothy J. Larson, P.E.
Project Manager

ec: B. Israel, Esq, - Arnold & Porter
J. Davis - NYSDOL, Albany
M. Schuck - NYSDOH, Albany
M. McDonald - Honeywell
R. Nunes - USEPA, NYC
M. Sergott - NYSDOH, Albany
L. Brussel – Parsons

Honeywell

Prepared for

Honeywell
301 Plainfield Road, Suite 330
Syracuse, NY 13212

POST-CLOSURE CARE PLAN

ONONDAGA LAKE SEDIMENT CONSOLIDATION AREA (SCA) FINAL COVER DESIGN SUBMITTAL

Camillus, New York

Prepared by

PARSONS

301 Plainfield Road, Suite 350
Syracuse, NY 13212

Beech and Bonaparte engineering p.c.

an affiliate of Geosyntec Consultants

1255 Roberts Boulevard, Suite 200
Kennesaw, Georgia 30144

Project Number GD5497

April 2017

TABLE OF CONTENTS

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1. INTRODUCTION

1.1 Project Background

Onondaga Lake is a 4.6 square mile (3,000 acre) lake located in Central New York State immediately northwest of the City of Syracuse. The Onondaga Lake Bottom Site is on the New York State Registry of Inactive Hazardous Waste Sites and is part of the Onondaga Lake National Priorities List Site. Honeywell entered into a Consent Decree (CD) (United States District Court, Northern District of New York, 2007) (89-CV-815) with the New York State Department of Environmental Conservation (NYSDEC) to implement the selected remedy for Onondaga Lake as outlined in the Record of Decision (ROD) issued on July 1, 2005 (NYSDEC, 2005). The following documents are appended to the Consent Decree: ROD, Explanation of Significant Differences, Statement of Work (SOW), and Environmental Easement. As specified in the ROD, a component of the selected lake remedy includes the dredging and onsite consolidation of sediments removed from the lake. Based on an evaluation of potential locations for building and operating a Sediment Consolidation Area (SCA) to contain sediment dredged from Onondaga Lake, the SCA was constructed on Wastebed 13. The Onondaga Lake SCA Civil and Geotechnical Final Design Report (Parsons and Geosyntec, 2011) presents the design of the liner system and perimeter berms of the SCA, which was constructed in 2010, 2011, and 2012. The SCA construction was completed in 2012. Dredging operations at the SCA site began in 2012 and were completed in November 2014. The Onondaga Lake SCA Final Cover Design (Cover Design) Report (Parsons and Beech and Bonaparte, 2016) presents the design of the SCA final cover system. Construction of the cover system began in 2015 and will be completed in 2017.

1.2 Purpose of Post-Closure Care Plan

This Post-Closure Care Plan (PCCP) was prepared in accordance with: (i) the requirements set forth in the ROD and SOW for "*Implementation of a long-term operation, maintenance, and monitoring program to monitor and maintain the effectiveness of the remedy*"; and (ii) the New York State Department of Environmental Conservation (NYSDEC) Regulation Section 360-2.15 (k) (7) that states "*A comprehensive post-closure monitoring and maintenance operations manual is required.*"

The overall objective of the PCCP is to maintain and verify the integrity and effectiveness of the SCA facility including final cover system, surface water management system, the liquid management system (LMS), and the SCA perimeter berm. The overall objective will be achieved by regular inspections and maintenance activities. The specific objectives of the PCCP are:

- to provide a routine inspection program that allows for assessment of conditions at the site;
- to provide a maintenance program for the site that will facilitate the long-term and continual performance of the SCA facility;
- to provide, if necessary, guidance and protocols for the repair and/or restoration of deficiencies in the SCA facility; and
- to provide a standardized procedure for notice to project parties (Honeywell and NYSDEC) regarding inspections, the conditions of the SCA, and annual reporting.

The NYSDEC Project Manager will be notified at least two weeks prior to major inspections (i.e., quarterly) and significant maintenance activities. More frequent minor inspections may be performed on a regular basis to monitor the status of the final cover. In addition, the NYSDEC will be notified immediately in the unlikely event of an action or occurrence which causes or threatens to cause a release of hazardous substances, pollutants, or contaminants on, at, or from the SCA, or which may create a danger to public health, welfare, or the environment.

Per NYSDEC regulations, the minimum post-closure care period is 30 years. Elements of the post-closure care activities may be discontinued sooner, as approved by NYSDEC, based on inspection and monitoring results.

1.3 Plan Organization

The remainder of the report is organized as follows:

- Section 2 contains the inspection and maintenance programs for the final cover system;
- Section 3 contains the inspection and maintenance programs for the surface water management, soil erosion, and sediment control;
- Section 4 contains the operation requirements and inspection and maintenance programs for the LMS;

- Section 5 describes the recordkeeping and reporting requirements;
- Section 6 presents the documentation requirements;
- Section 7 contains the operation, monitoring, & maintenance (OM&M) staffing requirements;
- Section 8 describes the citizen participation program;
- Section 9 contains the health and safety requirements;
- Section 10 contains the groundwater and environmental monitoring requirements;
- Section 11 describes the geotechnical monitoring;
- Section 12 contains the access control requirements;
- Section 13 presents the post-closure site use; and
- Section 14 contains the references.

Attachment 1, which is an Inspection, Operation, and Maintenance Schedule, is also included as part of this PCCP.

1.4 Administrative Requirements

Honeywell will appoint a Facility Supervisor for the SCA. This Facility Supervisor will serve as the contact person for the SCA. Pursuant to the requirements set forth in Paragraph 100 of the CD, Honeywell will provide a written notice and a copy of the CD to each contractor and subcontractor hired to perform any portion of the work required by this PCCP.

2. FINAL COVER

2.1 Introduction

The SCA final cover system must be periodically inspected and maintained. The subsequent sections discuss in more detail the requirements, procedures, protocols, and schedules of the inspection and maintenance activities for the final cover system. General post-closure care requirements for vegetation are presented herein. Any additional requirements related to the selected vegetation will be added to this PCCP at the completion of construction of the final cover.

2.2 Inspection Interval and Procedures

Visual inspection of the final cover system will be completed quarterly throughout the post-closure period. Honeywell may petition NYSDEC to modify the quarterly inspection to annual inspection as part of the five-year remedy review.

The objective of the final cover system inspection is to detect any observable issues or conditions that would prevent the final cover system from continuing to preclude direct contact with the underlying materials and off-site transport of contaminated media. During the inspections, the final cover system will be visually examined for the following:

- evidence of subsidence or settling that results in low points or depressions;
- evidence of burrowing animals;
- evidence of trespassing or unauthorized use of the final cover area;
- presence of any erosion rills;
- condition of vegetation (e.g., grass);
- observable irregularities such as bulges, bumps, slumps, or cracks;
- evidence of ponded water;
- condition of gas vents;
- condition of drainage pipe outlets;
- condition of any access roads (i.e., erosion, aggregate washout, exposed geotextile, and debris on the road);
- condition of SCA perimeter berm;
- condition of areas near anchor trenches; and
- any other irregularities.

In addition, visual inspections will be conducted as soon as practical after major storm events (i.e., 5-year storms per Part 360-2.15(k)(8)), possible flooding events, or other events that may result in damage to the final cover system, but only at such time as the safety and health of inspection personnel can be assured.

2.3 Maintenance Interval and Procedures

The following maintenance activities must be performed on the final cover system soil as needed and in consultant with NYSDEC, unless otherwise indicated:

- Erosion rills on the final cover system will be repaired by packing straw mulch into the void areas or by other alternate methods, to prevent further erosion and allow the cap vegetation to take root in the area, stabilizing the rill. If rills reach 4 to 6 inches in depth, additional soil material will be added and the area will be re-compacted, re-seeded or re-planted with native grassland species, fertilized, and mulched. Materials equivalent to those already in place will be used.
- Depressions caused by erosion, settlement, or subsidence that are observed to hold water will be repaired by placing additional soil in the depression and re-seeding or re-planting with native grassland species as soon as possible. Materials equivalent to those already in place will be used.
- If an area has less than 25 percent vegetative coverage at the end of the first growing season or at the mid-point of the growing season (July) thereafter, the area will be reworked, as necessary, and re-seeded and/or re-planted with native grassland species. High quality agricultural fertilizer or other amendments may be applied at the rate suggested by the manufacturer to promote the re-establishment of a self-sustaining vegetative cover.
- The herbaceous vegetative cover will be maintained by mowing on a regular schedule, except for the area within a 10-ft radius of the gas vents that will not be mowed. The plants near the gas vents were specifically selected so that they would not be woody (i.e., they are grasses) and grow tall enough to hide the vents. Trimming of the area around the gas vents will be performed by hand if the vegetation is interfering with gas vent operations. The mowing schedule for the remainder of the cover is intended to limit the growth of weeds or rooting of unplanned woody species. During the first growing season, it is anticipated that vegetation will be mowed in mid-May and mid-June to a height of 6 to 8 inches, and to a height of 10 to 15 inches in mid-August. This mowing regime will reduce competition for sunlight and moisture, prevent unwanted species from producing seed during the first growing season, and allow warm season grasses that are developing their root systems to establish. Prior to each scheduled mowing event during the first growing season, a site inspection will be performed to determine the extent and type of mowing that is needed. In the second and third growing seasons, vegetation will be mowed to a height of 10 to 15 inches before April 15th and after September 15th. If field conditions prior to April 15th do not allow for mowing to occur without potentially damaging the cover system, the vegetation will only be mowed after September 15th. Following the third growing season,

mowing will occur on a three-year rotating cycle with one-third of the vegetative cover area (approximately 17 acres) mowed once each year after October 1st to a height of 10 to 15 inches (i.e., each one-third area will be mowed once every three years). In addition, to prevent damaging the cover system, mowing equipment should not be used on the perimeter channels when they are wet/soft. If necessary, alternative methods for maintaining this area will be used. Safe mowing procedures will also be developed to prevent overturning of equipment on steep perimeter slopes.

- Animal burrows will be filled following inspection and seeded or planted with native grassland species to prevent creation of erosion rills. Honeywell will manage the animals present on the site before the burrows are sealed.
- Additional aggregate will be placed on access roads as needed to avoid exposed sub-base or potholes so that the access roads remain in drivable condition.
- Any penetrations through the soil cover will be repaired by locally reconstructing the soil cover similar to the surrounding cover and then seeded or planted with native grassland species. Penetrations through geosynthetic components will be temporarily covered with a tarp or other impervious cover and repaired as soon as practical by a geosynthetics installer using materials equivalent to those used to construct the final cover system in accordance with the requirements of the SCA Final Cover Project Technical Specifications. The geosynthetics installer shall meet the project qualification requirements and shall be approved by Honeywell prior to commencing the repair.
- If damage to soil mounds around the gas vent pipes used to divert surface water is identified, it will be repaired as soon as possible by placing additional soil and re-seeding or re-planting with native grassland species. Materials equivalent to those already in place will be used. If there is significant movement around the gas vent pipe, then a portion of the pipe will be excavated and the geomembrane boot will be adjusted to accommodate additional movement. The gas vent pipes will be maintained in a stable and upright position. Any objects obstructing the flow of gas at the gas vents will be removed.
- Debris or any other objects obstructing the flow of the drainage pipes (i.e., at pipe outlets) will be removed. Detection of areas that are too wet or boggy to support vegetation growth on the cover system may require repair or replacement of the existing drainage pipe with additional gravel and geotextile wrap.

- Routine maintenance will take place throughout the year and at such times as necessary based upon the results of the site inspections. Maintenance to repair the final cover system will be conducted on an as-needed basis.

3. SURFACE WATER MANAGEMENT, SOIL EROSION, AND SEDIMENT CONTROL

3.1 Introduction

The SCA final cover system was designed with permanent diversion berms, interception berms, and perimeter drainage channels, as shown on the SCA Final Cover Design Drawings. These permanent surface water management structures will be inspected per the Post-Closure Care Plan. Temporary erosion control measures, such as erosion mats, silt fences, woodchips, etc., installed as part of the SCA operations and closure construction are intended to be removed once the final cover vegetation is established, and hence are not addressed herein. These temporary erosion control structures will be inspected in accordance with the SCA Final Cover Project Technical Specifications. The current use of the East and West Basins will continue at least until an end use is determined for these areas. The basins are addressed in this plan.

3.2 Inspection Interval and Procedures

The inspection of the surface water management, soil erosion, and sediment control structures at the SCA facility includes visually examining and evaluating the integrity and proper functioning of the following items, as applicable:

- diversion berms;
- interception berms;
- drainage channels; and
- East and West Basins (including temporary pumps and pipes).

The surface water management, soil erosion, and sediment control structures will be inspected quarterly unless otherwise specified. Honeywell may petition NYSDEC to modify the quarterly inspection to an annual inspection as a part of the five-year remedy review.

3.3 Maintenance Interval and Procedures

The maintenance activities associated with the surface water management, and soil erosion and sediment control structures at the SCA facility include the following items:

- removal of debris or any other objects obstructing the flow in drainage channels;
- repair, as needed, of any damaged stormwater, erosion, and sediment control structures;
- cleaning of clogged riprap (by removal and replacement, as needed) and the East and West Basins; and
- calibration, operation, maintenance, and service of mechanical and electrical equipment including the pump, pressure transducers, and flow meters in accordance with the manufacturer's instructions.

4. LIQUID MANAGEMENT SYSTEM (LMS)

4.1 Introduction

This section of the PCCP establishes operating, inspection, and maintenance guidelines to be followed to achieve proper performance of the SCA LMS, which includes a liquid transmission system (LTS) and two sump areas for collecting and removing liquid through two vertical risers in each area. The LTS will transfer the collected liquid to the designated water treatment facility to properly manage the liquid.

4.2 LMS Operation

The LMS is designed to function automatically. Liquid will enter the risers via sumps by gravity flow. The riser pumps are designed to turn on and off automatically based on the liquid levels within the risers. The sump pump will be operated in the automatic mode, but only when the SCA water treatment plant operation staff is onsite. This is especially true in the winter months, when the system should be checked for leaks and all drain lines verified to be closed prior to restarting the sump pumps. The level alarms will alert the Facility Supervisor or representative if a high level occurs while the plant is unstaffed, and staff will be called in to re-start the sump pump operations. Pumping systems shall include monitoring devices to measure the total amount of liquid pumped from the sumps. The total amount of liquid at the treatment facility shall also be recorded.

4.3 Inspection Interval and Procedures

When liquid is present in the sump in pumpable quantities, the individual components of the LMS must be inspected monthly for the first year and quarterly thereafter to:

- ensure that the automatic controls of the LMS pumps are in operation when the water treatment plant staff is onsite and ready to operate the pumps;
- examine the condition of instrumentation and/or valves (e.g., note sticking or jammed devices, corrosion, leaks, and misalignments), or if liquid removal processes from the SCA facility are not functioning properly;
- verify that the operating conditions of the LMS are specified so that the liquid depth in the sump does not exceed 6 feet in order to achieve the design goal of the liquid head on the liner not exceeding 1 foot;
- verify that liquid is flowing from the sumps during pumping, either by using a remote monitoring system or direct inspection of the flow gauges;
- record the flow rate and volume of liquids flowing from the sumps, either by using a remote monitoring system or direct inspection of the flow gauges;
- confirm that the pumps are operating and high level alarm conditions are not reached, either by using a remote monitoring system or direct inspection of the flow gauges;
- examine the condition of the aboveground piping and the insulation around the pipes when pumping activities occur. The aboveground pipes include pipes at the top of riser as well as the LTS piping;
- verify appropriate warning signs are clearly visible (e.g., buried live electric line, liquid transmission pipe);
- examine the condition of any mechanical and electrical instrumentation devices in winter prior to starting up the automatic mode of the system. This examination prior to re-start shall include the verification that the heaters of the appropriate devices are in working order and the drains of the sump pump discharge piping are closed; and
- examine the condition of the sump riser covers to prevent any potential fall-into-riser accident.

It is recommended that if remote monitoring systems are used that they be equipped with automatic call options for alarm conditions. Additional inspections shall be conducted in the event a remote monitoring system becomes inoperable.

When there is no liquid in the sump risers or the liquid is present in an un-pumpable amount for a long time (i.e., several months), Honeywell may petition NYSDEC to modify the frequency of various inspections mentioned above for the LMS to semi-annually (i.e., twice per year) or annually, as a part of the five-year remedy review.

4.4 Maintenance Interval and Procedures

The following maintenance activities must be performed on the LMS in order to ensure proper functioning of the SCA facility:

- if an alarm is activated, an auto dialer will notify the Facility Supervisor or a representative who shall respond as soon as practical (i.e., 24 hours or less) to assess the reasons for the alarm sounding and to take corrective actions;
- the Facility Supervisor or a representative must remedy any problems identified during the inspection as soon as practicable;
- mechanical and electrical equipment including the pump, pressure transducers, and flow meters shall be calibrated, operated, maintained, and serviced in accordance with the manufacturer's instructions. The minimum frequency for the calibration of the equipment will be consistent with requirements specified by the manufacturers;
- any warning signs that are damaged to the point where the sign no longer is legible will be repaired/replaced;
- if an inspection indicates that a LTS pipe or a force main is obstructed, the pipe shall be cleared or flushed by pumping fresh water from a water truck through a hose inserted in the pipe cleanout. If flushing does not remove the obstruction, other methods shall be used to clean the pipe. Other methods may include blowing the obstruction out with air, vacuuming, rodding, or inserting a snake, fish tape, or other suitable devices. If air or water pressure is used, the working pressure inside the LTS pipe or the force main shall not exceed the pressure rating of those pipes; and
- any damage to the sump riser covers that threatens the integrity of this structure will be repaired.

5. RECORDKEEPING AND REPORTING

5.1 Recordkeeping and Record Retention Requirements

Recordkeeping procedures will be followed for post-closure care of the SCA facility including final cover system, surface water management system, LMS, and the SCA perimeter berm at the site. The records to be maintained include, at a minimum:

- a summary of the findings of inspections;
- a description of maintenance performed;
- a detailed description of any emergencies that occurred and the measures taken to address them;
- a detailed description of the issues encountered and the actions taken to correct them;
- the daily flow rates and volumes of liquids pumped from the LMS;
- the overall monthly average of the daily flow rates (gallons per acre per day or gpad) for each LMS sump; and
- a detailed description (what, when, where, and how much) of the information and/or documents provided to NYSDEC.

Records and files for post-closure care will be kept by Honeywell. Records will be preserved to document information relating to post-closure care inspection and maintenance activities for the most recent six years. Honeywell will provide the originals or copies of the documents to NYSDEC at the end of the six-year period. NYSDEC may keep these documents in perpetuity, if it is determined to be necessary.

5.2 Reporting Requirements and Procedures

Honeywell will follow all reporting requirements provided in the CD. Annual and Five-Year Post-Closure Care Reports will be submitted as described in Section 6.

6. DOCUMENTATION

6.1 Inspection, Operation, and Maintenance Forms

The information gathered during each inspection, operation, and maintenance event will be legibly recorded in Inspection, Operation, and Maintenance Forms listed in section 5.1. Data to be recorded on the Inspection, Operation, and Maintenance Form include:

- date and time of the inspection or maintenance;
- weather condition during inspection or maintenance;
- the name(s) of the personnel conducting the inspection or maintenance;
- a written description of the observation made;
- nature of any remedial actions to be taken;
- recommendation for corrective measures; and
- documentation of any repair/maintenance activities.

Photographs taken during inspection or maintenance activities will be recorded in Photographic Logs. The data to be recorded on the Inspection, Operation, and Maintenance Form will be consistent with the records to be maintained as listed in Section 5.1.

6.2 Annual Reports

The Annual Post-Closure Care Report will summarize the quarterly and other significant inspection, maintenance, and monitoring activities. The detailed logs for each inspection, maintenance, and monitoring event will be kept at the site and provided electronically in each annual report. The Annual Post-Closure Care Report will include:

- a description of the site, site location, historical site background, and responsible project parties;
- a narrative summary of inspections conducted at the site over the past year;
- a narrative summary of maintenance conducted at the site over the past year;
- a narrative summary detailing resolution of outstanding inspection or maintenance issues from the prior year, or in the event that resolution has not been reached, a descriptive summary of the outstanding issues and "go-forward" strategy;
- the Inspection, Operation, and Maintenance form for each quarterly inspection and the detailed logs for each inspection, maintenance, and monitoring event; and
- recommendations for modifications to this PCCP, if necessary.

The Annual Post-Closure Care Reports will be submitted to the NYSDEC within the first quarter of the following year and used as the basis to develop the Five-Year Post-Closure Care Report, which is also required for submittal to NYSDEC.

6.3 Five-Year Review Report

The inspection and maintenance program will be performed as described above for a minimum of five years. If the final cover system has stabilized, an abbreviated inspection and maintenance program will be presented to NYSDEC for approval. The final cover system shall be considered as stabilized when no significant erosion, settlement, or subsidence areas have been observed within two consecutive calendar years. The abbreviated inspection and maintenance program will consist of semi-annual or annual inspection, operation, and maintenance for the final cover system, surface water management, soil erosion and sediment control, and LMS. The Five-Year Post-Closure Care Report will be submitted as part of the closure and post-closure registration renewal for the site and will be developed based on the Annual Post-Closure Care Reports.

7. OPERATION, MONITORING, & MAINTENANCE (OM&M) STAFFING REQUIREMENTS

7.1 Manpower Requirements

The OM&M Contractor is responsible for providing sufficient manpower for executing this plan. Honeywell will have a representative that can communicate between the OM&M Contractor and NYSDEC in terms of documentation, reviews, and agency inspections.

7.2 Responsibilities and Duties

OM&M Contractor

The OM&M Contractor will be responsible for conducting site inspections, maintenance of the site, sampling, field documentation of the OM&M activities, and report preparation. The OM&M Contractor is responsible for site health and safety during OM&M activities.

Honeywell

Honeywell is ultimately responsible for implementing the OM&M program in accordance with the CD. Honeywell is financially responsible for the OM&M program and must contract for OM&M services. Honeywell will submit required documentation to NYSDEC and participate in five-year meetings, if requested by NYSDEC.

NYSDEC

The NYSDEC is responsible for enforcing the CD. The NYSDEC will review reports including the Five-Year Post-Closure Care Report and will participate in the five-year review meeting, as needed, to make decisions regarding the long-term OM&M program.

7.3 Qualifications and Training

Qualifications and training for OM&M personnel will be provided in a health and safety plan that will be submitted to the NYSDEC for informational purposes both initially and upon future modification.

8. CITIZEN PARTICIPATION

Honeywell is committed to cooperating with NYSDEC to inform the public during the OM&M period. Honeywell will conduct the OM&M with NYSDEC oversight, review, and approval. NYSDEC will implement the citizen participation activities with Honeywell's assistance. As discussed in Section 6.2, the detailed logs for each inspection, maintenance, and monitoring event will be included in the Annual Report, which will be provided to the document repositories. The community hotline will remain available as directed by NYSDEC.

For additional information, the public is encouraged to contact any of the following project staff:

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9. HEALTH AND SAFETY

Upon completion of the SCA Final Cover, impacted materials will have been contained in compliance with the approved plans and specifications. The OM&M Contractor will be responsible for preparing and submitting an OM&M Health and Safety Plan.

10. GROUNDWATER AND ENVIRONMENTAL MONITORING

Groundwater and environmental monitoring, except for vent odor monitoring described herein, are being addressed as part of the Wastebeds 9 through 15 Closure; therefore, they are not addressed herein. Specifically, groundwater and environmental monitoring are being addressed under the SCA Environmental Monitoring Plan (O'Brien and Gere, 2014) and quarterly monitoring reports.

Air quality monitoring that was conducted during SCA operations (2012-2014) and installation of the leveling layer (2015) demonstrated no exceedances of the project's air quality criteria for VOCs, mercury, and hydrogen sulfide. Dust monitoring was conducted during SCA operations and closure construction, and the results were provided to the NYSDEC in Daily Air Monitoring Reports. To estimate the potential of detectable odors from the cover vents, emissions modeling was conducted to estimate the emissions from the vents relative to emissions that were estimated for the SCA operations. Off-site odor monitoring results during operations indicated that odor levels, when detected, were usually less than 2 odor units (OUs) and did not exceed 2 OUs. Odors are typically considered just detectable at 1 OU, which corresponds to an order of magnitude reduction of mass[1] from 2 OUs, or a greater than 90 percent reduction in emissions as compared to emissions during SCA operations.

The same model that was used in 2010 to estimate air emissions from the SCA operations[2] was used to estimate emission potential from the cover vents. The model derived emission potential from the vents as the diffusion of compounds from the sediment pore spaces within the geotextile tubes toward the tube's fabric and into the leveling layer where they can be carried out to the atmosphere through the vents as a consequence of the SCA-generated gas flow. This is distinctly different from the SCA operations scenario, which involved several active sources of emissions (i.e., the debris screen, geotextile tube filling, inter-tube flow streams and cascades, flow through the gravel bed and perimeter channels, the holding ponds, and the water treatment plant). Although the sources of volatile losses to the atmosphere are different, the model is still applicable since it uses environmental chemodynamic equations developed by Dr. Louis Thibodeaux

[1] A liter of odorous air at 2 OUs needs to be diluted by a liter of odor-free air to be just detectable (i.e., 1 OU), which corresponds to an order of magnitude reduction of mass.
[2] Three memoranda to Tim Larson of NYSDEC from Honeywell contractors dated June 3, June 29, and October 28, 2010.

and others at Louisiana State University. Dr. Thibodeuax was consulted for both modeling efforts. The model used literature based mass transfer coefficients and Henry's Law constants for each modeled compound, as well as site-specific sediment concentrations, partitioning coefficients, fraction organic content, and dry bulk density.

The model predicted mass emission rates for each compound. When summed, the modeled vent emission rate is 97 percent less than the emission rate from the SCA operations model. Since the model indicates a greater than 90 percent reduction in emissions, detection of cover vent odors off-site is unlikely. However, the following odor monitoring approach and contingent odor control approach have been developed in the event that off-site odors do occur.

Vent odor monitoring will be conducted starting in 2017 following approval by NYSDEC. It will involve odor observations at the locations of the eight air monitoring stations along the SCA workzone perimeter road. Odor monitoring will be performed with the nose of a qualified individual who has experience with site-related odors. Odor observations will be conducted once per work day from the start of SCA cover construction in 2017 until the construction of the final cover is completed. At that time, the frequency of odor monitoring may be reduced to weekly odor observations or less, if acceptable to NYSDEC. Odor monitoring will continue until NYSDEC allows the monitoring to cease.

If vent odors are detected at any one or more of the eight air monitoring stations, odor levels will be measured at each vent using a field olfactometer to determine which vent(s) is(are) the source of the detected odor, and perimeter road monitoring will be conducted once per work day as appropriate. Carbon treatment, which will be located onsite for immediate installation on vent pipes if necessary, will be applied at the odor emitting vents to control odor emissions. Odor levels at the exhaust of the controlled vents will be checked at an appropriate frequency to confirm proper control. Periodically, the carbon treatment may be removed from the vent(s) to determine if the respective vent(s) is(are) still a source of odors. If the respective vent is determined to continue to be an odor source, then the carbon treatment will be reinstalled on the respective vent(s). Perimeter odor monitoring will continue until carbon treatment is no longer needed and the NYSDEC allows the monitoring to cease.

11. GEOTECHNICAL MONITORING

Geotechnical monitoring will be continued for 6 months after final cover construction is complete. The monitoring data will be reported at a frequency of every 3 months (i.e., quarterly). The geotechnical instrumentation system may be abandoned at the end of the 6-month monitoring period, which is estimated to be the end of November 2017, as long as the settlement data curves indicate that settlement has flattened out. The rates of measured settlement have been decreasing since the winter shutdown in 2016/2017. The measured settlement curves are expected to have flattened out by the time the geotechnical instrumentation system is abandoned, since limited final cover construction activities are planned for the 2017 construction season. The geotechnical monitoring data will be provided in the final geotechnical data summary report.

12. ACCESS CONTROL

Control of site access is being addressed as part of the Wastebeds 9 through 15 Closure; therefore, it is not addressed herein. Specifically, site access is currently handled in Section 3.2 of the approved Closure Investigation Work Plan (O'Brien and Gere, 2011).

13. POST-CLOSURE SITE USE

A schedule for addressing post-closure site use has not been developed yet and may not be completed prior to completion of the SCA final cover construction in 2017. The current use of the East and West Basins, the sediment processing area, and the water treatment plant will continue at least until an end use is determined for these areas. At that time, and if necessary depending on the end use, Honeywell will petition the NYSDEC for required changes.

14. REFERENCES

New York State Department of Environmental Conservation and United States Environmental Protection Agency Region 2. 2005. Record of Decision. *Onondaga Lake Bottom Subsite of the Onondaga Lake Superfund Site*. July 2005.

O'Brien and Gere. 2011. Wastebeds 9 through 15 Closure Investigation Work Plan. September 2011.

O'Brien and Gere. 2014. Sediment Consolidation Area (SCA) Environmental Monitoring Plan. December 2014.

Parsons and Beech and Bonaparte. 2016. Onondaga Lake Sediment Consolidation Area Final Cover Design. May 2016.

Parsons and Geosyntec. 2011. Onondaga Lake Sediment Consolidation Area (SCA) Civil and Geotechnical Final Design. April 2011.

United States District Court, Northern District of New York. 2007. State of New York and Denise M. Sheehan against Honeywell International, Inc. Consent Decree Between the State of New York and Honeywell International, Inc. Senior Judge Scullin. Dated October 11, 2006. File January 4, 2007.

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ATTACHMENT 1

Inspection, Operation, and Maintenance Schedule

Inspection, Operation, Maintenance, and Monitoring Schedule

SCA Component/ Activity	Items to Inspect/Monitor/Maintain	Minimum Frequency							
		Daily	Weekly	Monthly	Quarterly	Semi-annually	Annually	Every Five Years	Other
Final Cover[4]	Physical Inspection:								
	• evidence of trespassing or unauthorized use of the final cover area			X[5]	X				
	• evidence of subsidence or settling that results in low spots				X				
	• evidence of burrowing animals				X				
	• presence of any erosion rills				X				
	• condition of vegetation				X				
	• observable irregularities such as bulges, bumps, slumps, or cracks				X				
	• evidence of ponded water				X				
	• condition of gas vents				X				
	• condition of drainage pipe outlets				X				
	• condition of any access roads (i.e, erosion, aggregate washout, exposed geotextile, and debris on the road)				X				
	• condition of SCA perimeter berm				X				
	• condition of areas near anchor trenches				X				
	• any other irregularities.				X				
	Routine Maintenance:								
	• repairs								as needed
	• mowing								Note 6
	• re-seeding of vegetative cover (including additional irrigation or placement of amendments)								as needed
Surface Water Management, Soil Erosion, and Sediment Control	Physical Inspection:								
	• stormwater control berms				X				
	• drainage channels				X				
	• east and west basins (including temporary pumps and pipes)				X				
	Routine Maintenance:								
	• removal of debris or any other objects obstructing the flow in drainage channels								as needed
	• repair of damaged erosion and sediment control structures								as needed
	• cleaning of clogged riprap by removal and replacement								as needed
	• cleaning of the basins								as needed
	• calibration, operation, maintenance, and servicing of mechanical and electrical equipments including the pump and flow meters								per manufacturer recommendations
Liquid Management System	Monitoring/Recording:								
	• flow rate and volume of liquids flowing from the sumps	R							maintain spreadsheet
	• high level liquid alarm for each sump	R							
	Physical Inspection:								
	• verify that the automatic controls of the LMS pumps are on			X[5]	X				
	• examine the condition of instrumentation and/or valves			X[5]	X				
	• verify that the operating conditions of the LMS are specified so that the liquid depth in the sump does not exceed 6 feet			X[5]	X				
	• examine the condition of the aboveground piping and the insulation around the pipes when pumping activities occur			X[5]	X				
	• verify appropriate warning signs are clearly visible			X[5]	X				
	• examine the condition of any mechanical and electrical instrumentation devices in winter when the temperature fall below equipment-specific operating ranges								as needed
	• examine the condition of the sump riser covers to prevent any potential fall-into-riser accident			X[5]	X				
	Routine Maintenance:								as needed
	• calibration, operation, maintenance, and servicing of mechanical and electrical equipments including the pump and flow meters								per manufacturer recommendations
	• repair of warning signs								as needed
	• cleaning of LTS and forcemain pipes								as needed
	• other repairs								as needed
Environmental Monitoring	• groundwater monitoring				X				per December 2014 EMP[7]
	• leachate monitoring				X				per December 2014 EMP[7]
	• surface water monitoring				X				per December 2014 EMP[7]
	• odor monitoring	X[8]							Until reduced frequency approved by NYSDEC
Reports	• Inspection logs								For each event
	• Annual report						X		
	• 5-year Report – Regulatory submittal							X	
	Incident Report for any action or occurrence which causes or threatens to cause an additional release of hazardous substances, pollutants, or contaminants on, at, or from the SCA, or which may create a danger to public health, welfare, or the environment.								Immediately after each occurrence

Notes:

1. "X" indicates onsite physical inspection, monitoring, or repair work.
2. "R" indicates remote monitoring can be used in lieu of site visit and direct inspection or monitoring.
3. Based on the monitoring and inspection results obtained, Honeywell can petition NYSDEC for a reduced monitoring frequency for different items.
4. Visual inspections will also be conducted as soon as practical after 5-year storm events.
5. Inspections will be performed monthly for the first year and quarterly thereafter.
6. Specific guidelines for mowing are provided in Section 2.3 of the Post-Closure Care Plan.
7. SCA Environmental Monitoring Plan (EMP) prepared for Honeywell by O'Brien and Gere in December 2014.
8. Daily refers to once per work day.

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