ONONDAGA LAKE

WATER QUALITY MONITORING FOR CONSTRUCTION BASELINE WORK PLAN

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MAY 2011

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LIST OF ACRONYMS

C_P	beam attenuation coefficient
CPOIs	chemical parameters of interest
GPS	Global Positioning System
ISUS	In-Situ Ultraviolet Spectrophotometer
JSA	Job Safety Analysis
MDL	Method Detection Limit
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
PCBs	polychlorinated biphenyls
PDI	Pre-Design investigation
PSP	Project Safety Plan
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance / quality control
SOP	Standard operating procedure
SSP	Subcontractor Safety Plan
SU	Syracuse University
SVOCs	semivolatile organic compounds
T_n	Turbidity
TSS	total suspended solids
UFI	Upstate Freshwater Institute
VOCs	volatile organic compounds

2011 WORK PLAN
WATER QUALITY MONITORING FOR CONSTRUCTION BASELINE

1.0 INTRODUCTION

This work plan describes baseline water quality monitoring to be conducted in 2011 in the littoral and profundal regions of Onondaga Lake. Unless otherwise stated, the activities described in this work plan will be conducted in accordance with the procedures outlined in the Phase I Pre-Design Investigation (PDI) Work Plan (Parsons, 2005).

The primary objective of this sampling program is to obtain an understanding of baseline chemical and optical (i.e., turbidity/water clarity) water quality characteristics near proposed dredging and capping remediation areas where water quality monitoring during construction activities may occur. This program is an extension of the initial water quality sampling that was conducted in fall of 2010 in accordance with Addendum 3 to the Onondaga Lake Phase VI PDI Work Plan (Parsons, 2010). The 2011 sampling program will collect data over a range of natural forcing conditions that can affect various components of water quality, including tributary runoff, wind-driven waves, typical lake currents, and thermal stratification, to understand how these forcing conditions affect water quality within Onondaga Lake. The information collected as part of this sampling program will be used to:

- Define expected baseline conditions at the site for the construction contractor
- Develop a water quality monitoring plan as part of the overall construction monitoring program associated with the in-lake remediation activities
- Assess repeatability of results from the two years of data (2010 and 2011)

2.0 2011 FIELD ACTIVITIES

2.1 Overview

Program Components

Consistent with 2010, the 2011 field program will contain three components:

- Monthly discrete sampling events with a focus on water quality conditions (including chemistry) near the primary sediment remediation areas
- Bi-weekly lake-wide monitoring of *in situ* water quality parameters (e.g., turbidity, beam attenuation coefficient at 660 nm (C_P 660), temperature, specific conductance, optical backscattering, chlorophyll, and photosynthetically active irradiance) with rapid vertical profiling instrumentation
- Continuous measurement of turbidity at multiple locations within the lake

Sampling Period

The sampling period for the 2011 field program was selected based on review of the data from the 2010 water quality monitoring, which were presented in the *2010 Water Quality Monitoring for Construction Baseline Data Summary Report* (Parsons, 2011). Based on a preliminary review of those data, conditions in the lake appear to generally respond to precipitation, tributary flow, and wind events, as expected (i.e., with increased turbidity and some correlations to relative increases in concentration of chemical parameters of interest [CPOIs]). Based on this review of water quality monitoring results from 2010, and the limited temporal coverage of data collected over the approximately six week period during which the 2010 monitoring activities were conducted, it is recommended that monitoring activities commenced in 2010 should continue similarly during the 2011 field season to understand variations in water quality over a wider range of conditions. Therefore, the 2011 program is anticipated to span the entire field season, which for the purposes of this work plan is defined to run from mid May through mid October.

Sampling Locations

The locations for specific measurements in 2011 were selected based on consideration of: 1) expected dredge and capping operations and sequencing as well as information on proposed silt curtain alignments developed by the construction contractor; 2) field conditions experienced during the 2010 sampling effort; and 3) sampling results from the 2010 program. Based on these considerations, a few slight modifications to the 2010 sampling locations and depths have been made for 2011.

Details of the specific field activities, including the modifications to sampling locations and depths, are described below.

2.2 DISCRETE WATER COLUMN SAMPLING

Discrete water column sampling is anticipated to occur approximately monthly between mid-May and mid-October, for a total of six events in 2011. The discrete sampling component will collect data related to a range of natural forcing conditions that can affect various features of water quality, including tributary runoff, wind-driven waves, and thermal stratification. Consistent with 2010 field activities, grab samples will be collected from the water column at several locations within and adjacent to the major remediation areas of the lake, as well as from the profundal zone of the lake. Specifically, the discrete sampling will be conducted at four locations within the major remediation areas (designated as T1, T2, T3, and T4), five locations near the perimeters of the major remediation areas (designated as A2, B1, C1, D1, and E2), and two profundal zone sites (North Deep and South Deep), as shown on Figure 1. These proposed sampling locations were chosen to assess water quality both inside the remediation areas as well as within 500 ft. of remediation area boundaries, potentially representing “near-field” points that would be outside the silt curtained areas during remediation. Locations greater than 1,000 ft. outside of proposed remediation areas were selected to obtain a more representative baseline for assessing potential system-wide impacts. These locations are generally consistent with those sampled in 2010, except that the locations along the boundaries of Remediation Areas A and E were adjusted slightly. These adjustments were made 1) to maintain distances of 300 to 600 ft. from silt curtain alignments anticipated during remediation, and 2) based on a review of the 2010 data, which indicated that water quality did not differ greatly for adjacent sampling locations. As a result of these adjustments, the two 2010 locations outside of both Remediation Areas A and E were combined into single locations outside of each area for 2011.

In 2010, samples were collected from mid-depth at each location, which was appropriate given that the 2010 sampling was conducted post-turnover, during which the lake's water column is vertically well-mixed. However, the 2011 discrete water column samples will be collected from a fixed depth of 10 ft. from the water surface. Because Onondaga Lake is thermally stratified during most of the field season, it is unlikely that construction activities would have any impact on the deeper waters of the lake. This depth of 10 ft. was selected to be representative of water quality within the upper mixed layer of the lake during stratification, based on a review of the typical depths of the thermocline observed in the lake over the last ten years or so. In cases where the water depth is less than 20 ft., sampling will be conducted from the midpoint of the water column as was done in 2010. Approximate water depths and sampling depths for the sampling locations are provided in Table 1.

The discrete water column sampling will be conducted in accordance with Appendix A – Surface Water Sampling Standard Operating Procedure (SOP). The discrete water column samples will be analyzed for the suite of parameters listed in Table 2. Chemistry data (mercury [total and filtered], methylmercury [total], volatile organic compound [VOC] CPOIs, polychlorinated biphenyls [PCB], and semi-volatile organic compound [SVOC] CPOIs) will be collected to establish baseline concentrations of these constituents and to allow for comparisons to applicable water quality standards. Measurements of turbidity (T_n), the beam attenuation coefficient at 660 Nanometer (nm) (c_P660), and total suspended solids (TSS) will provide baseline information on particle concentrations and impacts on water clarity. Components of phosphorus (total phosphorus, total dissolved phosphorus, soluble reactive phosphorus) and inorganic nitrogen (nitrate, nitrite, ammonia) will be monitored to provide baseline information on nutrients and forms of nitrogen that are potentially toxic to aquatic organisms at high concentrations. Field measurements for pH will also be taken.

Table 3 provides a comparison of the practical quantitation limits for each parameter with the New York State Class B/C Surface Water Quality Standards and Guidance Values. Note that Table 3 provides all five standards (human consumption of fish [H(FC)], fish propagation in fresh water [Aquatic Chronic; A(C)], fish survival in freshwater [Aquatic Acute; A(A)], wildlife protection [W], and aesthetic [E]); however, it is anticipated that only acute standards would be relevant for comparison with water quality monitoring results during construction activities (i.e., short-term effects). Laboratory data will be reported down to the method detection limits (MDLs).

2.3 DISCRETE OPTICAL/TURBIDITY MONITORING USING RAPID PROFILING INSTRUMENTATION

During the discrete sampling events in 2011, a second vessel will collect spatially detailed water quality information with rapid profiling instrumentation. Vertical profiling will be conducted with a Sea-Bird probe package[1] at three locations within each of four transects within the major remediation areas of the lake (sample points designated as T1-*, T2-*, T3-*, and T4-*), and at North Deep and South Deep (see Figure 1), for a total of 14 profiles per sampling event.[2] This profiling will be conducted from the water surface to within one meter of the sediment-water interface. Profiling will also be conducted during approximately six additional occasions, such that optical/turbidity data are collected approximately bi-weekly in 2011 (a total of approximately thirteen discrete optical/turbidity monitoring events). The rapid profiling will be conducted in accordance with methods described in the 2008 Baseline Monitoring Book 1 Work Plan (Upstate Freshwater Institute [UFI] and Syracuse University [SU], 2008).

The focus of the rapid profiling will be measuring light scattering, including turbidity and the beam attenuation coefficient at 660 Nanometer (nm) (c_P660). Other sensors in the rapid profiling package (Table 4) provide additional information on stratification, tracer(s) patterns, and light penetration.

Weekly profiles in 2011 will also be conducted using an In-Situ Ultraviolet Spectrophotometer (ISUS)[3], at ten sites (six along the longitudinal axis of the lake and four additional sites to form a lateral transect at South Deep), as part of Honeywell's Book 1 Baseline Monitoring Program (UFI and SU, 2008). The ISUS profiling will provide vertically detailed (0.25 m resolution) lake wide measurements of a suite of water quality parameters, including turbidity and beam attenuation coefficient. These measurements will provide information on the horizontal and vertical distribution of light scattering particles in the lake. As part of the construction baseline monitoring, this Book 1 profile work will be supplemented with two additional lateral transects in the south basin, one additional transect in the north basin, and one additional location outside of Remediation Area B (Figure 2) in order to provide increased spatial resolution adjacent to the major remediation areas, consistent with 2010 activities.

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[1] The Sea-Bird Electronics, Inc. package of instruments contains:
1.) Temperature, specific conductance, pressure - SBE 25 SEALOGGER CTD (Sea-Bird Electronics), 2.) Chlorophyll - WETStar Fluorometer (WET Labs), 3.) Beam attenuation coefficient - C-star transmissometer (WET Labs), 4.) Photosynthetically Active Radiation (PAR) sensor (LI-COR Environmental), 5.) Optical Backscattering (OBS) - OBS-3 (D&A Instruments; UFI calibrates for turbidity), and 6.) Datalogger that stores and integrates all of the above components (Sea-Bird Electronics).

[2] The 2011 rapid profiling transects are similar to those sampled in 2010, except the sampling points for each transect were modified so that the point nearest to shore is located at a minimum water depth of 6 ft. This modification was made to avoid logistical issues associated with navigation and operation of sampling equipment in very shallow (e.g., 2 ft.) water (and potential impacts from artificial resuspension associated with such activities), and because collection of representative samples would likely be impacted by the presence of dense beds of aquatic vegetation that are established during summer and early fall close to shore at these locations. This modification also necessitated slight shifts in some of the other sample points at certain transects.

[3] The ISUS package of instruments contains:
1.) Nitrate probe - Satlantic ISUS sensor (Satlantic Instruments), 2.) Turbidity and chlorophyll - ECO FLNTU combination fluorometer and turbidity sensor (WET Labs), 3.) Beam attenuation coefficient - C-star transmissometer (WET Labs), 4.) Scalar PAR sensor (Biospherical Instruments), 5.) Temperature, specific conductance, and pressure - CTD 37I sensor (Sea-Bird Electronics), and 6.) Datalogger that stores and integrates all of the above components (WET Labs).

2.4 CONTINUOUS TURBIDITY MONITORING

Continuous turbidity measurements will be collected within the water column at buoyed stations to understand how turbidity levels near the primary sediment remediation areas change in response to natural forcing conditions. In 2011, three continuous turbidity monitoring stations (locations A2, D2, and E2; see Figure 1 for locations and Table 1 for approximate water depths) will be deployed for approximately five months (mid-May through mid-October). Compared to 2010, the 2011 locations have been adjusted so that monitoring will be in areas that are located 300 to 600 ft. outside of the silt curtain alignments anticipated during construction activities. Furthermore, as a result of this adjustment, and due to similarities in their statistical distribution of 2010 turbidity data, the two monitoring locations within Remediation Area E in 2010 were combined into a single location near the perimeter of that area for 2011. The turbidity probes at each deployment will be set at a fixed depth of 10 ft., consistent with the depth used to represent the upper mixed layer of the lake in the discrete water quality sampling (see Section 2.2). The continuous turbidity monitoring will be conducted in accordance with Appendix A – Surface Water Sampling SOP. The buoyed stations will be visited bi-weekly to download the turbidity data and perform maintenance on the turbidity probes.

2.5 SCHEDULE

A summary of the frequency of each sampling activity is provided below. In 2011, the discrete water column sampling will be scheduled to target events such as tributary runoff and wind-driven waves[4]; however, in absence of such events monthly sampling will occur under typical conditions.

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[4] The monitoring program will seek to take advantage of runoff and wind events as they occur by maintaining flexibility in scheduling. During a given month, weather forecasts and real-time tributary flow data will be monitored and as precipitation, flow, and/or high wind events occur, sampling will follow such events to the extent practicable. Sampling will occur only when conditions are considered safe (e.g., in-lake work will not be conducted during lightning or heavy rains and/or high winds), and therefore sampling may not occur during storm events themselves.

Sampling Activity	Frequency	Total Sampling Events
Discrete Water Column Sampling	Approximately monthly from mid-May through mid-October	6 events
Discrete Optical/ Turbidity Monitoring	Approximately bi-weekly from mid-May through mid-October	12 events
Continuous Turbidity Monitoring	Continuously from mid-May through mid-October	Not Applicable
ISUS Profiling	Approximately weekly from mid-May through mid-October	24 events

3.0 FUTURE FIELD ACTIVITIES

During 2012 and beyond, construction monitoring will be conducted with the following objectives: 1) collect water quality data during dredging and capping activities; and 2) assess construction performance and resulting system wide response of water quality in the lake. Details of the proposed 2012 construction monitoring plan will be submitted as part of construction plans to the New York State Department of Environmental Conservation (NYSDEC).

4.0 HEALTH AND SAFETY

The Honeywell team ranks health and safety as the highest priority. The Parsons' Project Safety Plan (PSP) used for previous phases of pre-design investigation (e.g., Appendix C to the Phase I Work Plan [Parsons, 2005]), as updated for 2011 will be used for this investigation. If any task is identified that falls outside the scope currently defined in the PSP, a new Job Safety Analysis (JSA) will be completed before the task begins. Anchor QEA and UFI have also submitted Subcontractor Safety Plans (SSPs) that have been approved by Parsons. Copies of the PSP, JSAs, and SSPs will be maintained at each work area.

5.0 QUALITY ASSURANCE

The support zone and facilities established during the Phase VI PDI will be used for this PDI effort. Decontamination and waste management activities will be conducted as needed in accordance with Phase I PDI Work Plan (Parsons, 2005, Appendix A). Laboratory procedures will be conducted in accordance with the revised Onondaga Lake PDI Quality Assurance Project Plan (QAPP) (Parsons, 2010b). Field quality assurance and quality control will consist of the collection and analysis of field duplicates, and matrix spike/matrix spike duplicate samples in accordance with the Phase I PDI Work Plan (Parsons, 2005). One rinse blank will be collected for each sampling event.

6.0 SAMPLE AND DATA MANAGEMENT AND REPORTING

Sample names, quality assurance/quality control (QA/QC) procedures, sample collection, data entry, and data validation for this portion of the work will be conducted in accordance with the Phase I PDI Sampling and Analysis Plan (Parsons, 2005). Any deviations from these procedures will be discussed with the NYSDEC before the work is executed.

Analytical data generated during this investigation will be reviewed and validated for usability in accordance with pre-established data validation procedures summarized in the Phase I PDI Work Plan (Parsons, 2005), as well as the QAPP Modification (Parsons, 2011). Parsons will incorporate the validated data into the Honeywell Locus Focus database.

After the sample collection and processing, laboratory analyses, and data evaluation efforts have been completed, a data summary report will be prepared and submitted to NYSDEC that describes results from this baseline water quality monitoring program.

7.0 REFERENCES

Parsons. 2005. *Onondaga Lake Pre-Design Investigation: Phase I Work Plan*. Prepared for Honeywell. September 2005.

Appendix A *Phase I Sampling And Analysis Plan*
Appendix B *Quality Assurance Project Plan*
Appendix C *Project Safety Plan* Updated March 2007.

Parsons, 2010. *Onondaga Lake Pre-Design Investigation: Phase VI Work Plan*. Prepared for Honeywell. May 2010.

Parsons, 2010. *Onondaga Lake Pre-Design Investigation: Phase VI Addendum 3*. Prepared for Honeywell, Morristown, New Jersey and Syracuse, New York.

Parsons, 2010b. *Onondaga Lake Pre-Design Investigation: Revised Quality Assurance Project Plan.* Prepared for Honeywell, Morristown, New Jersey. Syracuse, New York.

UFI and SU, 2008. *Onondaga Lake Baseline Monitoring Book 1 Deep Basin Water and Zooplankton Monitoring Work Plan for 2008*. Prepared for Honeywell, Inc., East Syracuse, NY. Upstate Freshwater Institute and Syracuse University, Syracuse, NY. May 2008

Parsons, 2011. *Onondaga Lake Pre-Design Investigation: 2010 Water Quality Monitoring for Construction Baseline Data Summary Report*. Prepared for Honeywell, Morristown, New Jersey. Syracuse, New York.

TABLES

TABLE 1

APPROXIMATE WATER DEPTHS AT EACH SAMPLING LOCATION AND SAMPLING DEPTHS FOR DISCRETE WATER COLUMN SAMPLING

Location	Approximate Water Depth (feet)	Approximate Sampling Depth (feet)
A2	45	10
B1	58	10
C1	51	10
D1	50	10
E2	25	10
North Deep	62	10
South Deep	66	10
T1	10.5	5.25
T2	10	5
T3	8	4
T4	6.5	3.25

NOTE:

1. These depths represent conditions observed during discrete water sampling during the October 25 and 26, 2010 event. Depths recorded during the other two sampling events in 2010 were no more than 1 ft. different with the exception of location T1, where the water depth was measured to be approximately 2.5 ft. shallower during the November 9 to 10, 2010 event. Depths for locations A2, D1 and E2 were estimated based on measurements from 2010 and bathymetric data.

TABLE 2

WATER QUALITY PARAMETERS TO BE MEASURED IN SAMPLES COLLECTED DURING DISCRETE SAMPLING EVENTS IN 2011

Parameter	Data Usage[3]	Method	Frequency	Locations	No. of Samples[1]
Mercury (total and filtered)	Chemistry	1631E	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Methylmercury (total)	Chemistry	1630	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
VOCs (CPOIs)[2]	Chemistry	8260B	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
SVOCs (CPOIs)[2]	Chemistry	8270C	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
PCB Aroclors	Chemistry	8082	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Turbidity	Particle concentrations and water clarity	Probe / Meter	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Total suspended solids	Particle concentrations and water clarity	SM 20 2540D	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Beam attenuation coefficient @ 660 nm (c_P660)	Particle concentrations and water clarity	Probe / Meter	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Total phosphorus	Nutrients	SM 20 4500-P	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Total dissolved phosphorus	Nutrients	SM 20 4500-P	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66

TABLE 2 (CONT'D)

WATER QUALITY PARAMETERS TO BE MEASURED IN SAMPLES COLLECTED DURING DISCRETE SAMPLING EVENTS IN 2011

Parameter	Data Usage[3]	Method	Frequency	Locations	No. of Samples[1]
pH	General water quality	Probe / Meter	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Soluble reactive phosphorus	Nutrients	SM 20 4500-P	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Nitrate	Nutrients	USEPA 353.2 Rev. 2.0	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Nitrite	Nutrients	USEPA 353.2 Rev. 2.0	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66
Ammonia	Nutrients	USEPA 350.1 Rev. 2.0	6 events	A2, B1, C1, D1, E2, North Deep, South Deep, T1, T2, T3, T4	66

NOTES:

1. The number of samples includes field samples only. Four additional QA/QC samples will be collected per event for chemical parameters and one set of triplicate samples per event will be collected for conventional water quality parameters for assessment of sample precision.

2. The CPOI list for VOCs and SVOCs are the same compounds as the Phase I PDI (Parsons, 2005).

3. Uses of the various categories of water quality data (i.e., chemistry, water clarity, nutrients) are discussed in Section 2.2.

TABLE 3
PARAMETER LIST COMPARISON WITH WATER QUALITY VALUES

Parameter Name	Method	PQL	MDL Lab Specific	Units	Class B/C H(FC)	Class B/C A(C)	Class B/C A(A)	Class B/C W	Class B/C E
Benzene	SW-846 8260B	1		µg/L	10	210	760	NS	NS
Chlorobenzene	SW-846 8260B	1		µg/L	400	5	NS	NS	NS
1,2-Dichlorobenzene	SW-846 8260B	1		µg/L	NS	5 (1)	NS	NS	NS
1,3-Dichlorobenzene	SW-846 8260B	1		µg/L	NS	5 (1)	NS	NS	NS
1,4-Dichlorobenzene	SW-846 8260B	1		µg/L	NS	5 (1)	NS	NS	NS
Ethylbenzene	SW-846 8260B	1		µg/L	NS	17	150	NS	NS
Toluene	SW-846 8260B	1		µg/L	6000	100	480	NS	NS
1,2,3-Trichlorobenzene	SW-846 8260B	5		µg/L	NS	5 (2)	NS	NS	NS
1,2,4-Trichlorobenzene	SW-846 8260B	5		µg/L	NS	5 (2)	NS	NS	NS
1,3,5-Trichlorobenzene	SW-846 8260B	5		µg/L	NS	5 (2)	NS	NS	NS
o-Xylene	SW-846 8260B	1		µg/L	NS	65 (3)	590 (3)	NS	NS
m,p-Xylene	SW-846 8260B	1		µg/L	NS	65 (3)	590 (3)	NS	NS
Xylenes, Total	SW-846 8260B	1		µg/L	NS	65 (3)	590 (3)	NS	NS
Acenaphthene	SW-846 8270C SIM	0.1		µg/L	NS	5.3	48	NS	NS
Acenaphthylene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Anthracene	SW-846 8270C SIM	0.1		µg/L	NS	3.8	35	NS	NS
Benzo(a)anthracene	SW-846 8270C SIM	0.1		µg/L	NS	0.03	0.23	NS	NS
Benzo(a)pyrene	SW-846 8270C SIM	0.1		µg/L	0.0012	NS	NS	NS	NS
Benzo(b)fluoranthene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Benzo(g,h,i)perylene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Benzo(k)fluoranthene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Chrysene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Dibenzo(a,h)anthracene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Fluoranthene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Fluorene	SW-846 8270C SIM	0.1		µg/L	NS	0.54	4.8	NS	NS
Indeno(1,2,3-cd)pyrene	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	NS
Naphthalene	SW-846 8270C SIM	0.1		µg/L	NS	13	110	NS	NS
Phenanthrene	SW-846 8270C SIM	0.1		µg/L	NS	5	45	NS	NS
Pyrene	SW-846 8270C SIM	0.1		µg/L	NS	4.6	42	NS	NS
Phenol	SW-846 8270C SIM	0.1		µg/L	NS	NS	NS	NS	5
Total PCBs	SW-846 8082	0.5		µg/L	1.00E-06	NS	NS	1.20E-04	NS
Mercury (Total and Dissolved)	USEPA 1631E	0.0005		µg/L	0.0007	7.70E-01	1.40E+00	2.60E-03	NS
Methylmercury (total)	USEPA 1630E	0.00005		µg/L	NS	NS	NS	NS	NS
Total Phosphorus(4)	SM 20 4500-P	4.7	1.1	µgP/L	NS	NS	NS	NS	NS
Total Dissolved Phosphorus	SM 20 4500-P	4.8	1.2	µgP/L	NS	NS	NS	NS	NS
Soluable Reactive Phosphorus	SM 20 4500-P	1.4	0.4	µgP/L	NS	NS	NS	NS	NS
Nitrate	USEPA 353.2 Rev. 2.0	37	9	µgN/L	NS	NS	NS	NS	NS
Nitrite	USEPA 353.2 Rev. 2.0	15	4	µgN/L	NS	100	NS	NS	NS
Ammonia	USEPA 350.1 Rev. 2.0	40	10	µgN/L	NS	0.7 to 50 (5) 35(6)	9.1 to 370 (5) 230(6)	NS	NS
Total Suspended Solids	SM 20 2540D			mg/L	NS	NS	NS	NS	NS
pH	Probe/Meter			s.u.	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5	6.5 to 8.5
Turbidity	SM 20 2130B	0.8	0.2	NTU	NS	NS	NS	NS	NS
Beam Attenuation Coefficient, c660	Wet Labs Transmissometer	0.1	0.05	m^{-1}	NS	NS	NS	NS	NS

NOTES:

PQL - Practical Quantitation Limit.

MDL - Method Detection Limit. Laboratory-specific MDLs will be less than PQLs.

ND - Not detectable by the analytical tests specified or approved pursuant to Part 700 of this Title.

NS - Not specified.

Water Quality values are generally found in NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, unless otherwise noted.

(1) - applies to sum of DCBs

(2) - applies to sum of TCBs

(3) - applies to sum of Xylenes

(4) - a guidance value of 20 µg/L based on aesthetic effects for primary and secondary contact recreation is listed in TOGS 1.1.1 - Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations

(5) - varies depending on pH and temperature. See NYSDEC Part 703: Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations

(6) - Applies to un-ionized ammonia as NH_3

TABLE 4

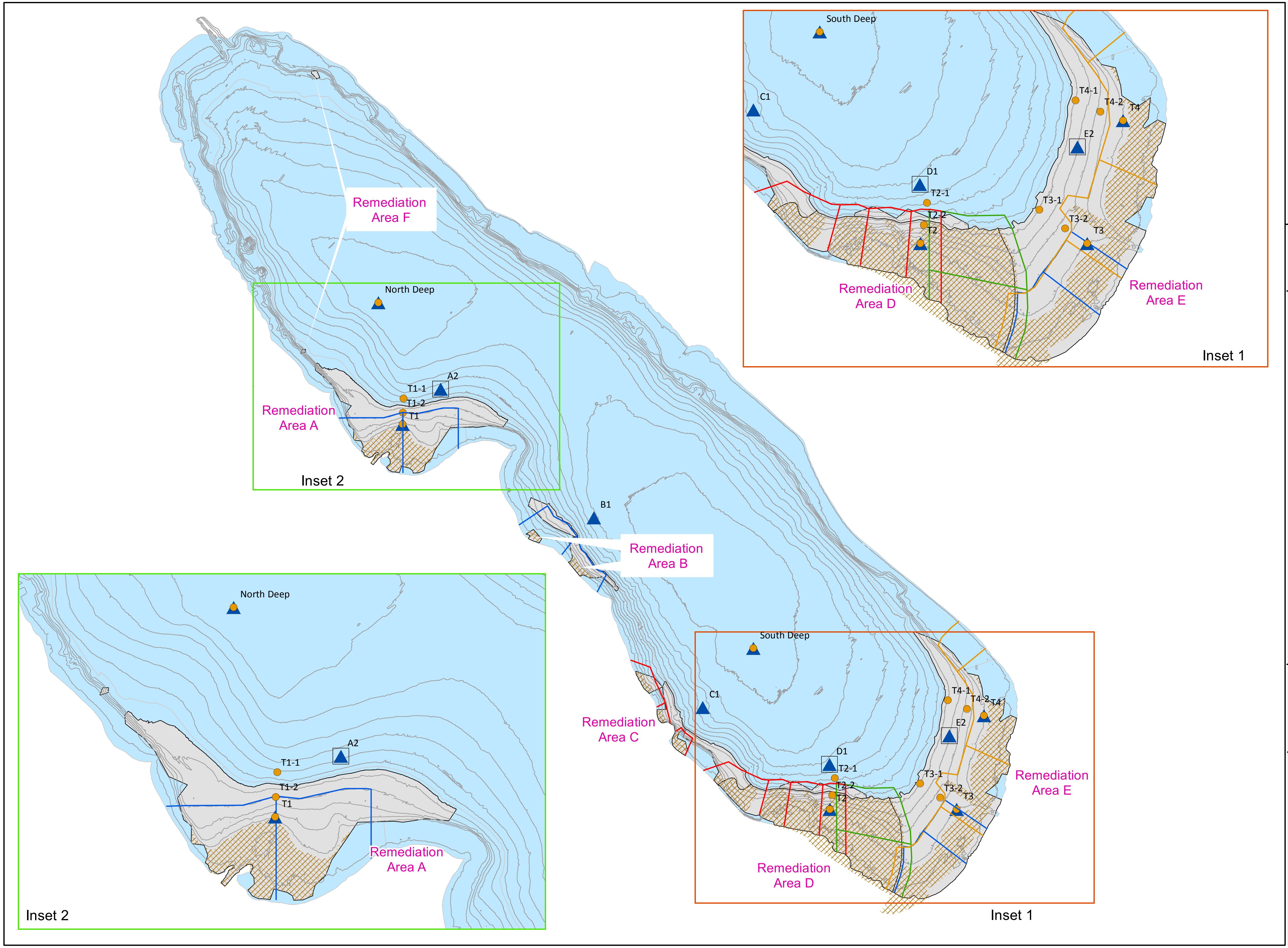
SPECIFICATIONS FOR RAPID PROFILING INSTRUMENTATION

Parameter	Data Usage	Sensor	Performance (accuracy/ resolution)	Attribute/Value
Temperature	General water quality	SBE 3F	± 0.002 °C/0.0003 °C	stratification
Specific conductance	General water quality	SBE4	± 3 μS/cm/0.1 μS/cm	tracer/stratification
Beam attenuation coefficient @ 660 nm	Particle concentrations and water clarity	Wetlabs C-Star	± 0.1% transmission	particle indicator
Optical backscattering	Particle concentrations and water clarity	D&A OBS-3	± 0.25 NTU/0.1 NTU	particle indicator
Chlorophyll	Nutrients	Wetlabs WETstar	± NA/0.1 μg/L Chl	indicator of phytoplankton biomass
Photosynthetically active irradiance	Nutrients and water clarity	Li-Cor LI-193	± 5% reading	light penetration

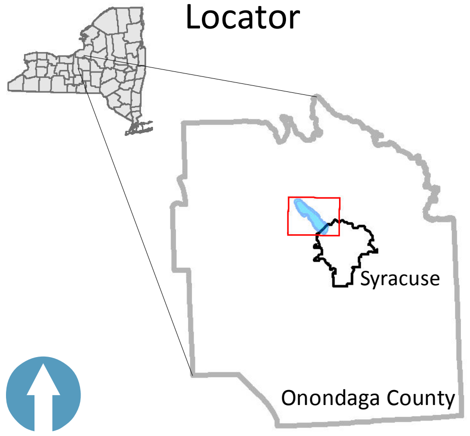
NOTES:

1. Uses of the various categories of water quality data (i.e., water clarity, nutrients) are discussed in Section 2.2.

FIGURES



Locator



Scale

0 1,000 2,000 4,000 Feet

Legend

● Discrete Optical/Turbidity Rapid Profiling

▲ Discrete Water Column Sampling Locations

☐ Continuous Turbidity Monitoring Station

— 2005 Bathymetry (displayed every 5 ft)

▭ Remediation Areas

▨ Dredge Areas

Turbidity Curtain Locations (by year)*

— 2012

— 2013

— 2014

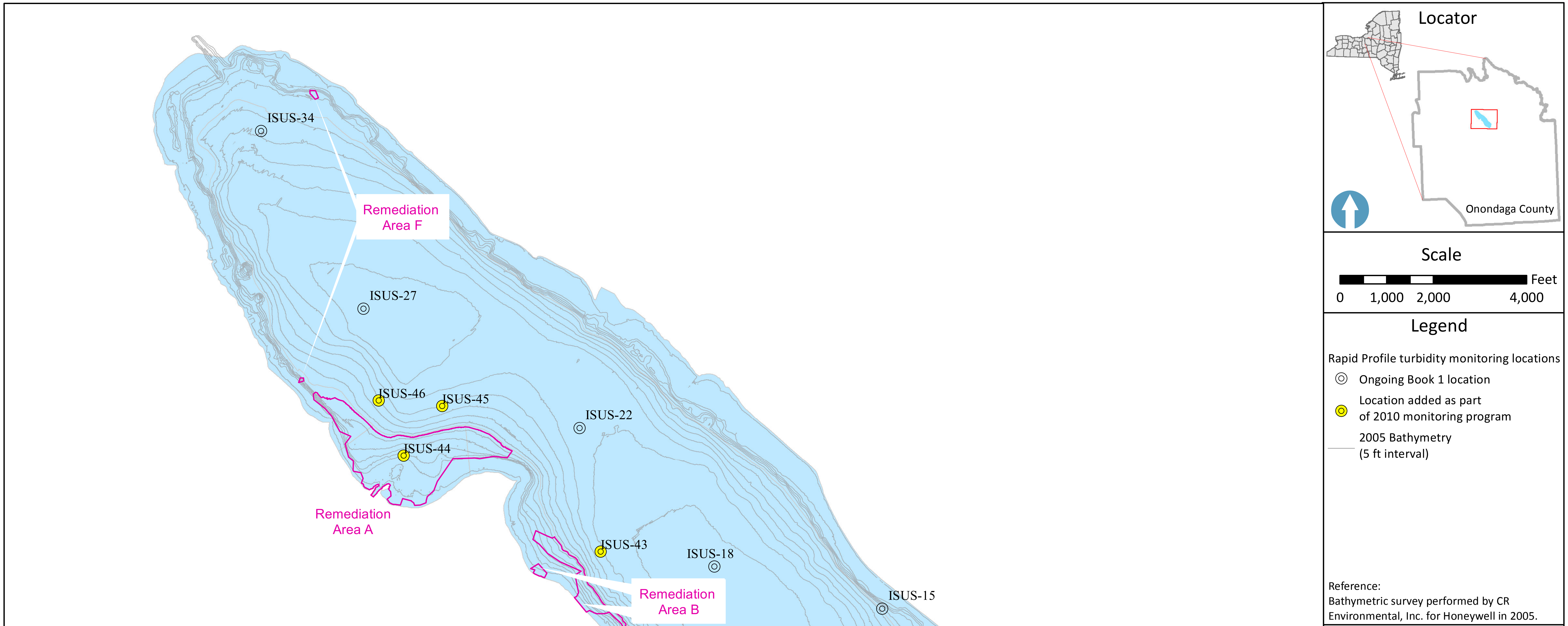
— 2015

* Turbidity curtain alignment is preliminary.

Reference:
Bathymetric survey performed by CR Environmental, Inc. for Honeywell in 2005.

Figure 1
2011 Baseline Water Quality Monitoring Locations Onondaga Lake

Honeywell
PARSONS
ANCHOR QEA
UPSTATE FRESHWATER INSTITUTE



Reference:
Bathymetric survey performed by CR Environmental, Inc. for Honeywell in 2005.

Figure 2
2011 Baseline Water Quality Monitoring Locations Onondaga Lake -

Rapid Profiling Locations

Honeywell
PARSONS
ANCHOR QEA
UPSTATE FRESHWATER INSTITUTE

090139-01 task21

MAY 2011

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APPENDICES

APPENDIX A

STANDARD OPERATING PROCEDURE (SOP)
SURFACE WATER QUALITY MONITORING AND SAMPLING

1.0 SCOPE

This Standard Operation Procedure (SOP) describes procedures used to collect baseline water quality data in Onondaga Lake. These activities will include deployment and servicing of continuous monitoring water quality sondes, field measurements using a multi-parameter probe focusing on turbidity, and the collection of water samples for subsequent laboratory analysis for selected parameters.

2.0 HEALTH AND SAFETY CONSIDERATIONS

A safety briefing will be held at the beginning of each sampling event and at each shift in personnel. The designated safety officer on the vessel shall be responsible for ensuring the safety of personnel and will be contacted immediately in the event of an emergency. The standard safety considerations for marine sampling – caution deploying and retrieving heavy equipment, keeping hands and clothing out of winches and A-frame supports, and stepping in the bight of lines or cables – apply to the field crew during sampling. Winches, lifts, cables, and lines will be used within their designed limits to avoid injury from equipment failures. Appropriate personal protective equipment (PPE) will be donned prior to the start of work as described in the project safety plan (PSP). When using standard solutions for calibrating conductivity probes, care will be taken to avoid inhalation, skin contact, eye contact and ingestion. These considerations are discussed in more detail in the PSP (Appendix C of Parsons 2005a [Updated 2007]) and SSPs.

3.0 EQUIPMENT

The following equipment list contains materials that may be needed to carry out the procedures contained in this SOP. Since multiple procedures may be contained in this SOP, not all of which are necessarily conducted when using this SOP, not all materials on the Equipment List may be required for a specific activity.

- Sampling vessel
- Global positioning system (GPS)
- Multi-parameter sonde with data logger (YSI 6600 series or equivalent)
- Buoys for sonde deployment
- Anchors for buoys
- Kemmerer bottle sampler

- Teflon-lined submersible pump with Teflon-lined tubing (or other Teflon-lined sampling equipment [e.g., peristaltic pump, Van Dorn sampler])
- Sample containers (supplied by laboratory)
- Coolers for sample storage
- Ice
- Log book
- Labels
- Chain of custody forms
- Disposable gloves

3.1 Field Instrument Calibration

All instrument probes will be calibrated as needed per manufacturer recommendations. Before performing any calibration procedure, the sonde and display/logger must stabilize (warm-up) at least 15 minutes. During the warm-up period, check the display/logger to determine the battery level in the display/logger to see if recharging is necessary. Prior to calibration, all instrument probes on the sonde must be cleaned according to the manufacturer's instructions. Failure to perform this step can lead to erratic measurements. The probes must also be cleaned by rinsing with deionized water before and after immersing the probe into a calibration solution. For each of the calibration solutions, provide enough volume so that the probe and the temperature sensor are sufficiently covered (see the manufacturer's instructions for required volumes of calibration solutions). Calibration logs will be maintained on all calibrated equipment on a daily basis.

Temperature

For instrument probes that rely on the temperature sensor (pH, dissolved oxygen/specific conductance, and oxidation-reduction potential), the sonde temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST). This accuracy check should be performed at least once a year, and the date and results of the check kept with the instrument. Below is the verification procedure.

1. Allow a container filled with water and the sonde to come to ambient temperature.
2. Place a thermometer that is traceable to the NIST into the water and wait for both temperature readings to stabilize.
3. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer within the accuracy of the sensor (+/- 0.15°C). If the measurements do not agree, the instrument may not be working correctly and the manufacturer should be contacted.

pH

The pH of a sample is determined electrometrically using a glass electrode. Choose the appropriate standards that will bracket the expected values at the sampling locations. For this procedure three standards will be used: pH 4, pH7, and pH10.

1. Allow the buffered samples to equilibrate to the ambient temperature.
2. Clean all of the probes on the sonde with deionized water. Shake off excess water.
3. Place the probes on the sonde into the pH 7 buffer.
4. On the display/logger use the up/down arrow keys to highlight the "Calibrate" option and press the enter key.
5. Highlight the "pH" option and press enter.
6. Highlight the "3-point" option and press enter.
7. Input the value of the buffer, which is 7.00 and press enter.
8. Wait for the value of pH to stabilize and then press enter. Wait for "Calibrated" message. If an "Out of Range" message appears, do not accept, check the probe and refer to operators manual.
9. Rinse probe with Deionized water and shake off excess water.
10. Place the pH probe into a pH buffer of 4.00.
11. Press enter key to continue calibration.
12. When prompted, enter the pH of the second buffer, "4.00" and wait for "Calibrated" message, and press any key to continue.
13. Rinse probe with Deionized water and shake off excess water.
14. Place the pH probe into a pH buffer of 10.00.
15. Press any key to continue calibration.
16. When prompted, enter the pH of the third buffer, "10.00" and wait for "Calibrated" message, and press any key to continue.
17. Rinse probe with Deionized water and shake off excess water.
18. Insert probe into pH 7 buffer and make sure it is reading correctly (+ 0.05). If buffer reading is not correct, repeat the calibration procedure.

Specific Conductance

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current.

Specific conductance is the conductivity value corrected at 25°C.

1. Place the cleaned probes into the specific conductivity standard solution, making sure that the specific conductivity probe is fully submerged.
2. For field calibration go to step 3, for a more accurate laboratory calibration continue with the procedure below. For calibration in the laboratory place the display/logger in

"Sonde Run" mode, and check the temperature of the standard solution. For calibration of specific conductivity the standard must be at 25°C (± 0.5°C). If the temperature of the solution is not within this range, adjust the solution temperature by placing the container (with lid firmly tightened), into a bath of warmer or colder water (depending on standard's temperature). Check on the progress of temperature change by placing the instrument probes into the solution. Once the temperature falls within ± 0.5°C of 25°C continue the calibration procedure.

3. Return to the display/logger main menu and select "Calibrate" and press enter.
4. Select "Conductivity" and press enter.
5. Select "spCond" and press enter.
6. Enter the standard concentration in mS/cm^3 and press enter. The standard concentration should be close to the concentrations you expect to measure.
7. After the specific conductivity reading has stabilized press enter to calibrate. Wait for the "Calibrated" message to appear.
8. Rinse probe with deionized water and shake off excess water.
9. Insert probe back into the standard concentration and make sure it is reading within 10 percent.

Turbidity

The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by standard reference solutions. Critical to the instrument's operation is that the lens covering the detection unit is kept clean both during calibration and field use. The turbidity probes used on the YSI 6-Series sondes include an automated optics wiper. This wiper can be activated using the display/logger. A 2-point calibration procedure is recommended. The manufacturer recommends that the YSI 6-Series Turbidity probe be calibrated using the calibration cup provided with the sonde. This method is preferred; however, one major drawback to this is that the standard solutions must be discarded after calibration due to possible contamination. An alternative is to place the standard solutions in secondary containers with openings large enough to allow the turbidity probe to be placed into the standard. These containers should have similar physical properties as the calibration cup (i.e., clear to opaque, plastic). The sides of the container should not have any material such as tape or writing on them.

1. Allow the standard samples to equilibrate to the ambient temperature.
2. Clean all of the probes on the sonde with deionized water. Shake off excess water.
3. Place the probes on the sonde into the 0.0 NTU standard (which can be deionized water).
4. From the "Calibrate" Menu, on the display/logger, select the "Turbidity" option and press enter.
5. Select the "2-point" option and press enter.
6. Enter "0.0" as the first calibration standard and press enter.

7. Select the “clean optics” option to activate the automated wipers. Once the cleaning process is completed, wait for the turbidity measurement to equilibrate, and then press the enter key.
8. Place the probe in the 10 NTU standard. Do not clean the probe before placing into the second standard.
9. Press enter to continue calibration.
10. Enter “10.0” as the second calibration standard and press enter.
11. Again, select the “clean optics” option to activate the automated wipers. Once the cleaning process is completed, wait for the turbidity measurement to equilibrate, and then press the enter key.
12. Clean all of the probes on the sonde with deionized water. Shake off excess water.
13. Insert probes back into the 10.0 NTU standard and make sure it is reading between 9.5 and 10.5 NTU. If the buffer reading is not correct, repeat the calibration procedure.

Dissolved Oxygen

Dissolved oxygen (DO) content in water is measured using a membrane electrode. The DO probe’s membrane and electrolyte solution should be inspected for any damage or air bubbles prior to calibration. If air bubbles or damage are present, replace the membrane according to manufacturer suggestions. (After changing the membrane you should wait 12 hours before use to allow the membrane to equilibrate) YSI 6-Series DO probe be must calibrated using the calibration cup provided with the sonde. Calibration of the DO probe requires inputting the current barometric pressure. The YSI 650 display/logger has a barometer within the unit and automatically provides this during the calibration procedure. Other display/loggers do not supply the barometric pressure, and this must be obtained from other sources. Do not use barometric pressure obtained from meteorology reports as these are usually corrected to sea level. Two calibration procedures are listed below for dissolved oxygen, one for sampling applications and one for long-term monitoring applications.

Calibration Procedure for Sampling (non-deployment) Applications

The dissolved oxygen probe should be calibrated in the field prior to use. An initial inspection and calibration should be performed the day before to assure the membrane is in good shape and the instrument is working properly. Follow the procedure below to calibrate.

1. Clean all of the probes on the sonde with tap (or clean ambient water) water. Shake off excess water.
2. Place approximately 1/8 inch of water in the bottom of the calibration cup. Place the probe end of the sonde into the cup. Engage only 1 or 2 threads of the calibration cup to insure the DO probe is vented to the atmosphere. Make sure that the DO and temperature probes are NOT immersed in water and that the sonde cup is not in direct sunlight. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.

3. For sampling applications the dissolved oxygen probe is continuously pulsing, therefore the “Autosleep RS232” function should be deactivated. From the “Main” menu on the display/logger, select the “System Setup” option and press enter. Then select the “Advanced” option and press enter. Select the “Autosleep RS232” option and press enter to obtain the “off” setting. Then press the “ESC” button until returning to the main menu.
4. From the calibration menu select the “Dissolved Oxy” option, then the DO% option (Note: For the YSI 6-Series Sondes, calibration of dissolved oxygen by the DO% procedure also results in the calibration of the DO mg/l mode and vice versa.)
5. Enter the current barometric pressure in mm of Hg. The correct pressure will often be provided but double check with the reading provided in the lower right hand corner of the display.
6. Press enter and then wait for the DO% reading to equilibrate. Press enter to accept the calibration. Press enter again to return to the calibration menu.
7. Immediately enter the “Sonde Run” mode and record the temperature, dissolved oxygen in mg/l and %, and the barometric pressure used for calibrating.
8. For some applications it may be necessary to verify the probe with a zero DO solution. If so continue with the following.
    a) Place the probe in a zero DO solution.
    b) Verify the probe reads < 1.0mg/l.
    c) Rinse probe and store the probe in tap water.
9. Fill the calibration cup half way with tap water and screw on to the sonde. The sonde is now ready for use.

Calibration Procedure for Continuous Monitoring (deployment) Applications

When the instrument will be used for long-term monitoring applications, the “Autosleep RS232” function must be activated before calibration. After making sure this function is on, follow steps 1-9 (skipping 3) in “Calibration Procedure for Sampling Applications.”

4.0 PROCEDURES

4.1 Field Data Collection Procedures (buoy)

Data will be obtained using multi-parameter sondes suspended from buoys at each continuous turbidity monitoring station (Figure 1). IDs and target coordinates for each station will be predetermined. Download the station IDs and coordinates to the on-board GPS. GPS accuracy will be verified on a monthly basis using known survey control points on the Onondaga Lake shoreline.

1. Before collecting any data, calibrate the multi-parameter sonde in accordance with the manufacturer’s specifications specified in Section 3 above. Enter the IDs for each data collection point into the datalogger.

2. avigate the sampling vessel to the continuous turbidity monitoring station of interest. Anchor a buoy at the desired monitoring location.
3. Program the multi-parameter sondes to begin collecting data immediately after deployment and continue to collect and store data at 10 minute intervals.
4. Suspend the sonde at a depth of 10 ft. within the water column from each buoy using light duty chain or rope.
5. Retrieve the buoys, anchors and sondes at the end of the data collection period. Download the data stored on each sonde and download to the appropriate database.

4.2 Water Sample Collection Procedures

Samples will be collected in general accordance with SOP SB-9 (Parsons, 2008; Littoral Zone Surface Water Sampling), with the following modifications:

- The USEPA “Clean Hands / Dirty Hands” protocols specified in SOP SB-9 (Parsons, 2008) will be followed for mercury and methylmercury samples, but will not be followed for the other analytes (e.g., TSS, VOCs).
- Obtain water quality data at each station by lowering a YSI 6000 series (or equivalent) water quality sonde to a depth of 10 ft. (or mid-depth if the total water depth is less than 20 ft.) and record data in the field database and field notebook.
- Instead of collecting near-surface grab samples (as specified in SOP SB-9; Parsons, 2008), a sample will be collected at a depth 10 ft. from the water surface or from mid-depth if the total water depth is less than 20 ft. The sampling depth will be determined either by using the vessel’s depth finder/sonar, hand held electronic depth finder/sonar, or by manually deploying a telescoping stadia rod or weight attached to a calibrated rope/cable.
  - All samples except those to be analyzed for VOCs will be collected by lowering a Teflon-lined submersible pump with Teflon-lined tubing (or via deployment of other Teflon-lined sampling equipment [e.g., peristaltic pump, Van Dorn sampler]) to the desired sampling depth and filling sample containers from the other end of the tubing.
  - For collection of samples to be analyzed VOCs, a Kemmerer Bottle sampler will be lowered to the desired sampling depth, deploying the messenger to trigger sample collection, and then filling sample containers. Samples will be discharged from the sampling port on the bottom of the Kemmerer Bottle slowly and allowed to flow in a laminar manner along the side of the containers designated for VOC analysis to minimize concerns over volatilization loss.

4.3 Decontamination Procedures

Sampling equipment that comes into contact with lake water will be decontaminated between each sampling location according to the following procedures.

1. Before commencing a sampling event, sampling equipment will be rinsed with a 10 percent nitric acid solution.
2. Place equipment in a wash tub or bucket containing Alconox (or other low-phosphate detergent) along with deionized water, and scrub with a bristle brush or similar utensil.
3. This rinse shall utilize sufficient amounts of water to flush rather than just wet the surface.
4. Rinse with deionized water in a second wash tub.
5. Rinse with dilute solution of nitric acid.
6. Rinse with deionized water.
7. Place equipment in a clean area and allow to air dry to the extent practicable.

4.4 Sample Handling and Tracking

Samples will be handled, preserved, shipped, and tracked as described in SOP 1 (Parsons, 2005b).

Sample Handling and Preservation

Sample containers will be labeled prior to sample collection in accordance with labeling requirements specified in the QAPP (Parsons, 2010). Each container will be placed in re-sealable food storage bags (double bagged, one inside the other for mercury samples), and placed in a clean dedicated cooler. The samples will be chilled with ice to approximately 4° C. Samples will be shipped by overnight delivery to the laboratory at the end of each day. Chain of custody procedures will be followed, as specified in the QAPP.

Data and Records Management

Data from water sample collection will be recorded in the field database using a laptop computer and field notebooks upon completion of sampling at one location. Blank field log sheets can also be used to record information manually in case difficulties with data entry using the computer are encountered. Manually recorded data will be transcribed into the field database at the end of each day, if necessary.

Quality Control and Quality Assurance (QA/QC)

QA/QC procedures are defined in the QAPP, and include collecting field QA/QC samples. Field QA/QC samples to be collected are blind duplicate samples, equipment blank samples, and matrix spike samples. One set of field QA/QC samples will be collected for each sampling event. Blind duplicate samples and matrix spike samples will be prepared by filling additional appropriately marked containers at pre-selected sampling stations (both samples will not be collected at the same station). The station where these samples are collected will be rotated randomly for each sampling event.

Sample Methods

Water samples will be analyzed using the methods shown in Table 2 of the main body of this report (i.e., the March 2011 Water Quality Monitoring for Construction Baseline Work Plan).

5.0 PERSONNEL

The captain and cruise leader shall be the primary persons responsible for ensuring the safety of personnel and following procedural guidelines. The field crew will be informed of boat rules and shall follow the captain's and cruise leader's guidelines. Documentation of training and certifications for the captain, cruise leader, and field crew will be maintained in the SSP.

6.0 REFERENCES

Parsons. 2005a. *Onondaga Lake Pre-Design Investigation: Phase I Work Plan*. Prepared for Honeywell. September 2005.

Appendix A *Phase I Sampling And Analysis Plan*
Appendix B *Quality Assurance Project Plan*
Appendix C *Project Safety Plan* Updated March 2007

Parsons, 2005b. *Onondaga Lake Pre-Design Investigation: Standard Operating Procedures*. Prepared for Honeywell, Morristown, New Jersey. Syracuse, New York.

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