YEAR 2012 ANNUAL

ONONDAGA LAKE

AMBIENT MONITORING PROGRAM

Final
June 2012

Onondaga County
Department of Water Environment Protection
Syracuse, New York

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ANNUAL AMBIENT MONITORING PROGRAM

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APPENDIX A
2012 Non-Event Water Quality
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
April 2012			
April 3/Tuesday	Onondaga Lake	Double Lake Quarterly (w/Lake Special Weekly)	E & G
April 5/Thursday	Tributary	Tributary Bacteria	C
April 9/Monday	Onondaga Lake	Lake Special Weekly	G
April 10/Tuesday	Tributary	Tributary Biweekly	C
April 12/Thursday	Tributary	Tributary Bacteria	C
April 17/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
April 19/Thursday	Onondaga Lake	Lake Bacteria	G
April 23/Monday	Onondaga Lake	Lake Special Weekly	G
April 24/Tuesday	Tributary	Tributary Biweekly	C
April 26/Thursday	Tributary	Tributary Bacteria	C
May 2012			
May 1/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
May 3/Thursday	Tributary	Tributary Bacteria	C
May 7/Monday	Onondaga Lake	Lake Special Weekly	G
May 8/Tuesday	Tributary	Tributary Biweekly	C
May 10/Thursday	Tributary	Tributary Bacteria	C
May 15/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
May 17/Thursday	Tributary	Tributary Bacteria	C
May 21/Monday	Onondaga Lake	Lake Special Weekly	G
May 22/Tuesday	Tributary	Tributary Biweekly	C
May 24/Thursday	Onondaga Lake	Lake Bacteria	G
May 30/Wednesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
June 2012			
June 4/Monday	Onondaga Lake	Lake Special Weekly	G
June 5/Tuesday	Tributary	Tributary Quarterly Extended	C
June 7/Thursday	Tributary	Tributary Bacteria	C
June 12/Tuesday	Onondaga Lake	Double Lake Quarterly (w/Lake Special Weekly)	E & G
June 14/Thursday	Tributary	Tributary Bacteria	C
June 18/Monday	Onondaga Lake	Lake Special Weekly	G
June 19/Tuesday	Tributary	Tributary Biweekly	C
June 20/Wednesday	Onondaga Lake	Lake Bacteria	G

APPENDIX A (Continued)

2012 Non-Event Water Quality
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
June 25/Monday	Tributary	Tributary Bacteria	C
June 26/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
July 2012			
July 2/Monday	Onondaga Lake	Lake Special Weekly	G
July 5/Thursday	Tributary	Tributary Biweekly	C
July 9/Monday	Tributary	Tributary Bacteria	C
July 10/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	E & G
July 12/Thursday	River*	River Annual	I
July 16/Monday	Onondaga Lake	Lake Special Weekly	G
July 17/Tuesday	Tributary	Tributary Biweekly	C
July 19/Thursday	Tributary	Tributary Bacteria	C
July 23/Monday	Tributary	Tributary Bacteria	C
July 24/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
July 30/Monday	Onondaga Lake	Lake Special Weekly	G
July 31/Tuesday	Tributary	Tributary Biweekly	C
August 2012			
August 6/Monday	Tributary	Tributary Bacteria	C
August 7/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
August 13/Monday	Onondaga Lake	Lake Special Weekly	G
August 14/Tuesday	Tributary	Tributary Biweekly	C
August 16/Thursday	Tributary	Tributary Bacteria	C
August 21/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
August 23/Thursday	Tributary	Tributary Bacteria	C
August 27/Monday	Onondaga Lake	Lake Special Weekly	G
August 28/Tuesday	Tributary	Tributary Biweekly	C
August 29/Wednesday	Onondaga Lake	Lake Bacteria	G
September 2012			
September 5/Wednesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
September 6/Thursday	Tributary	Tributary Bacteria	C
September 10/Monday	Onondaga Lake	Lake Special Weekly	G
September 11/Tuesday	Tributary	Tributary Quarterly Extended	C
September 17/Monday	Tributary	Tributary Bacteria	C

APPENDIX A (Continued)
2012 Non-Event Water Quality
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
September 18/Tuesday	Onondaga Lake	Double Lake Quarterly (w/Lake Special Weekly)	E & G
September 20/Thursday	Onondaga Lake	Lake Bacteria	G
September 24/Monday	Onondaga Lake	Lake Special Weekly	G
September 25/Tuesday	Tributary	Tributary Biweekly	C
September 27/Thursday	Tributary	Tributary Bacteria	C
October 2012			
October 2/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
October 4/Thursday	Tributary	Tributary Bacteria	C
October 8/Monday	Onondaga Lake	Lake Special Weekly	G
October 9/Tuesday	Tributary	Tributary Biweekly	C
October 11/Thursday	Onondaga Lake	Lake Special Weekly	G
October 16/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
October 18/Thursday	Tributary	Tributary Bacteria	C
October 22/Monday	Onondaga Lake	Lake Bacteria	G
October 23/Tuesday	Tributary	Tributary Biweekly	C
October 25/Thursday	Tributary	Tributary Bacteria	C
October 30/Tuesday	Onondaga Lake	Lake South Deep Biweekly	E
November 2012			
November 1/Thursday	Tributary	Tributary Bacteria	C
November 6/Tuesday	Tributary	Tributary Quarterly Extended	C
November 13/Tuesday	Onondaga Lake	Lake South Deep Biweekly	E
November 15/Thursday	Tributary	Tributary Bacteria	C
November 20/Tuesday	Tributary	Tributary Biweekly	C
November 26/Monday	Tributary	Tributary Bacteria	C
November 27/Tuesday	Onondaga Lake	Lake South Deep Biweekly	E
December 2012			
December 4/Tuesday	Tributary	Tributary Biweekly	C
December 6/Thursday	Tributary	Tributary Bacteria	C
December 11/Tuesday	Onondaga lake	Lake South Deep Biweekly	E
December 13/Thursday	Tributary	Tributary Bacteria	C
December 18/Tuesday	Tributary	Tributary Biweekly	C
December 20/Thursday	Tributary	Tributary Bacteria	C

APPENDIX A (Continued)
2012 Non-Event Water Quality
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
January 2013			
January 3/Thursday	Tributary	Tributary Biweekly	C
January 8/Tuesday	Onondaga Lake	Lake Winter**	F
January 16/Wednesday	Tributary	Tributary Biweekly	C
January 21/Monday	Tributary	Tributary Bacteria	C
January 24/Thursday	Tributary	Tributary Bacteria	C
January 29/Tuesday	Tributary	Tributary Biweekly	C
February 2013			
February 4/Monday	Tributary	Tributary Bacteria	C
February 5/Tuesday	Onondaga Lake	Lake Winter**	F
February 7/Thursday	Tributary	Tributary Bacteria	C
February 12/Tuesday	Tributary	Tributary Biweekly	C
February 21/Thursday	Tributary	Tributary Bacteria	C
February 26/Tuesday	Tributary	Tributary Biweekly	C
March 2013			
March 5/Tuesday	Onondaga Lake	Lake Winter**	F
March 7/Thursday	Tributary	Tributary Bacteria	C
March 12/Tuesday	Tributary	Tributary Biweekly	C
March 18/Monday	Tributary	Tributary Bacteria	C
March 21/Thursday	Tributary	Tributary Bacteria	C
March 26/Tuesday	Tributary	Tributary Quarterly Extended	C

*** One (1) River sampling event some time during the months of July through September to target low flows (at or less than 500cfs at Baldwinsville); sampling event date may be altered.**

**** Lake Winter dates are tentative and will depend on weather conditions/extent of ice cover on lake.**

APPENDIX A (Continued)
Non-Event Biological
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
May 2012			
Week of May 13th[1]	Fish Community	Littoral Laval	K
Week of May 20th [2]	Fish Community	Adult Electrofishing	K
Week of May 27th [3]	Fish Community	Adult Fish Littoral Profundal Zone (Gill Nets)	K
June 2012			
Week of June 3rd [4]	Fish Community	Nesting Survey	K
July 2012			
Week of July 4th	Fish Community	Littoral Laval	K
Week of July 15th	Fish Community	Juvenile Seines	K
Week of July 22nd	Fish Community	Juvenile Electrofishing	K
Late July[5]	Macrophyte	Aerial Flight	L
Late July[5]	Macrophyte	Field Species Verification	L
August 2012			
Week of August 5th	Fish Community	Juvenile Seines	K
Week of August 26th	Fish Community	Juvenile Seines	K
September 2012			
Week of September 16th	Fish Community	Juvenile Seines	K
Week of September 23rd [2]	Fish Community	Adult Electrofishing	K
Week of September 30th [3]	Fish Community	Adult Fish-Littoral Profundal Zone (Gill Nets)	K
October 2012			
Week of October 7th	Fish Community	Juvenile Seines	K

[1]Littoral Larval sampling events will begin in May when the water temperatures are 15-20°C; all events are weather dependent.

[2]Electrofishing events are night events; dependent on weather conditions and water temperatures of 15-20°C; (Tentative back-up events: week of May 27th/September 30th)

[3]Gill Nets are done at dusk/night within one week of littoral electrofishing; (Tentative back-up events: week of June 3rd/October 7th).

[4] Nesting Survey event occurs once in June dependant upon water temperatures of 15-20°C, clarity, and peak spawning of select gamefish.

[5] Field Species Verification will take place within one week of Aerial Photography; Aerial photography is dependent upon water clarity (secchi disk transparency approximately >2.5 meters) and weather (wind and cloud cover/rain).

APPENDIX B
2012 Event-Based Water Quality Sampling Schedule

PROGRAM/EVENT(S)	FREQUENCY	PARAMETERS	LOCATIONS
I. ONONDAGA LAKE TRIBUTARIES			
1. High-Flow	Minimum 5 times/year.	APPENDIX C	All Tributary Monitoring Sites.
2. Enhanced Tributary Sampling	2 times/year	APPENDIX D	Onondaga Creek @ Plum Street
II. ONONDAGA LAKE			
1. Winter	Once per month January, February, March (Weather Permitting).	APPENDIX F	North or South Deep (sampling station depends on extent of ice cover).
2. Fall Monitoring	Weekly sampling and field data more frequently.	APPENDIX H	Onondaga Lake
III. RIVER MONITORING			
1. River Monitoring	Once per year - sometime during July through September (target low-flow).	APPENDIX I	6 River Monitoring Stations (Seneca/Oneida/ Oswego Rivers)

APPENDIX C
2012 Tributary Sampling Program

Sampling site numbers correspond to the following sites:
(Figure 1-1: AMP Monitoring Locations Tributary and Lake)

1 Ninemile Creek at Lakeland (Route 48)
2a Harbor Brook at Hiawatha Blvd.
2b Harbor Brook at Velasko Road
2c Harbor Brook at Bellevue Avenue
3a Onondaga Creek at Kirkpatrick Street
3b Onondaga Creek at Dorwin Avenue
3c Onondaga Creek at Spencer Street[1]
4 Ley Creek at Park Street
5 Tributary 5A at State Fair Boulevard[2]
6 Metro Effluent[3]
7 East Flume - Manhole #015
8a Onondaga Lake Outlet at Long Branch Road - 2 feet (0.61 meters)
8b Onondaga Lake Outlet at Long Branch Road - 12 feet (3.66 meters)
9 Bloody Brook at Onondaga Lake Park
10 Sawmill Creek at Onondaga Lake Recreational Trail[4]

PARAMETER/ FREQUENCY	1	2a	2b	2c	3a	3b	3c	4	5	6	7	8a	8b	9	10
Cd, Cr, Cu, Ni, Pb, Hg[5], Zn, As, K/ Quarterly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CN/ Quarterly	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Ca, Na, Mg, Mn, Fe/ Biweekly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TP, SRP, TDP/ Biweekly	X	X	X	X	X	X		X	X	X	X	X	X	X	X
BOD_5, TSS, TDS, Cl, SiO_2-diss, SO_4, TOC, TOC-F, TIC, Turbidity/ Biweekly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
TKN, NH_3-N, NO_3, NO_2, Org-N, TN[6]/ Biweekly	X	X	X	X	X	X		X	X	X	X	X	X	X	X
ALK-T/ Biweekly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fecal Coliform[7]/ (Minimum 5 samples/month)	X	X	X	X	X	X		X	X	X	X	[8]		X	X

APPENDIX C (Continued)
2012 Tributary Sampling Program

PARAMETER/ FREQUENCY	1	2a	2b	2c	3a	3b	3c	4	5	6	7	8a	8b	9	10
In-situ: pH, Temperature, Salinity, Conductivity, Redox Potential, Dissolved Oxygen/ Biweekly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Equipment Blank 1 – Dunker-Churn (Churn A - Biweekly)/ BOD_5, TSS, TOC, TDS, TOC-F, TIC, SO_4, NO_3, NO_2, TP, Cl, SiO_2-diss, NH_3-N, TKN, Org-N, Na, Ca, Mg, Mn, Fe, SRP, TDP, ALK-T, Turbidity															
Equipment Blank 1 – Dunker-Churn (Churn A - Quarterly)/ BOD_5, TSS, TOC, TDS, TOC-F, TIC, SO_4, NO_3, NO_2, TP, Cl, SiO_2-diss, NH_3-N, TKN, Org-N, Na, Ca, Mg, Mn, Fe, As, Cd, Cr, Cu, Hg, K, Ni, Pb, Zn, SRP, TDP, CN, ALK-T, Turbidity															
Equipment Blank 2 – Churn (Churn B - Biweekly)/ BOD_5, TSS, TOC, TDS, TOC-F, TIC, SO_4, NO_3, NO_2, TP, Cl, SiO_2-diss, NH_3-N, TKN, Org-N, Na, Ca, Mg, Mn, Fe, SRP, TDP, ALK-T, Turbidity															
Equipment Blank 2 – Churn (Churn B - Quarterly)/ BOD_5, TSS, TOC, TDS, TOC-F, TIC, SO_4, NO_3, NO_2, TP, Cl, SiO_2-diss, NH_3-N, TKN, Org-N, Na, Ca, Mg, Mn, Fe, As, Cd, Cr, Cu, Hg, K, Ni, Pb, Zn, SRP, TDP, CN, ALK-T, Turbidity															

APPENDIX C (Continued)
2012 Tributary Sampling Program

[1] Spencer Street sampling will be sampled semi-annually in 2012 (at the same frequency as the Spence-Patrick Spring wellpoint sampling) during a tributary sampling event for the same list of parameters analyzed at the Spence-Patrick Spring (Cl, Ca, Na, Mg, K, SO_4, Fe, Mn, Alk-T, pH, Temperature, Dissolved Oxygen, Redox, Salinity and Conductivity). This sampling will allow the assessment of impacts of Spence-Patrick Spring as data will be available upstream (at Spencer Street) and downstream (at Kirkpatrick Street).

[2] Tributary 5A flow will also be monitored quarterly (during the Quarterly Extended Tributary sampling events, which includes the quarterly and biweekly parameters).

[3] Metro Effluent is sampled biweekly for all parameters. If any flow is bypassed on tributary sampling date, this water is sampled for the same parameters as all other tributaries.

[4] Sawmill Creek at Onondaga Lake Recreational Trail will be sampled biweekly from June 1 - September 30 during the Tributary sampling events.

[5] Hg analysis using Method 1631 (Revision E) using a CVAAS detector.

[6] TN - Total Nitrogen is a calculated value adding the TKN result and the combined NO_2-N and NO_3-N results.

[7] A minimum total of five (5) fecal coliform bacteria samples will be collected each month (year round) at each of the designated tributary sampling sites, to compare results with the NYS Ambient Water Quality Standard for Fecal Coliform bacteria. These include samples collected during the Tributary Biweekly, Quarterly Extended and Tributary Bacteria sampling events scheduled during each month (refer to Appendix A for list of dates).
Fecal Coliform bacteria samples are collected just below the water surface (depth <1m), at each of the designated tributary sampling sites.

Note: ***During predetermined high flow conditions, a minimum of 5 sampling events will be conducted per year with a focus on conducting the events during the summer recreational period; high flows are defined as one standard deviation above the long-term monthly mean flow value based on the USGS gage height at Onondaga Creek (Spencer Street site).***

APPENDIX D
2012 Enhanced Tributary Sampling Program
Onondaga Creek (CSO 080)
(Event #1 and #2*)

Tributary Sampling Location (CSO Outfall)	Parameters	Sampling Methodology	Sample Type	Sample Frequency	Total Number of Measurements/ Samples/ Observations
Onondaga Creek - Upstream side of Plum Street Bridge (Figure 1-2: AMP Monitoring Locations Enhanced Tributary Sampling) (CSO080 – Erie Boulevard Storage System)	**In-Situ:** Dissolved oxygen, pH, Temperature and Conductivity	Record in-situ DO, pH and Temperature measurements with YSI 600 to correspond to the depth of the 3 samples collected/transect ((1) near surface, (2) mid-depth, and (3) near bottom).	"In-Situ"	5 cycles: 0-1 hour, 2-hour, 4-hour, 6-hour and 8-hour	45 measurements (3 measurements/ transect x 3 transects/cycle x 5 cycles)
	Conventionals: Ammonia-N, TKN, NO_2-N, NO_3-N, Total Nitrogen and Total Phosphorus	"Modified Depth Integrated" method: A total of three (3) samples will be collected at three transect locations (center of stream, and half the distance from the centerline and bank on both sides). These 3 samples will be collected from each of the three transects with a horizontal sampler as follows: (1) near surface, (2) mid-depth, and (3) near bottom; these 3 samples will be composited into a single sample for analysis per transect.	"Vertical Composite"	5 cycles: 0-1 hour, 2-hour, 4-hour, 6-hour and 8-hour	15 samples (1 sample/transect x 3 samples/cycle x 5 cycles)
	Visual: Floatables	Visual observation recorded on C-O-C form.	"Visual observation" (No samples)	5 cycles: 0-1 hour, 2-hour, 4-hour, 6-hour and 8-hour	5 observations (1 observation/cycle x 5 cycles)
	Bacteria: Fecal Coliform, Total Residual Chlorine	One (1) Fecal Coli sample will be collected as a grab from just below the water surface (depth <1m), mid-channel/in-stream bridge sampling site. The Chlorine residual will be measured and recorded in the field with a Hach Pocket Colorimeter Kit and recorded on the sample bottle & C-O-C form.	"Grab"	5 cycles: 0-1 hour, 2-hour, 4-hour, 6-hour and 8-hour	5 samples (1 sample/transect x 5 cycles)
	Equipment Blank 1 - Horizontal Beta Sampler (NO_3, NO_2, TP, NH_3-N, TKN)				

NOTE: Sampling for Event #2 may be modified based on evaluation of data from Event #1 with NYSDEC/ASLF staff.

APPENDIX E
2012 Onondaga Lake Sampling Program

	DEPTH, METERS							
PARAMETER	**0**	**3**	**6**	**9**	**12**	**15**	**18**	**FREQUENCY[1]**
	UML[2]			LWL[2]				
Cd, Cr, Cu, Ni, Pb, Zn, As, Se, K	Composite			Composite				Quarterly
Hg[3]		X					X	April (pre-stratification), August (stratification), and October (post-turnover)
Ca, Na, Mg, Mn, Fe	Composite			Composite				Biweekly
Cl, SO_4	Composite			Composite				Biweekly
TS, TSS, TDS, SiO_2-diss, TOC, TIC	X		X		X		X	Biweekly
Turbidity	Composite							Biweekly
TP, SRP, TDP	X	X	X	X	X	X	X	Biweekly
NO_3, NO_2	Composite			Composite				Biweekly
TKN, NH_3-N, Org-N, F-TKN	X	X	X	X	X	X	X	Biweekly
ALK-T	Composite			Composite				Biweekly
Fecal Coliform, E. Coli [4]	X							Biweekly
CHLOR-A[5], PHAEO-A	Composite							Biweekly
Sulfide[6]					X	X	X	Biweekly
Temperature, pH, Salinity, Conductivity, Dissolved Oxygen, Oxidation-Reduction Potential	Measured every half-meter from 0- to 18-meter depth							Biweekly
Underwater Illumination profile, Secchi Disk Transparency	Recorded at each site							Biweekly
Phytoplankton[7]	Composite							Biweekly
Zooplankton[8]		X			X			
Equipment Blank 1 – Pump TS, TSS, TDS, SiO_2-diss, TOC, TIC, TP, SRP, TDP, TKN, NH_3-N, Org-N, F-TKN								Biweekly

APPENDIX E (Continued)
2012 Onondaga Lake Sampling Program

	DEPTH, METERS							
PARAMETER	**0**	**3**	**6**	**9**	**12**	**15**	**18**	**FREQUENCY[1]**
	UML[2]			LWL[2]				
Equipment Blank 2 – Dunker-Churn (Churn Blank)/ Ca, Na, Mg, Mn, Fe, Cl, SO_4, NO_3, BOD_5, NO_2, ALK-T, Turbidity								Biweekly
Equipment Blank 2 – Dunker-Churn (Churn Blank)/ Cd, Cr, Cu, Ni, Pb, Zn, As, Se, K, Ca, Na, Mg, Mn, Fe, Cl, SO_4, NO_3, NO_2, ALK-T								Quarterly

[1] Samples are taken at the South Deep Station, which is representative of the lake conditions (Figure 1-1). Additional quarterly sampling is conducted at the North Deep Station (during Double Lake sampling events).

[2] Please note that "UML" (Upper Mixed Layer) and "LWL" (Lower Water Layer) composite samples collected during the sampling events will be made by mixing samples from each depth according to the following field protocol:

(a) Late fall, winter, and early spring (October 1 – May 31) when the lake waters are not strongly stratified.

- *i. The default UML during this period of the year is 0, 3, 6m.*
- *ii. The default LWL during this period of the year is defined as 9, 12, 15 and 18m.*

(b) Summer stratification period (June 1 – September 30)

- *i. The UML composite shall always include samples collected at 0 and 3m depths. Inclusion of water collected at 6m in the composite shall be evaluated based on the temperature profiles measured during the sampling event to define the metalimnion, which includes the thermocline (defined as the region where water temperature changes at least 1 degree C per meter).*
- *ii. The composite sample of the LWL will typically include water collected at depths of 12, 15 and 18m during this period. The inclusion of the 12m depth in the composite of the lower waters should be reviewed during each sampling event. Because the 9m depth is consistently in the metalimnion during this period, water from this depth will not be included in either composite sample.*

[3] Hg - Special ultra low-level Hg (total and methyl Hg analysis by Contract Laboratory) at the Lake South and North Deep stations. A duplicate sample will be collected at the 18m depth at the South and North Deep station during each sampling event. Also, a separate equipment rinseate blank will be collected for special ultra low-level Hg analysis.

[4] Bacteria samples collected just below the water surface (depth <1m).

[5] The Chlorophyll-*a* tube composite sample has been standardized to a depth of 0-3m year round.

APPENDIX E (Continued)
2012 Onondaga Lake Sampling Program

[6] Sampling of sulfides only if anoxic conditions are determined through the YSI profile (to be completed prior to sampling).

[7] Phytoplankton tube composite sample has been standardized to a depth of 0-3m year round.
Frequency of Phytoplankton samples will be:
South Deep station: biweekly from April - November and monthly January, February, March, December.

[8] Zooplankton will be collected with a flowmeter attached to the net to quantify the volume of water filtered at the following depths:

i) a 15 meter net haul will be collected during each event; and in addition
ii) a 6 meter vertical net haul will be collected only during the thermally stratified period (June - September)
Note: For additional flowmeter details, refer to Attachment 1 (Page 20 Quality Assurance Program Plan for the 2012 Water Quality Monitoring Program).
Frequency of Zooplankton samples will be:
South Deep station: biweekly from April - November and monthly January, February, March, December.
North Deep station: quarterly (during the Double lake sampling events).

APPENDIX F
2012 Onondaga Lake Winter Sampling Program

	DEPTH, METERS							
PARAMETER	**0**	**3**	**6**	**9**	**12**	**15**	**18**	**FREQUENCY[1]**
Ca, Na, Mg, Mn, Fe, Hardness	Composite[2]			Composite[2]				
Cl, SO_4	Composite			Composite				
TS, TSS, TDS, SiO_2-diss, TOC, TIC	X		X		X		X	
Turbidity	Composite							
TP, SRP, TDP	X	X	X	X	X	X	X	
TKN, NH_3-N, Org-N, F-TKN	X	X	X	X	X	X	X	
NO_3, NO_2	Composite			Composite				
ALK-T	Composite			Composite				
CHLOR-A, PHAEO-A	Composite							
Fecal Coliform, E. Coli[3]	X							
Sulfide[4]					X	X	X	
Temperature, pH, Salinity, Conductivity, Dissolved Oxygen, Oxidation-Reduction Potential	Measured every half-meter from 0-to 18-meter depth							
Underwater Illumination profile[5], Secchi Disk Transparency	Recorded at site							
Phytoplankton [6]	Composite							
Zooplankton [7]	X			X				
Equipment Blank 1 – Pump/ TS, TSS, TDS, SiO2, TOC, TIC, TP, SRP, TDP, TKN, NH_3-N, F-TKN								
Equipment Blank 2 – Dunker-Churn (Churn Blank)/ Ca, Na, Mg, Mn, Fe, Cl, SO_4, BOD5, NO_3, NO_2, ALK-T, Turbidity								

APPENDIX F (Continued)
2012 Onondaga Lake Winter Sampling Program

[1] Samples are taken at the South Deep Station, which is representative of the lake conditions. Sampling will be conducted at North Deep Station if sampling during ice cover.
Frequency is once per month during January, February, and March (as weather allows).

[2] As the lake waters are not stratified in the winter:

i) The default UML during this period of the year is 0, 3, 6 m.

ii) The default LWL during this period of the year is defined as 9, 12, 15 and 18 m.

Composites are made by mixing samples from each depth.

[3] Bacteria samples collected just below the water surface (depth <1m).

[4] Sampling of sulfides only if anoxic conditions are determined through the YSI profile (to be completed prior to sampling).

[5] Underwater Illumination profile only recorded at South Deep station when lake is ice free.

[6] Phytoplankton tube composite sample has been standardized to a depth of 0-3m year round.

[7] Zooplankton will be collected as a 15 meter vertical net haul when lake is ice free. When sampling over ice for a qualitative assessment, a special zooplankton sample will be collected using an 8 inch diameter net (with 80 um mesh through the corresponding UML default depth during this period (0-6m) and poured into a 1-liter container and preserved according to the Field Preservation Guide).

APPENDIX G

2012 Onondaga Lake Special Weekly & Bacteria Sampling Programs

PARAMETERS	FREQUENCY	LOCATIONS
Fecal Coliform[1] E. Coli Turbidity Secchi Disk Transparency Temperature	Weekly sampling: April 1 - October 30 Bacteria sampling: Minimum 5 x month	Onondaga Lake (Nearshore sites)[2] Figure 1-1: GPS Coordinates: Site 1 - Ninemile Creek 43° 05.477' N; 76° 13.650' W Site 2 - Harbor Brook 43° 03.877' N; 76° 11.043' W Site 3 - Metro 43° 03.937' N;76° 10.931' W Site 4 - Ley Creek 43° 04.407' N; 76° 10.768' W Site 5 - Eastside 43° 06.529' N; 76° 13.598' W Site 6 - Willow Bay 43° 06.873' N; 76° 14.156' W Site 7 - Maple Bay 43° 06.732' N; 76° 14.713' W Site 8 - Bloody Brook 43° 05.720' N; 76° 12.225' W Site 9 - Wastebeds 43° 04.880' N; 76° 12.620'W Site 12 - Onondaga Creek 43° 04.087' N; 76° 10.731'W
Chlorophyll-*a*[3]	Weekly sampling: May - September	Onondaga Lake South Deep station - Site 10 43° 04.670' N 76° 11.880' W
Fecal Coliforms E. Coli Turbidity Secchi Disk Transparency In-situ field data (measured every half-meter from 0- to 18-meter depth): pH, Temperature, Salinity, Conductivity, Dissolved Oxygen, Oxidation-Reduction Potential	Weekly sampling: April 1 - October 30 Bacteria sampling: Minimum 5 x month	Onondaga Lake South Deep station - Site 10 43° 04.670' N 76° 11.880' W
Fecal Coliforms[1] E. Coli Turbidity Secchi Disk Transparency In-situ field data (measured every half-meter from 0- to 18-meter depth): pH, Temperature, Salinity, Conductivity, Dissolved Oxygen, Oxidation-Reduction Potential	Weekly sampling: April 1 - October 30 Bacteria sampling: Minimum 5 x month	Onondaga Lake North Deep station - Site 11 43° 05.930' N 76° 13.730' W

[1] Fecal Coliform only for the bacteria sampling events at the Onondaga Lake nearshore, South & North Deep stations.

[2] The nearshore sampling stations are standardized to water depths of 4-5 feet of water. Bacteria samples collected from just below the water surface (<1m).

[3] Chlorophyll-*a* composite samples will be collected at the South Deep station weekly from May - September only, at a standardized depth of 0-3m year round.

APPENDIX H
2012 Onondaga Lake Fall Turnover Sampling Program

PARAMETER	DEPTH, METERS							FREQUENCY
	0	3	6	9	12	15	18	
Cl, NO_3, NO_2	Composite			Composite				Weekly[1] (During Fall Turnover)
TDS, SiO_2-diss	X		X		X		X	
TP, SRP, TDP	Composite			Composite				
NH_3-N, TKN, F-TKN	Composite			Composite				
ALK-T	X		X		X		X	
CHLOR-A[2]	Composite							
Hg[3]		X					X	Once (during post-turnover)
Temperature, pH, Dissolved Oxygen, Specific Conductance, Salinity, Redox Potential	Measured every half-meter from 0- to 18-meter depth (South & North Deep)							More frequently. Target daily profiles during the first three days of fall mixing, as possible.
Secchi Disk Transparency								During each event.
Equipment Blank 1 - Pump TDS, SiO_2-diss, ALK-T								Weekly (during Fall Turnover)
Equipment Blank 2 - Dunker-Churn (Churn Blank)/ Cl, NO_3, NO_2, TP, SRP, TDP, NH_3-N, TKN, F-TKN								Weekly (during Fall Turnover)

[1] Samples are taken at the South Deep Station, which is representative of the lake conditions.
[2] The Chlorophyll-*a* tube composite sample has been standardized to a depth of 0-3m year round.
[3] Hg - Special ultra low-level Hg (total and methyl Hg analysis by Contract Laboratory) at the Lake South and North Deep stations. A duplicate sample will be collected at the 18m depth at the South and North Deep station during the sampling event. Also, a separate equipment rinseate blank will be collected for special ultra low-level Hg analysis (Refer to Appendix E -2012 Onondaga Lake Sampling Program).

APPENDIX I
2012 Seneca/Oneida/Oswego River Sampling Program

Sampling Locations: (Figure 1-3: AMP Monitoring Locations Seneca/ Oneida/Oswego River)

Buoy 412 (immediately downstream of Cross Lake and upstream of the State Ditch Cut)
Buoy 316 (downstream of Baldwinsville Dam and upstream of the BSK WWTP)
Buoy 269 (downstream of the Onondaga Lake outlet)
Buoy 240 (downstream of the Wetzel Road WWTP and upstream of Anheuser-Busch WWTP)
Buoy 222 (downstream of Anheuser-Busch WWTP and close to the Three Rivers Junction)
Buoy 212 (downstream of the Oak Orchard WWTP discharge in Oneida River)

Frequency: Annual (some time between July through September 2012) - target critical low stream flows.

The following table summarizes the in-situ field data to be collected during the annual sampling event:

IN-SITU FIELD DATA	DEPTH
pH, S.U.	At 0.5m increments
Specific Conductance, mS/cm	At 0.5m increments
Temperature, Deg C	At 0.5m increments
Dissolved Oxygen, mg/l	At 0.5m increments
Salinity, ppt	At 0.5m increments
Oxidation-Reduction Potential, mV (ORP)	At 0.5m increments
Underwater Illumination Profile ($\mu mol\ s^{-1}\ m^{-2}$)	At 20 cm increments in the water column.
Secchi Disk Transparency (m)	From Surface

APPENDIX I (Continued)
2012 Seneca/Oneida/Oswego River
Sampling Program

The following table summarizes the parameters for analysis. One set of samples will be collected at 2 depths for Buoy 316 (1-meter below the water surface and 1-meter above the river sediments) during the 24-hour period, during the annual sampling event conducted sometime during the months of July through September 2012, during low flow conditions.

ANALYTICAL PARAMETERS		
PARAMETER	**NO. OF SAMPLES PER EVENT (2 SAMPLES)[1]**	**FREQUENCY/TIMING**
TOC	2	Annual (target low flows - annual event some time during the months of July through September 2012)
TOC-F	2	
TKN	2	
NO_2	2	
NH_3-N	2	
Org-N	2	
F-TKN	2	
NO_3	2	
Chlorophyll-*a*[2]	2	
Phaeophytin-*a*	2	
SRP	2	
TDP	2	
TP	2	
TSS	2	
Cl	2	
BOD_5[3]	2	
Turbidity	2	
Equipment Blank 1 – Dunker-Churn/ TOC, TOC-F, TKN, NO_2, NH_3-N, Org-N, F-TKN, NO_3, SRP, TDP, TP, TSS, Cl, BOD_5, Turbidity		

APPENDIX I (Continued)
2012 Seneca/Oneida/Oswego River
Sampling Program

[1] Field duplicates will be collected at Buoy 316 (1-meter below the water surface and 1-meter above the river sediments) during the sampling event for each parameter.

[2] Chlorophyll-*a* will be collected at Buoy 316 from the 2 depths (1-meter below the water surface and 1-meter above the river sediments) during each of the sampling events.

[3] BOD_5 will be field composited from the 2 depths for the buoy location during each of the sampling events (1-meter below the water surface and 1-meter above the river sediments for one composite sample).

APPENDIX J
2012 Seneca River Diurnal Monitoring (Automated Sonde)

The following table summarizes the field data to be collected typically at 15-minute intervals over a 24-hour period at Buoy 316 in Seneca River by installing two (2) YSI data-loggers (one placed at 1 meter below the water surface and one placed at 1 meter above the river bottom) from July through October 2012.

FIELD DATA (YSI DATALOGGER)
pH, S.U.
Specific Conductance, mS/cm
Temperature, Deg C
Dissolved Oxygen, mg/l
Salinity, ppt
Oxidation-Reduction Potential, mV (ORP)

APPENDIX K
2012 Onondaga Lake Fish Community Sampling Program

Component	Methodology/Gear	Sampling Objectives	Location and Number of Samples	Timing	Changes
Pelagic Larvae	Modified double oblique Miller high-speed trawl, with flow meter attached, collected during the day in the pelagic zone.	Determine species richness.	- 4 double oblique tows in each basin (North and South) per event. -Tows will sample water depths from the surface to approximately 5.0-5.5 meters. -Total No. of events =8 -Total No. of samples =64	-Daytime -Bi-weekly. -April (when water temps. are 7-8 ºC) through end of July.	- Pelagic larvae sampling deleted in 2012.
Littoral Larvae	Larval fish seine swept for 10 m in littoral zone	Determine community structure and species richness.	-5 strata with 3 sites in each strata and 1 sweep at each site. -No. of Sites = 15 -Total No. of events = 2 -Total No. of samples = 30	-Daytime Twice per year - Mid May -Early July	-Reinstate larval seine program.
Juvenile Fish	50’ x 4’ x 1/4” bag seine swept into shore in the littoral zone.	Determine community structure and species richness.	-5 strata with 3 sites in each strata and 1 sweep at each site. -No. of Sites = 20 -Total No. of events = 5 -Total No. of samples = 100	-Daytime -Every 3 weeks. -Mid July - October.	-Deleted first event. - Additional sample location in each strata
Juvenile Fish (boat electrofishing)	Boat mounted electrofisher in the littoral zone at night.	Determine community structure and species richness.	- 1 electrofishing transect per strata. -Total No. of events = 1 -Total No. of samples = 5	-night-time -Once per year in late July.	-Supplement juvenile fish sampling program with boat electrofishing
Nesting Fish	Lake wide nest survey.	Document spatial distribution and species composition	-Entire perimeter of lake divided into 24 equal length sections. -Total No. of events = 1 -Total No. of samples = 24	-Once in June when water temperature is between 15° and 20 °C.	-No Change from previous year.

APPENDIX K (Continued)
2012 Onondaga Lake Fish Community Sampling Program

Adult Fish-Littoral Zone	Boat mounted electrofisher in the littoral zone at night.	Determine community structure, species richness, CPUE, and relative abundance.	-Entire perimeter of lake shocked in 24 contiguous transects. -Alternating all-fish/gamefish transects. -Total No. of events = 2 -Total No. of samples = 48	-Night-time. -Twice per year; Spring and Fall. -Spring and Fall. -Water temp. between 15º and 21 ºC.	-No Change from previous year.
Adult Fish-Littoral Profundal Zone	Experimental gill nets of standard NYSDEC dimensions.	Determine community structure, and species richness.	-Two net per strata. -Nets set on bottom, perpendicular to shore at a water depth of 3-10m for two hours. -Total No. of events = 2 -Total No. of samples = 20	-Night-time. -Twice per year, within one week of littoral electrofishing.	-Set nets at night. -One additional sample location in each strata -Set nets perpendicular to shore
Angler Census	Angler diary program.	Determine catch rates, species composition.	-Recruit diary participants at fish & game clubs and fishing organizations.	-Issued annually and collected at end of fishing season (fall).	-Discontinue angler diary program in 2012 due to lack of interest and participation by anglers.

APPENDIX L
2012 Onondaga Lake Macrophyte Assessment Program

Component	Methodology/Gear	Sampling Objectives	Location and Number of Samples	Timing	Change
Onondaga Lake Aerial Photography	Program utilizes plane with belly mounted 9x9 camera. 60% forward overlap, 30% side overlap.	Determine annual percent of littoral zone with macrophytes.	-Three (3) flight lines full lake coverage.	-August when water clarity is approximately 3-meters on the secchi disk. -Early morning with low sun angle.	-Timing change from August to late July.
Field Species Verification of Aerial Photography	Visual identification.	Determine species.	-Two (2) sites in each of the five (5) strata for a total of ten (10) sites.	-Within 1 week of the aerial photos.	-Timing change from August to late July.

APPENDIX M
Summary of Proposed 2012 AMP Modifications

WATER QUALITY SAMPLING PROGRAMS

Appendix A: **Year 2012 Non-Event Sampling Schedule (April 2012 - March 2013)**

As required by Appendix D of the Amended Consent Judgment, included is an annual sampling schedule for the 2012 non-event related sampling, specifying dates, locations, and parameters.

Appendix B: **Year 2012 Event-Based Sampling Schedule**

The monitoring program for event related sampling specifies the number of annual activities.

Appendix C: **Year 2012 Tributary Sampling Program**

Added parameter "TN" (Total Nitrogen) to the Tributary sampling program to support NYSDEC's development of numerical criteria for nutrients in flowing waters (calculated by adding TKN, NO_3-N and NO_2-N).

Added footnote to clarify that the Fecal Coliform samples will be collected just below the water surface (depth <1m) from the sampling sites.

Appendix D: **Year 2012 Enhanced Tributary Sampling Program**

Added new Appendix which details sampling for Event #1 of the Enhanced Tributary Program. Added note to clarify that the bacteria samples will be collected just below the water surface (depth <1m) from the sampling site

Appendix E: **Year 2012 Onondaga Lake Sampling Program**

Added footnote to clarify that the Fecal Coliform sample will be collected just below the water surface (depth <1m).

Appendix F: **Year 2012 Onondaga Lake Winter Sampling Program**

Added footnote to clarify that the Fecal Coliform sample will be collected just below the water surface (depth <1m).

Appendix G: **Year 2012 Onondaga Lake Special Weekly Sampling Program**

Added footnote to clarify that the Fecal Coliform sample will be collected just below the water surface (depth <1m).

Appendix H: **Year 2012 Fall Turnover Sampling Program**

No change from previous year.

Appendix I: **Year 2012 Seneca/Oneida/Oswego River Sampling Program**

Now that the river model is complete, Anchor QEA recommends (see attached memorandum dated February 8, 2012), that river sampling be continued, but with a reduction in the frequency and number of locations. The same suite of parameters will be measured as in previous years. This Three Rivers monitoring program has now been incorporated as part of the annual AMP.

Appendix J: **Year 2012 Seneca River Diurnal Monitoring (Automated Sonde)**

Anchor QEA recommends (see attached memorandum dated February 8, 2012), deploying YSI sondes only at Buoy 316.

APPENDIX M (Continued)
Summary of Proposed 2012 AMP Modifications

BIOLOGICAL SAMPLING PROGRAMS

Appendix K: Year 2012 Onondaga Lake Fish Community Sampling Program

1. Removed pelagic larval trawls from sampling program, see attached memorandum from Anchor QEA, dated February 1, 2012.
2. To replace the larval fish sampling component of the AMP, larval fish seines have been reinstated. Based on the reproductive timing of the fish species found within Onondaga Lake two sampling events will be completed, one in mid-May to target early spawning species such as yellow perch and white suckers and a second in early July to target later spawning species such as largemouth bass and bluegill.
3. One additional sampling location within each stratum with little or no macrophyte coverage will be sampled to supplement the current program providing comparisons between fish sampling success. The juvenile seine sampling program will also begin two weeks later in mid July.
4. Littoral zone juvenile boat electrofishing was added to the 2012 sampling program after discussions with Dave Lemon from the NYSDEC at the 2011 OLTAC meeting, concerning the proliferation of macrophytes in the seine locations and the possible impacts to the sample integrity. One boat electrofishing event for juvenile fish is scheduled late July and will occur at night time. Five randomly selected preexisting adult fish electrofishing transects will be sampled, one for each stratum. It is anticipated that this sampling methodology will provide a more thorough assessment of the juvenile fish community.
5. The adult pelagic fish community is currently under sampled with one 2-hour gillnet set during the day within each stratum. The net is set parallel to shore at the 5 meter water depth, which does not allow for a full assessment of the pelagic fish community. Because fish are more active from dusk to dawn, the current program will be modified by setting gillnets perpendicular to shore in approximately 3 to 10 meters water depth (Littoral Profundal Zone). Sampling will occur at nighttime and be expanded to include 2 gillnet sets per stratum each net will be fished for 2 hours.

Appendix L: Year 2012 Onondaga Lake Macrophyte Assessment Program

Modified the Onondaga Lake Aerial Photograph timing to late July from August to increase the likelihood that the flight occurs during the peak growing season for the macrophyte.

Year 2012 Tributary Macroinvertebrate Sampling and Habitat Assessment Program

Deleted from the Year 2012 AMP (reference attached memorandum from Dr. Elizabeth Moran, EcoLogic, dated February 14, 2012). As summarized in the memo, the status and trends of the macroinvertebrate community has largely unchanged since the AMP assessment in 2000. The existing data set (2000-2010) provides a detailed assessment of current conditions, and an additional year of measurement prior to the improvements will not improve the power/efficiency of the ability to detect change.

Note: East Flume location to be revised and Harbor Brook at Bellevue Avenue to be added.

Onondaga County Dept. of Water Environment Protection

Figure 1-2
AMP Routine Monitoring Locations

Existing AMP Sampling - Type

- Onondaga Lake-Nearshore (10)
- Onondaga Lake-North Deep (1)
- Onondaga Lake-South Deep (1)
- Seneca River Sampling Location(1)
- Tributary Sampling Program(9)
- USGS Gauge (6)
- Waterways
- Buried Streams
- Waterbodies
- City/Town Boundary

Label	Sample Type	Sample Location
1	Tributary Sampling Program	Metro Effluent
2	Tributary Sampling Program	Metro Bypass
4	Onondaga Lake-South Deep	Onondaga Lake South Deep
5	Onondaga Lake-North Deep	Onondaga Lake North Deep
6	Onondaga Lake-Nearshore	Ninemile Creek
7	Onondaga Lake-Nearshore	Harbor Brook
8	Onondaga Lake-Nearshore	Metro
9	Onondaga Lake-Nearshore	Ley Creek
10	Onondaga Lake-Nearshore	Eastside
11	Onondaga Lake-Nearshore	Willow Bay
12	Onondaga Lake-Nearshore	Maple Bay
13	Onondaga Lake-Nearshore	Bloody Brook
14	Onondaga Lake-Nearshore	Wastebeds
15	Onondaga Lake-Nearshore	Onondaga Creek
16	Seneca River Sampling Location	Buoy 316
17	USGS Gauge	Dorwin Ave
20	USGS Gauge	Spencer St
21	Tributary Sampling Program	Kirkpatrick St
23	Tributary Sampling Program	East Flume
24	USGS Gauge	Route 48
25	USGS Gauge	Harbor Brook at Hiawatha B
26	USGS Gauge	Velasko Rd
28	Tributary Sampling Program	Bloody Brook Parkway
29	Tributary Sampling Program	Onondaga Lake Outlet
30	USGS Gauge	Ley Creek at Park Street
31	Tributary Sampling Program	Sawmill Creek
32	Tributary Sampling Program	Tributary 5A
33	Tributary Sampling Program	Onondaga Creek at Route 20

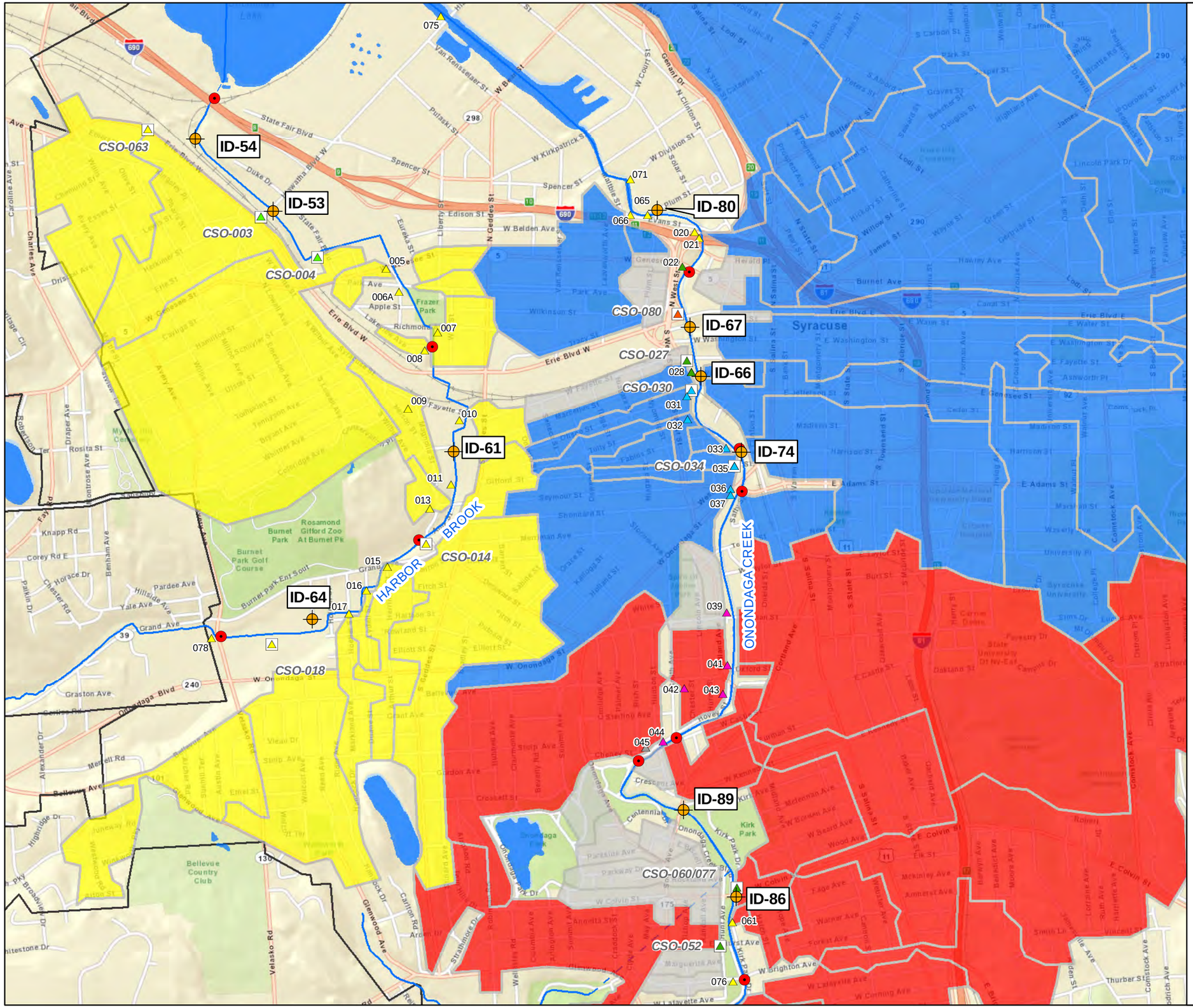
0 6,500 13,000
Feet

Data Sources
Monitoring Locations: OCDWEP; Aug 2010
Surface Water Classification: NYSDEC, 2007
CSO Service Areas: OCDWEP

Map prepared 11.18.10 | CMF

Onondaga County Dept. of Water Environment Protection

Figure 7-1
AMP Modifications Workplan: Representative CSO Outfall Flow Monitoring (Quantity) & Instream Water Quality Sampling Locations (Quality)



- CSO Outfall Flow Monitoring (CSO-###)
- Tributary Sampling Program (ID-##)

CSO Outfalls (###)

- Active
- Clinton Storage
- EBSS
- Facility Planning
- Harbor Brook Storage
- Midland RTF
- Separate

- Waterways
- Buried Streams
- Roadways
- City/Town Boundary

CSO Sewersheds

- Clinton/Lower MIS
- Harbor Brook
- Hiawatha RTF
- Midland RTF
- Separate

0 1,700 3,400

Feet

N W E S

Data Sources
Monitoring Locations: OCDWEP; Aug 2010
Surface Water Classification: NYSDEC, 2007
CSO Service Areas: OCDWEP

CH2MHILL

Map prepared 12.22.11 | CMF

ANCHOR QEA

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MEMORANDUM

To:	Elizabeth C. Moran, Ph.D., EcoLogic	**Date:**	February 8, 2012
From:	Wen Ku, Anchor QEA, LLC Kevin T. Russell, Anchor QEA, LLC	**Project:**	090582-01.06
Cc:	Margaret H. Murphy, Ph.D., Anchor QEA, LLC		
Re:	Recommendations for the Ambient Monitoring Program for the Three Rivers System		

At the request of the Onondaga County Department of Water Environment Protection (OCDWEP), Anchor QEA, LLC (Anchor QEA) has developed this memorandum to provide recommendations on sampling of the Three Rivers System (i.e., Seneca River, Oneida River, and Oswego River) as part of the Ambient Monitoring Program (AMP).

BACKGROUND

River sampling began in 1994 and has been included in the AMP since 1998 due in part to requirements set forth in the Amended Consent Judgment (ACJ), but also to support the development of the Three Rivers Water Quality Model (TRWQM). The objectives of the river sampling efforts were as follows:

- Evaluate the spatial and temporal variations of dissolved oxygen (DO), nutrients (e.g., nitrogen, phosphorus, and chlorophyll-*a*), and in situ parameters (e.g., temperature, turbidity, and salinity) between Cross Lake and Three Rivers Junction
- Monitor the river during critical conditions of warm weather and low river flow to assess compliance with New York State ambient water quality standards
- Quantify the effects of zebra mussels on water quality
- Provide data to assist with the development and calibration of the TRWQM

There are three components in the river monitoring: manual water quality sampling, automated data collection sonde deployments, and zebra mussel surveys. The manual water quality sampling has been conducted three times a year between July and September when the river flows are low. For each survey, grab samples are taken at the top and bottom waters[1] for 18 buoy locations: 11 locations in Seneca River, three locations in the Onondaga Lake outlet, three locations in Oneida River, and one location in Oswego River. One extra grab sample is collected at mid-depth for Buoy 269 in Seneca River. A total of 22 parameters are measured for the Three Rivers water quality samples. In addition, 5-day Biological Oxygen Demand (BOD5) is measured as a composite of top and bottom water samples at Buoy 316.

Three YSI sondes have been deployed at Buoy 409, Buoy 316, and the Onondaga Lake outlet since 2004. The YSI sonde at the Lake outlet was moved to Buoy 236 starting in 2008. Fifteen-minute in situ data are collected from top and bottom waters for DO, temperature, specific conductivity, salinity, turbidity, pH, and total chlorophyll[2] at each sonde location.

A full zebra mussel survey was conducted in 1999 to assess the zebra mussel population in 19 habitat zones along Seneca River to assist the development of the TRWQM and also provide a baseline to evaluate the change in zebra mussel population over time. Additional mussel data were collected in spring, summer, and fall 2004. As part of routine monitoring efforts, starting in 2005, focused zebra mussel surveys have been conducted in four habitat zones in Seneca River each fall to continue monitoring for potential changes in mussel size/age distributions and population density in the river.

In 2005, development and calibration of the TRWQM was completed, including a peer review. In 2011, in conjunction with the Onondaga Lake Water Quality Model (OLWQM), the TRWQM was validated and peer reviewed. The validated TRWQM can now serve as a management tool for OCDWEP to aid in decision making of potential diversion of the Syracuse Metropolitan Waste Water Treatment Plant (Metro). Because there are four

[1] Top and bottom water samples are collected at 1 meter below the water surface and 1 meter above the river sediments, respectively.
[2] In situ total chlorophyll only collected at Buoy 409.

wastewater treatment plants (WWTPs) with effluent discharging to the Three Rivers System (i.e., Baldwinsville-Seneca Knolls [BSK], Wetzel Road, Anheuser-Busch, and Oak Orchard), the TRWQM was also developed to assist in future evaluation of receiving water quality issues associated with these discharges, as well as for development of Total Maximum Daily Loads (TMDLs) for the system.

RECOMMENDATIONS

The river monitoring data collected over the past 18 years have successfully established baseline conditions for the system and confirmed our understating of water quality dynamics. In general, the river exhibits a consistent water quality pattern from one year to another; observed differences can almost all be explained by river flow conditions, time of year when the sampling was conducted, inflow from Onondaga Lake, and to a lesser extent the variation in the zebra mussel activity. Details can be found in each year's annual AMP report. The data also supported the TRWQM development, which is now complete. Although the objectives set forth at the beginning of the AMP river sampling have been met, Anchor QEA recommends that river sampling be continued, but with a reduction in the frequency and number of locations. A scaled-back monitoring program would require fewer resources from OCDWEP, while still providing valuable information, including the following:

- Assessment of compliance with New York State ambient water quality standards
- Means of identifying potential changes in water quality conditions
- Long-term river monitoring record
- Evaluation of WWTP impacts on receiving water quality

Anchor QEA's recommendations for the AMP river sampling program in the future are provided below.

Water Quality Sampling

It is our recommendation to continue river monitoring by conducting one event each year some time during the months of July through September under low flow conditions. We recommend collection of water quality samples from the top and bottom waters at the following six monitoring locations (Figure 1):

- Buoy 412: This sampling location is immediately downstream of Cross Lake and upstream of the State Ditch Cut, where water quality is impacted by zebra mussel activity. Data from this location represent a "background" water quality condition for the portion of Seneca River located within Onondaga County.
- Buoy 316: This sampling location is downstream of Baldwinsville Dam and upstream of the BSK WWTP. It is also located at the downstream end of the area of relatively high zebra mussel activity. Data from this location represent the overall water quality conditions in Seneca River upstream of Onondaga Lake.
- Buoy 269: This sampling location is downstream of the Onondaga Lake outlet. Low DO and elevated nitrogen and phosphorous were observed in the past as a result of a combination of inflowing lake water and the effects of the "deep hole." Data from this location provide a means of quantifying the impacts of Onondaga Lake water on Seneca River, and serve as an upstream condition to assess influences from the Wetzel Road and Anheuser-Busch WWTP discharges.
- Buoy 240: This sampling location is downstream of the Wetzel Road WWTP and upstream of Anheuser-Busch WWTP. Data from this location provide a means of evaluating the influence from Wetzel Road WWTP effluent, and assessing the impacts of Onondaga Lake water on Seneca River.
- Buoy 222: This sampling location is downstream of Anheuser-Busch WWTP and close to the Three Rivers Junction. Data from this location provide a means of evaluating the influence from Anheuser-Busch WWTP effluent, and also present the overall impact of Seneca River water on the Oswego River.
- Buoy-212: This sampling location is downstream of the Oak Orchard WWTP discharge in Oneida River. Data from this location provide a means of evaluating general water quality in the Oneida River, and a measure of its impact on the Oswego River.

We recommend analyzing each sample for the same suite of parameters[3] measured in previous years (Table 1).

[3] We recommend BOD5 to be measured on a composite of top and bottom water samples at Buoy 316, same as previous years.

Table 1
List of Parameters Measured in the Three Rivers System

Parameter	Description
TOC	Total Organic Carbon
TOC-F	Filtered Total Organic Carbon
TKN	Total Kjeldahl Nitrogen
TKN-F	Filtered Total Kjeldahl Nitrogen
NH3	Ammonia
NO2	Nitrite
NO3	Nitrate
ORGN	Organic Nitrogen
TP	Total Phosphorous
TDP	Total Dissolved Phosphorous
SRP	Soluble Reactive Phosphorous
Chlorophyll-*a*	Chlorophyll-*a*
Phaeophytin-*a*	Phaeophytin-*a*
TSS	Total Suspended Solids
TURB	Turbidity
SECCHI	Secchi Depth
CL	Chloride
COND	Specific Conductivity
Salinity	Salinity
PH	pH
Temp	Temperature
BOD5	5-day Biological Oxygen Demand
DO	Dissolved Oxygen

Automated Sonde Monitoring

Anchor QEA recommends deploying one YSI sonde at Buoy 316. The 15-minute data collected from this location would provide information on daily and seasonal variations of DO and other parameters, and would allow for monitoring of compliance with the ambient water quality standard. These data would provide continuity with the long-term sonde dataset that has been collected at this location since 2004.

Zebra Mussel Survey

Anchor QEA recommends that the annual zebra mussel surveys in Seneca River be discontinued. The baseline zebra mussel conditions and yearly variations in mussel

population have been established through more than 10 years of monitoring that has been conducted, and this information has been incorporated in the TRWQM. If a large variation in zebra mussel activity were to occur in the future, the impacts would be detected through the water quality sampling described above (i.e., changes in DO, nitrogen, phosphorous, and chlorophyll-*a* would be observed), and diagnostic simulations with the TRWQM could be conducted to evaluate the potential longer term impacts and help design future monitoring activities, if warranted.

N
W E
S

To Lock O-7 in Oswego

OSWEGO

OSWEGO R

OX CR

CAUGHDENOY DAM

ERIE CANAL
LOCK 23

ONEIDA R

Brewerton

ONEIDA L

Phoenix

PHOENIX WWTP

OSWEGO CANAL LOCK O-1
PHEONIX DAM

BREWERTON
WPCP

Buoy 212

Three Rivers

Buoy 222

OAK ORCHARD STP

ONEIDA

Buoy 240

ANHEUSER-BUSCH WWTP

Baldwinsville

CROSS L

SENECA R

LOCK 24 ERIE CANAL
BALDWINSVILLE DAM

Buoy 316

WETZEL ROAD WWTP

BALDWINSVILLE-
SENECA KNOLLS
WWTP

Buoy 269

SAWMILL CR

Buoy 412

State Ditch Cut

BLOODY BROOK

ONONDAGA L

SENECA R

Jacks Reef

LEY CR

SENECA

NINEMILE CR

JORDAN WPCP

TRIBUTARY 5A

METROPOLITAN SYRACUSE WWTP

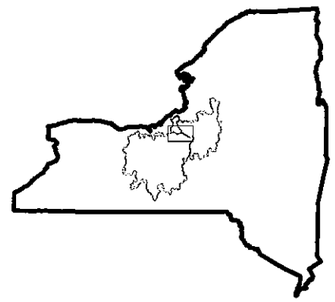
ONONDAGA CR

EAST FLUME

HARBOR BROOK

Syracuse

LOCATOR



SCALE

1 0.5 0 1 2 3 Miles

LEGEND

- AMP Sampling Locations
- YSI Sonde Locations
- Wastewater Treatment Plants
- Locks and Dams
- Cities / Towns
- USGS Gages
- Shoreline
- Watershed Boundaries

Figure 1. Recommended AMP Monitoring Locations in the Three Rivers System

ANCHOR QEA

090582-01 Feb 2012

\\HELIOS\D_Drive\Projects\Onondaga_County\Ambient_Monitoring_Program(090582-01)\DOCUMENTS\Reports\2010_AMP_chapter\River_Appendix\Fig1__study_area_withFigNum1.mxd ; IF, CP, PS

ANCHOR QEA

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MEMORANDUM

To:	Elizabeth C. Moran, Ph.D., EcoLogic	**Date:**	February 1, 2012
From:	Margaret H. Murphy, Ph.D., Anchor QEA, LLC	**Project:**	090582-01.06
Cc:	Files		
Re:	OCDWEP Ambient Monitoring Program		

During the Onondaga Lake Technical Advisory Committee (OLTAC) meeting on September 20, 2011, there were questions on potential sampling changes to the biological monitoring program, but there was insufficient time for discussion. I followed up with Chris Gandino at Onondaga County Department of Water Environment Protection (OCDWEP) and we discussed several opportunities for the program. Following are my recommendations for the 2012 program that would help better evaluate the changing fish community.

Littoral zone juvenile seining is conducted at five locations around the lake with just a single sweep from the shoreline. Due to the changing conditions and much more vegetation in the littoral zone, additional methods may be warranted. These would not replace the current approach but supplement it to assess if additional sampling is more successful. Some of these ideas and methods were discussed with Dave Lemon from the New York State Department of Environmental Conservation (NYSDEC) during the OLTAC meeting as well. My recommendations for the juvenile seining are as follows:

- Seine an additional location in each strata to obtain a high confidence sample
- Conduct a nighttime electrofishing survey
- Start sampling in mid-July

Because many of the seining locations have dense macrophyte coverage, the sample integrity may be compromised with the lead line not always maintaining contact with the substrate. Sampling one additional location within each strata that has little or no aquatic vegetation would likely result in a high confidence sample (i.e., the bottom of the seine maintained contact with the substrate); however, this does not provide an assessment of the juvenile fish community within the vegetation. Conducting a nighttime electroshocking survey for one

night in mid to late summer and targeting several transects around the lake would allow for a more thorough assessment of the juvenile fish community within the littoral zone and assess differences between vegetated and unvegetated sites. Settings on the electroshocker can be adjusted to target the smaller fish. Finally, the juvenile seine program could be shortened by starting sampling a bit later. In recent years, the first sampling event was conducted much earlier than in previous years; in 2004 it occurred from July 6 through July 9, approximately 2 weeks later than sampling in 2010 and 2011. In most years, this first sampling event yielded fewer juvenile fish than later events and often is dominated by adult banded killifish. A mid-July time frame, when many more fish are typically captured (excluding banded killifish), may be a more appropriate starting date while still collecting the juvenile data necessary for the program.

The adult pelagic community is currently undersampled with one 2-hour gillnet set during the day within each stratum. The net is set parallel to shore at the 5-meter water depth, which does not allow for a full assessment of the pelagic fish community. The initial intent of this modification was to target the smallmouth bass community, but the catch rates have been low. Because many fish are more active from dusk to dawn, it is recommended to replace the current program by setting gillnets perpendicular to shore in approximately 3 to 10 meters water depth during this period. Data collected during the College of Environmental Science and Forestry (ESF) sampling program indicates higher catch rates during nighttime sampling with walleye and smallmouth bass captured over the past several years. Nets should be set for a standardized period of time (not exceeding 2 hours) to reduce fish mortality. Two randomly placed net sets per stratum should be sufficient.

The final recommendation is for the larval trawl program. Because so few larval fish have been captured in the past during the trawling events (a total of 19 fish in 2011), the program could be modified in two ways: abandoning trawl sampling and reinstating the larval seining program. Littoral larval seining could be implemented with the juvenile seining program, following the same protocols as the program in 2000, 2002, and 2003. Two sampling events—one in early to mid-May to target early spawners and one in early July when the most fish and species were captured in the previous events—are recommended due to the amount of labor required to pick through these samples. Previous sampling indicated many more species and individual larval fish were captured with this method (between 3,000 and 6,000 fish in the early to mid-July event in 2000, 2002, and 2003).

EcoLogic Memorandum

TO: Janaki Suryadevara, Jeanne Powers, Tony Deskins and Chris Gandino
FROM: Liz Moran
RE: Recommendations for modifying the AMP tributary macroinvertebrate program
DATE: February 14, 2012

At DWEP request, we have examined the tributary macroinvertebrate program to assess whether changes in the program's design and frequency could be justified from a scientific and statistical perspective. Monitoring has occurred every two years, in even years, since completion of a baseline assessment in 1999. This is a relatively costly undertaking, in terms of both staff time and consultant fees. We understand that the DWEP is committed to ensuring that all elements of the AMP provide meaningful data in a cost-effective manner. To this end, we have asked aquatic biologist Kurt Jirka and limnological statistician (and OLTAC member) Dr. Bill Walker to review the program in detail and determine whether a request for reduced frequency of data collection and/or reduction in sampling locations could be justified. This effort has been completed; the technical memoranda from Mr. Jirka and Dr. Walker are appended. We recommend that the experts' findings be reflected in your 2012 AMP workplan submittal to NYSDEC.

Reduction in locations

The recommendation is to eliminate one site on Harbor Brook, the Route 690 site. This monitoring location is a non-riffle site sampled by jab sampling. Since the Hiawatha Blvd. and Route 690 sites are both close together and near the lake, they are somewhat redundant. The methods and analysis used at the Hiawatha Blvd. site are consistent with those used at the upstream Velasko Road site, so the Hiawatha Blvd. site is inherently more comparable to the Velasko Road site than is the Route 690 site. Given this, there is ample justification to eliminate the Route 690 site. We have also learned from Dr. Margaret Murphy of Anchor QEA of Honeywell's plans to reconfigure lower Harbor Brook to create spawning habitat for northern pike. This effort will completely and permanently alter the monitoring location.

Reduction in Frequency

The recommendation is to not include tributary macroinvertebrate sampling in the 2012 AMP workplan. The justification for this recommendation is found in the description of the status and trends of the macroinvertebrate community, which has been largely unchanged since the AMP began this detailed assessment in 2000, and is reinforced by Dr. Walker's statistical analysis. The AMP design has provided a good basis for categorizing each site, establishing baseline conditions, detecting trends, and characterizing spatial variations across sites within and among the three tributaries. Most sites exhibit relatively stable signals with respect to the index score and the pollution tolerance category. Dr. Walker has concluded that the standard errors associated with the metrics are sufficiently low to provide high statistical power for detecting changes relative to the overall range of values and to the classification increment. He reached this conclusion after examining subsets of the data (in effect, eliminating every

other year from the database). Barring unforeseen site disturbances, it is reasonable to expect that omitting the 2012 survey would not significantly compromise the objectives of the program for detecting changes in the BAP values in response to implementation of CSO and other nonpoint control measures over the next several years.

Relationship to Major CSO Projects

The major storage projects that will affect CSO discharges to lower Harbor Brook and Onondaga Creek are scheduled for completion by the end of 2013. Consequently, data collection in 2012 would serve only to extend the baseline monitoring. As documented in Bill Walker's analysis, addition of another sampling point in 2012 will not increase the power of the sampling program to detect change.

The next sampling event for tributary macroinvertebrates should occur after the major storage projects are completed. The macroinvertebrate community will take about a year to reach a new equilibrium to changed water quality conditions. If construction remains on schedule, the next round of tributary macroinvertebrate sampling is recommended for 2015.

Attachment 1
Evaluation by Kurt Jirka, EcoLogic LLC

(1) Are there certain metrics that are more robust for detecting change in the macroinvertebrate community?

The AMP tributary macroinvertebrate monitoring program follows protocols developed by the New York State Department of Environmental Conservation (NYSDEC) Stream Biomonitoring Unit and recommended for use in biological monitoring of surface waters in New York State (NYSDEC 2009). NYSDEC has been applying and refining these protocols since the 1980s. The current protocols provide specific methodologies for assessing the level of impact to water quality based on characteristics of aquatic macroinvertebrate communities from a variety of aquatic habitats. These include specific sample collection, sample processing, and data analysis procedures for the two types of habitats sampled as part of the AMP tributary macroinvertebrate monitoring program: wadeable riffle habitats and non-riffle habitats in slow, sandy streams. Following the NYSDEC protocols, a suite of metrics is calculated from data produced from samples collected from riffle habitats via kick sampling and a similar suite of metrics is calculated from data produced from samples collected from non-riffle habitats via jab sampling. The metrics calculated for each habitat type are listed below.

Riffle
Species richness
Ephemeroptera/Plecoptera/Trichoptera (EPT) richness
Hilsenhoff biotic index (HBI)
Percent model affinity (PMA)

Non-riffle
Species richness
EPT richness
HBI
Non-Chironomidae and Oligochaeta (NCO) richness

These individual metrics are calculated for each sample, converted to a common scale (0-10), and averaged. This average value is designated as the Biological Assessment Profile (BAP) score and provides an overall measure of the level of impact reflected in the aquatic macroinvertebrate community comprising that sample. The BAP scores for all replicate samples for a site are averaged to arrive at a mean BAP score for the site. The site is then assigned a level of impact (non-impacted, slightly impacted, moderately impacted, or severely impacted) based on its mean BAP score.

Use of all of the metrics within each suite is necessary to follow the NYSDEC protocols. Omitting one or more metrics would result in increasing the influence of individual metrics on the overall assessment of water quality at a site and make comparison the AMP program results with BAP scores from other waters invalid. NYSDEC has specifically designed or calibrated the suite of metrics used for each habitat type based collection and analysis of data from aquatic systems throughout New York over the past four decades (NYSDEC 2009).

Given this, I do not recommend omitting calculation of any of the metrics used to calculate BAP scores for the various habitats sampled. Each individual metric evaluates a different aspect of community composition, and using multiple metrics in combination provides a more robust interpretation of the quality of the overall macroinvertebrate community than any individual metric alone.

(2) **Given the historical data, are there important signals and trends?**

The following provides an overview of the trends observed in BAP scores for the 10 tributary monitoring sites from 2000-2010. Graphical presentation of these data is provided in Figure 1. A more detailed description and discussion of these results is provided in the 2010 tributary macroinvertebrate monitoring report.

Onondaga Creek

Sites on Onondaga Creek showed a wide range of conditions in 2010 with a trend toward increasing impacts downstream (Figure 1). This downstream trend has been evident since 2000, and is likely related to downstream increases in loading due first to changes from forested to agricultural land use in the upper watershed followed by a shift to urban land use downstream. Impacts to the macroinvertebrate community are generally slight upstream (Sites 1, 2 and 3) of urban areas and CSOs and moderate downstream (Site 4) of urban areas and CSOs. The Tully Farms Road site has shown little change since 2000, with BAP scores generally close to the impact demarcation for *non-* and *slightly impacted* (Figure 1). The BAP for this site in 2010 showed a slight decline from the 2008 value, resulting in an overall assessment of *slightly impacted*. Inspection of the data shows this minor decline to be due to reduced species and EPT richness. The BAP score for the Webster Road site has remained close to the demarcation for *slightly* and *moderately impacted* since 2000 and was classified as *moderately impacted* in 2010. The Dorwin Avenue site has consistently been assessed as slightly impacted and has shown the least variability of any of the Onondaga Creek sites. The Spencer Street site has consistently been the most impacted monitoring site on Onondaga Creek, but it has also shown the most improvement over time. It was assessed as *severely impacted* in 2000 but has shown a relatively consistent improvement since then and scored well into the *moderately impacted* category in 2010.

Ley Creek

Ley Creek tends to show the greatest degree of overall impact of the three Onondaga Lake tributaries monitored for macroinvertebrates. Sites in Ley Creek have been consistently assessed as *severely impacted* (Figure 1). With the exception of extremely low values in 2006, the BAP scores for the Townline Road site have been consistently right at the demarcation between *severely impacted* and *slightly impacted*. The 7th North Street sampling location has consistently been assessed as *severely impacted* throughout the duration of the monitoring program. Although data from 2008 showed some minor improvement at this station compared to previous years, the 2010 data showed a decline toward pre-2008 conditions. The Park Street location has typically been assessed as *severely impacted* but has shown slight improvement in recent years, with BAP scores trending slightly upward and into the *moderately impacted* category in 2010.

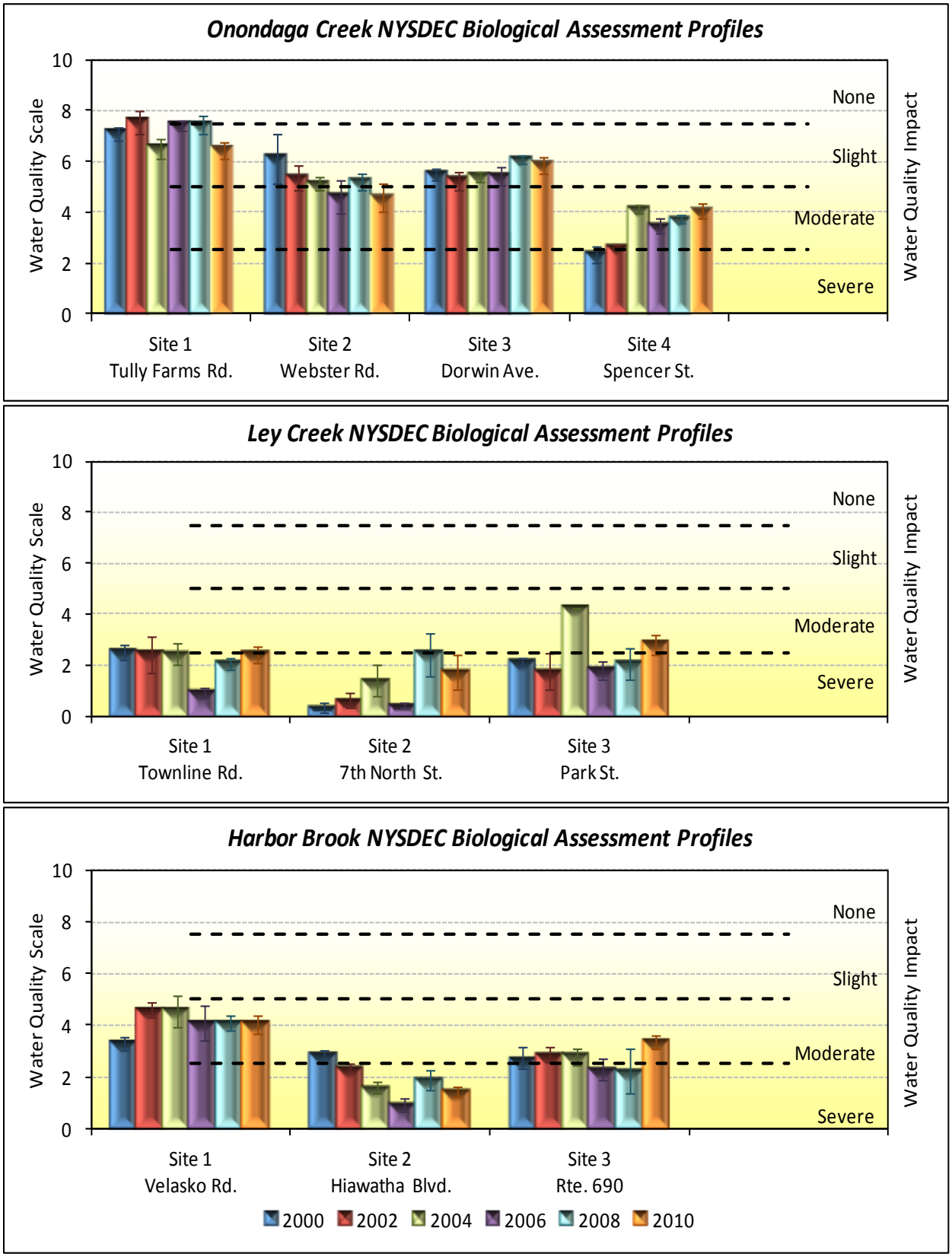

Figure 1. Biological Assessment Profile (BAP) scores for AMP tributary monitoring sites, 2000-2010. Error bars are standard errors.

Harbor Brook

Sites on Harbor Brook have consistently ranged from *moderately* to *severely impacted* based on BAP scores (Figure 1). The two sites downstream of the most urbanized areas and all CSOs have shown a greater degree of impact than the upstream reference site. The Velasko Road site has consistently been assessed as *moderately impacted* and has shown virtually no change in BAP score since 2006. The Hiawatha Blvd. sampling location is approximately two miles downstream of the Velasko Road site of which about one mile is composed of an underground culvert. The level of impact at the Hiawatha Blvd. site has shown a worsening trend since 2000 when it was assessed as *moderately impacted*. This station has been assessed as *severely impacted* since 2002, and BAP scores have shown a declining trend since that time. Prior to 2010, the level of impact at the Route 690 site had been relatively stable over the course of the monitoring program, remaining near the demarcation of *severely* and *moderately impacted*. In 2010, the BAP score improved considerably, placing this site in the middle of the *moderately impacted* range.

The 2000- 2010 data show no clear trend to improvement or degradation. This question is further addressed by Bill Walker, in his statistical framework review. Overall, the data collected can be considered as a robust baseline of pre- improvement conditions.

(3) Is there a technical justification for reducing the number of monitoring sites?

I considered the usefulness and necessity of each of the ten tributary macroinvertebrate sampling sites with regard to their contribution of data useful in detecting trends in water quality, their location within the watershed, and their location in relation to CSOs or other potential sources of impact. I am not aware of the details of how and why the different sites were selected at the start of the monitoring program. My opinions presented here assume the goal of the current analysis is to identify sites that could potentially be eliminated in the future without a significant reduction in the ability to detect changes in water quality within each of the three tributaries.

First, I think it is important to keep the farthest upstream site in each tributary because this site can serve as a measure of water quality in the stream prior to it entering areas currently showing the highest level of impact. It is important to have some baseline condition to which downstream sites can be compared. The Townline Road and Velasko Road sites on Ley Creek and Harbor Brook, respectively, are by no means unimpaired, but the data show they are in better condition than sites farther downstream.

Focusing on Onondaga Creek, the Spencer Street site is the most downstream, is located in the heart of the City, and is downstream of most CSOs, making it a useful site for assessing water quality before the stream enters the lake and for assessing changes to water quality that may occur due to improvements in CSOs and other actions. The Dorwin Avenue site is a useful site in that it is also a site of intensive water quality sampling, and it is located just upstream of the CSOs affecting this stream. It therefore provides a good measure of water quality just before CSOs and other municipal influences begin affecting stream water quality. The Webster Road site is the least useful of the sites on Onondaga Creek because it is located relatively high in the watershed, upstream of municipal and CSO impacts. This makes it somewhat redundant with both the Tully Farms Road site and the Dorwin Avenue site. The

Webster Road site has also shown more variability and somewhat inconsistent results when compared to the adjacent Tully Farms Road and Dorwin Avenue sites. The variability is likely due to the presence and periodic eruptions of the mud boils. The additional effort to include the Webster Road site in the AMP may help the County (and other interested stakeholders) understand and document these impacts. As previously stated, I believe it is important to retain the Townline Road site on Ley Creek as a measure of water quality as far upstream as possible. The 7th North Street site on Ley Creek is severely impacted, and the data for this site have shown relatively high variability. This site is located just downstream of a relatively large tributary (Beartrap Creek), which could explain some of the inconsistency in the data, and having a sampling site at this location could be useful in interpreting results at the downstream Park Street site. The Park Street site is the most downstream site on Ley Creek and is located immediately upstream of the lake. It is also downstream of the CSOs on Ley Creek, making it a useful site for evaluating changes to CSOs and other actions taken in the watershed upstream. Given all of this, I have no strong justification for eliminating any sites on Ley Creek.

I have previously stated that I think it is appropriate to keep the Velasko Road site on Harbor Brook. The remaining two sites on this stream are located near its downstream end and are only about one-half mile apart. The Hiawatha Blvd. site is upstream of the Route 690 site. The Hiawatha Blvd. site is a riffle site sampled by kick sampling, and the Route 690 site is a non-riffle site sampled by jab sampling. Results from the Hiawatha Blvd. site have shown more variability and have reflected generally poorer water quality conditions than those from the Route 690 site, despite these sites being close to one another and there being no readily identifiable source of impact between them. This difference in results may be attributable to the different sampling and analysis approaches used at these sites. It is advantageous to have a site very near the lake in order to have a measure of water quality immediately prior to the stream entering the lake. Since the Hiawatha Blvd. and Route 690 sites are both close together and near the lake, they are somewhat redundant and one could probably be eliminated without an appreciable loss of information. The methods and analysis used at the Hiawatha Blvd. site are consistent with those used at the upstream Velasko Road site, so the Hiawatha Blvd. site is inherently more comparable to the Velasko Road site than is the Route 690 site. Given this, there is ample justification to eliminate the Route 690 site.

We have also learned from Dr. Margaret Murphy of Anchor QEA of Honeywell's plans to reconfigure lower Harbor Brook to create spawning habitat for northern pike. This effort will eliminate the Route 690 sampling site.

Recommend eliminating the Harbor Brook tributary monitoring site at Route 690 for the reasons discussed above.

(4) Is there justification for modifying the sampling schedule based on the projected build-out of the gray and green infrastructure projects?

Table 3.1 in Section 3 of the 2010 AMP Annual Report provides a summary of CSO abatement actions through 2010. Figure 3.1 in this same section provides a map of CSOs as well. The major storage projects that will affect CSO discharges to lower Harbor Brook and Onondaga Creek are scheduled for

completion by the end of 2013. Consequently, data collection in 2012 would serve only to extend the baseline monitoring. As documented in Bill Walker's analysis, addition of another sampling point in 2012 will not increase the power of the sampling program to detect change.

The next sampling event for tributary macroinvertebrates should occur after the major storage projects are completed. The macroinvertebrate community will take about a year to reach a new equilibrium to changed water quality conditions. If construction remains on schedule, the next round of tributary macroinvertebrate sampling is recommended for 2015.

Literature Cited

NYSDEC. 2009. Standard Operating Procedure: Biological Monitoring of Surface Waters in New York State. New York State Department of Environmental Conservation, Division of Water. 159 pp.

Statistical Evaluation of Proposed Modifications to the AMP Sampling Schedule for Tributary Macroinvertebrates

Prepared for

EcoLogic, LLC

By

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February 10, 2012

The Onondaga Lake Ambient Monitoring Program (AMP) was designed to provide information supporting future decisions on wastewater and watershed management (Onondaga County, 1998). These decisions are based in part upon measured responses in the Lake, its tributaries, and Seneca River as specific point and non-point source control measures are implemented over the 2000-2020 period. Decisions will also rely upon comparisons of monitored conditions with water quality standards, indices of ecosystem health, and other management goals. Specific hypotheses have been formulated to track the progress of the program, guide data collection, and guide statistical analysis.

Previous reports (Walker, 1998; 1999; 2000a; 2002ab; 2007) describe a statistical framework (AMPSF) with the following functions:

- Identifying and quantifying sources of variability in the data;
- Evaluating precision of yearly summary statistics, expressed as relative standard
- errors, RSE = standard error / mean);
- Evaluating power for detecting long-term trends, expressed as likelihood of
- detecting hypothetical trends or step changes of specific magnitudes;
- Refining monitoring program designs;
- Developing methods for testing hypotheses regarding trends or compliance.

The framework uses a statistical model that expresses precision and power with a common set of numerical indices. The APSF reports supplement the statistical analyses and interpretations of each dataset in the AMP yearly monitoring reports. The analytical approach to support biological and limnological interpretation of the data varies with monitored component and metric.

The cumulative database for each water quality and biological metric provides a good basis for continued refinement of the program to increase cost-effectiveness. Review of the data analyses in the AMP reports suggests that that designs have provided a good basis for detecting trends and establishing baselines. Stable signals, high precision, and redundancy in some of the data suggest that spatial and/or temporal sampling intensity could be scaled back without compromising objectives. The statistical framework provides a basis for adjusting to the program to increase cost-effectiveness.

This report analyzes the cumulative database for tributary macroinvertebrate data collected at two year intervals between 2000 and 2010 (Figure 1). The AMP design calls for biennial sampling at 10 stations starting in 2000 (Figure 1). Four replicates are collected at each site. A variety of indices have been used over the years to express the organism counts in terms that reflect the health of the stream community. The previous AMPSF report (Walker, 2007) developed precision and power estimates for four indices (Species Richness, HBI Score, DEC Index Score, and % Oligocheates).

The Biological Assessment Profile (BAP) is computed from the four individual indices and is currently the primary metric for expressing organism counts in terms that reflect the health of the benthic community and sensitivity to ambient water quality. Ecologic (2012) provided summaries and interpretations of the cumulative database thru 2010 (Figure 2). Seven sampling events between 2000 and 2010 provide a good baseline for measuring changes in the as the CSO controls and other watershed management measures are implemented over the next several years.

This report evaluates the potential impacts of omitting the 2012 survey on the precision of the baseline and power for measuring future changes in the BAP score in response to management measures. The measurements are costly because counting the organisms is labor intensive and requires considerable expertise. Omitting the 2012 survey would allow reallocation of funds to other AMP efforts. If this adjustment can be made without significantly reducing the baseline precision, the overall cost-effectiveness of the program could be improved.

Simple inspection of the data (Figure 2) suggests that the monitoring program design has provided a good basis for categorizing each site, establishing baseline conditions, detecting trends, and characterizing spatial variations across sites within and among the three tributaries. Most sites exhibit relatively stable signals with respect to the index score and the pollution tolerance category.

The same data are re-plotted in Figure 3 expressed as follows:

- Means by site and sampling event. The standard errors are computed from an average of 4 replicates per site.

- Cumulative baseline by site and sampling event. The cumulative baseline is defined as the period-of-record mean at a given site. Baseline values are shown starting in 2004 (2000-2004 mean) and ending in 2010 (2000-2010 mean). Standard errors are computed from the distribution of the individual event means.

- 3-Year rolling baselines by site and sampling event. The first value for each site represents the 2000-2004 mean and the last represents 2006-2010 mean.

At most sites, the 2000-2004 data provided a solid baseline for measuring changes. Adding 2006, 2008, and 2010 data did not have a significant impact on the cumulative baseline mean or standard error. The standard errors are sufficiently low to provide high statistical power for detecting changes relative to the overall range of values and to the classification increment (~2.5 BAP units, Figure 2).

Based upon linear regression analysis, trends are indicated at 4 sites: Harbor-2 (-0.06 units/yr, $p < 0.06$), Ley-2 (+0.07 units/yr, $p < 0.08$), Onondaga-2 (-0.08 units/yr, $p < 0.01$), and Onondaga-5 (+0.06 units/yr, $p < 0.11$). The Ley-2 data are suspect because of substrate characteristics (Ecologic, 2012). Most of the changes at the other sites occurred after the first

two sampling events (2000-2002). Linear regression slopes have been used to adjust the cumulative baseline to 2010 conditions (Figure 4). Stable signals are also evident in the adjusted data.

Barring unforeseen site disturbances, it is reasonable to expect that omitting the 2012 survey would not significantly compromise the objectives of the program for detecting changes in the BAP values in response to implementation of CSO and other nonpoint control measures over the next several years. In the event of a major site disturbance, such as a toxic chemical spill or scouring event, it is hypothetically possible that the BAP baseline established in the previous decade could be dramatically lowered. This may call for an additional stream survey to re-establish a limited baseline, depending on the specific circumstances and best professional judgment.

It is likely that solid baselines have also been established for other AMP water quality and biological metrics. A similar analysis is recommended for future updates of the AMPSF. It would also provide a basis for enhancing the program to focus on metrics and locations currently considered to be most important for measuring status and restoration progress in the lake and tributaries.

References

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NYSDEC. "Standard Operating Procedure: Biological Monitoring of Surface Waters New York State", New York State Department of Environmental Conservation, Division of Water. 159 pp., 2009.

Walker, W.W., "A Statistical Framework for the Onondaga Lake Ambient Monitoring Program", prepared for Onondaga County, Department of Drainage & Sanitation, July 1998.

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Walker, W.W., "Update of Statistical Framework for the Onondaga Lake Monitoring Program", prepared for Onondaga Department of Water Environment Protection, November 2007.

Figure 1 Site Map and HBI Results for 2000-2010 Baseline (Ecologic, 2012)

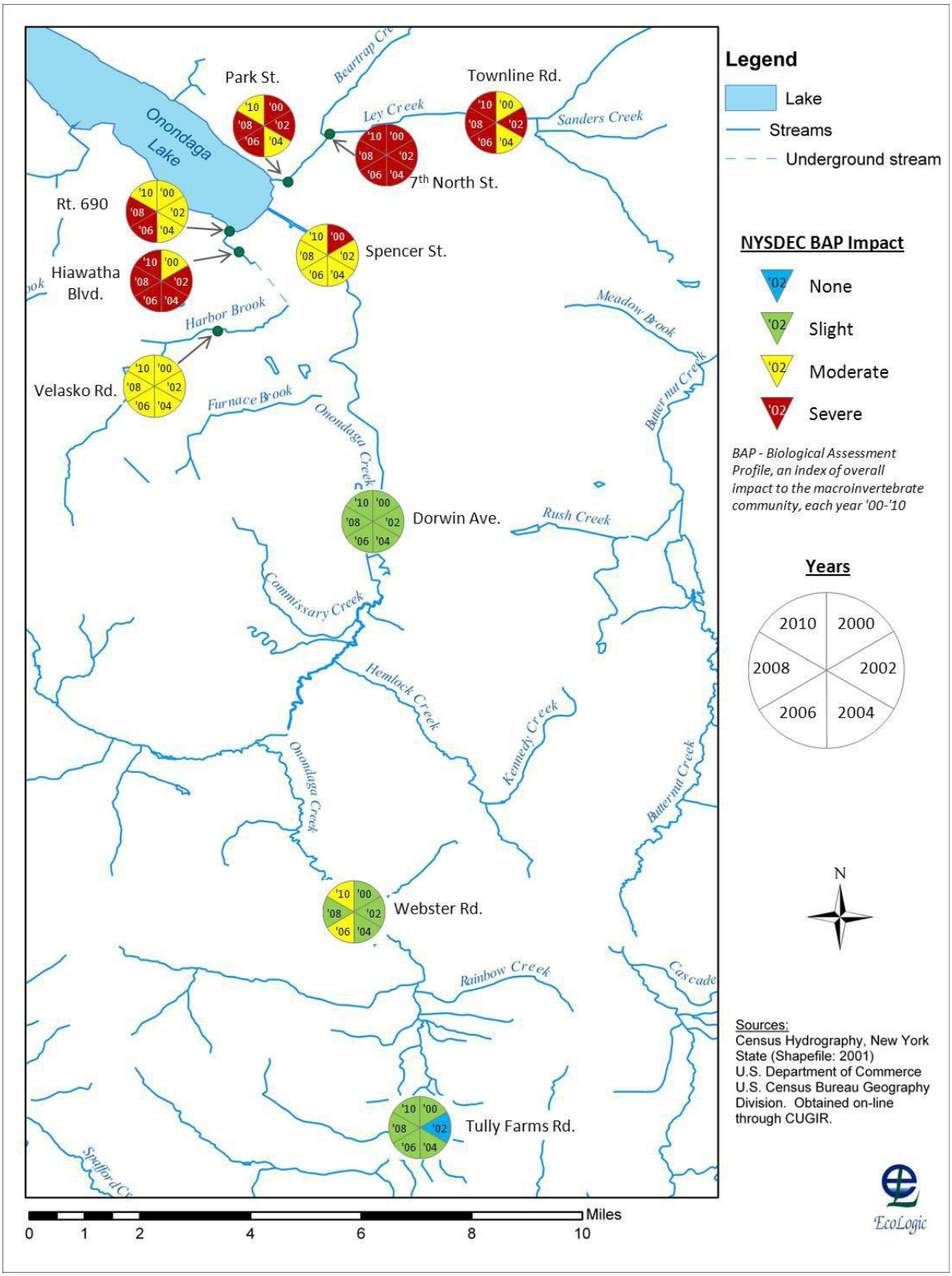


Figure 2 Biological Assessment Profiles, 2000-2010 (Ecologic, 2012)

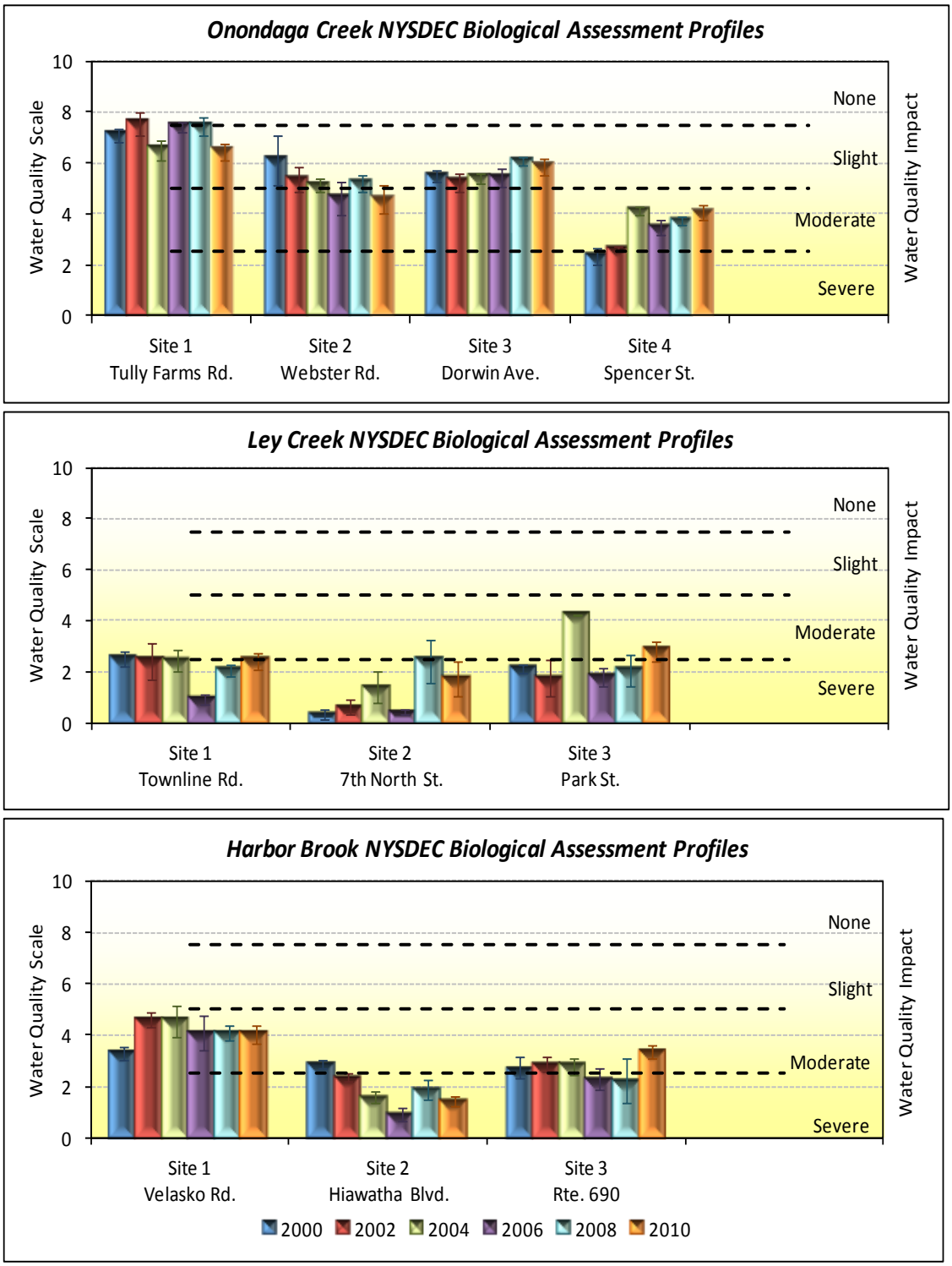
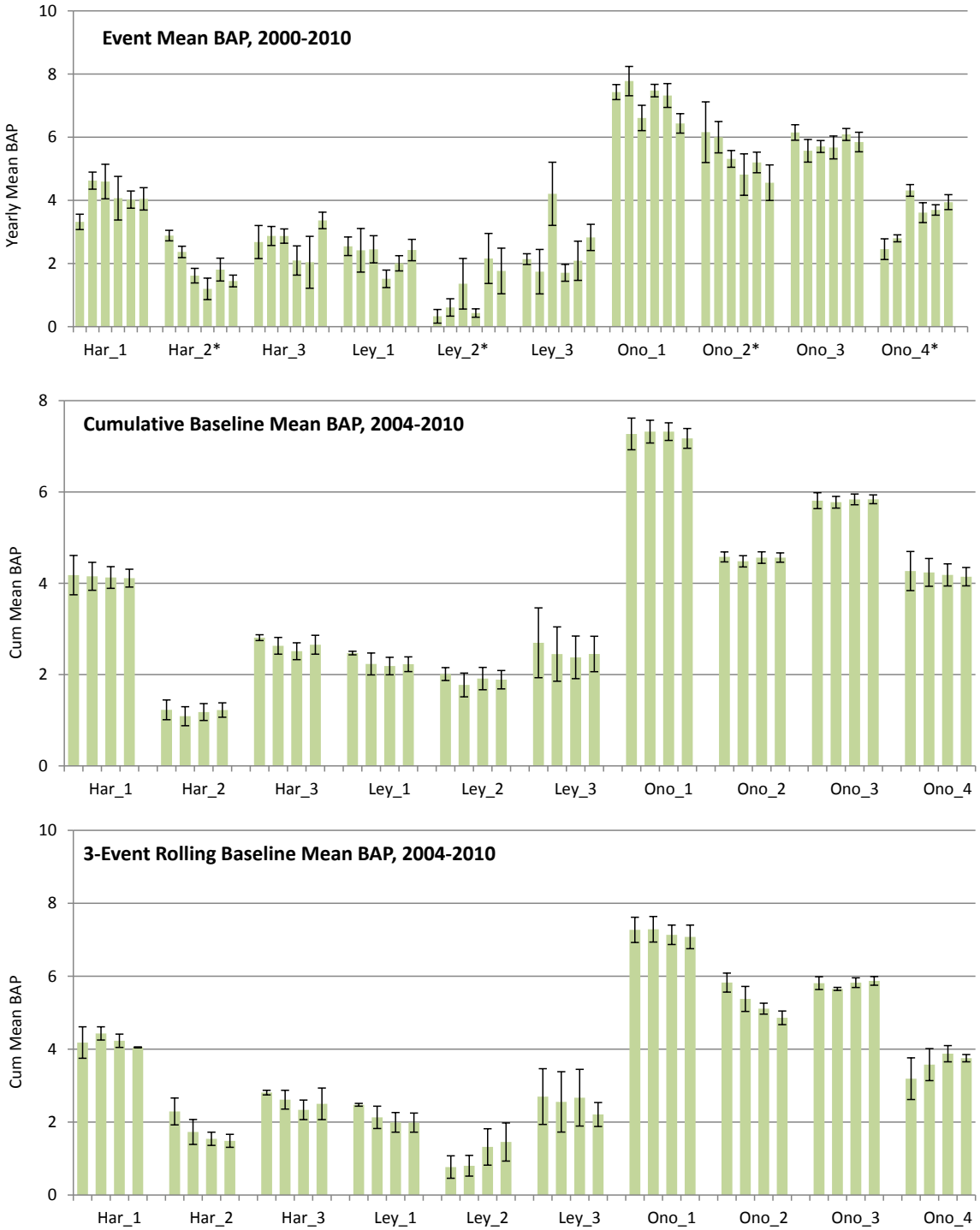
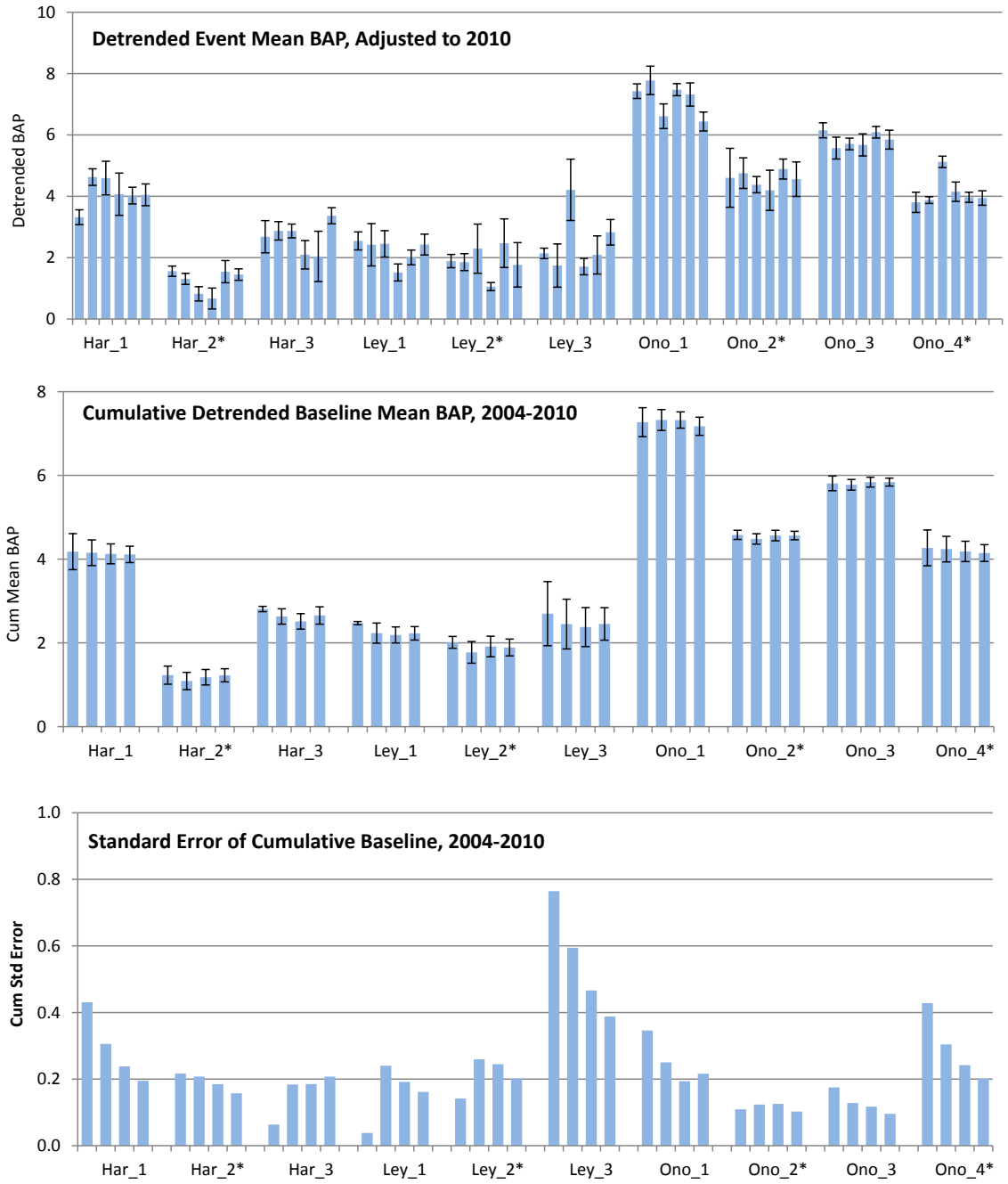


Figure 3 BAP Scores by Sampling Event and Site



* Significant linear trend, $p < 0.12$

Figure 4 Detrended BAP Scores by Sampling Event and Site



* significant yearly trend (p<.1) adjusted to 2010

ATTACHMENT 1

QUALITY ASSURANCE PROGRAM PLAN
FOR THE
2012 WATER QUALITY MONITORING PROGRAM

AMBIENT MONITORING PROGRAM

June 2012

Prepared for the NYSDEC

by:

Onondaga County
Department of Water Environment Protection

TABLE OF CONTENTS

I. PROGRAM DESCRIPTION

Onondaga Lake is an urban lake located in Onondaga County, New York. The lake has several natural tributaries and receives overflow from combined sewers in the City of Syracuse, treated effluent from the Metropolitan Syracuse Wastewater Treatment Plant (Metro) as well as non-point runoff from a mix of urban, residential, and agricultural areas.

Onondaga Lake is located immediately northwest of the City of Syracuse in Onondaga County, New York, USA (43° 06' 54" N, 76° 14' 34" W). The outlet of Onondaga Lake flows into the Seneca River, which joins with the Oswego River which eventually flows into Lake Ontario. The Onondaga Lake drainage basin encompasses approximately 700 km^2 and with exception of 2 km^2 in Cortland County lies almost entirely in Onondaga County. The tributary drainage basins include six natural sub-basins: Ninemile Creek, Harbor Brook, Onondaga Creek, Ley Creek, Bloody Brook, and Sawmill Creek. Although much of the lake watershed is agricultural, the lake itself is surrounded by urban and suburban development.

Since 1968, the water quality of Onondaga Lake and its tributaries have been monitored to meet the objectives of assessing: trophic status, compliance with New York State ambient water quality standards and guidance values, external loading of pollutants to Onondaga Lake through its tributaries, and trends in water quality in response to major pollutant abatement activities at Metro and the CSOs.

The annual lake monitoring program was originally implemented to comply with a special federal grant condition for the major upgrade of the Metro facility completed in the early 1970s. The scope of the annual monitoring program has expanded over the years in response to the enhanced understanding of the complex interactions between pollutant inputs and lake response. In 1998, the monitoring program was modified to provide specific data and information needed to assess the effectiveness of another round of improvements to the wastewater collection and treatment system. The Year 2012 Onondaga Lake Ambient Monitoring Program (AMP) is designed to determine whether planned controls on point and nonpoint source pollution loading will be sufficient to bring the lake, the lake tributaries, and a segment of the Seneca River into compliance with state and federal standards.

Trophic status of the lake will be assessed by monitoring Secchi disk transparency, major nutrient concentrations, chlorophyll-*a*, phytoplankton abundance and species composition, zooplankton species composition and abundance, the fish community, hypolimnetic dissolved oxygen, and accumulation of reduced species.

Compliance of the lake and tributary waters with the New York State ambient water quality standards will be evaluated. The lake is Class B and Class C; tributaries are Classes B, C, or C (T). Numerical standards exist for dissolved oxygen, ammonia, nitrite, and nitrate nitrogen, bacteria, pH, dissolved solids, and a large number of other organic and inorganic parameters. Narrative standards are in effect for several water quality parameters of Class B and C waters (including Onondaga Lake and its tributaries)."

As detailed in Section 703.2 of the New York State Environmental Conservation Law, parameters regulated by a narrative standard include:

Taste-, color-, and toxic and other deleterious substances	AA, A, B, C, D, SA, SB, SC, I, SD, A-Special, GA, GSA, GSB	None in amounts that will adversely affect the taste, color, or odor thereof, or impair the waters for their best usages.
Turbidity	AA, A, B, C, D, SA, SB, SC, I, SD	No increase that will cause a substantial visible contrast to natural conditions.
Suspended, colloidal and settleable solids	AA, A, B, C, D, SA, SB, SC, I, SD, A-Special	None from sewage, industrial wastes, or other wastes that will cause deposition or impair the waters for their best usages.
Oil and floating substances	AA, A, B, C, D, SA, SB, SC, I, SD, A-Special	No residue attributable to sewage, industrial wastes or other wastes, nor visible oil film nor globules of grease.
Phosphorus and nitrogen	AA, A, B, C, D, SA, SB, SC, I, SD, A-Special	None in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.
Thermal discharges	AA, A, B, C, D, SA, SB, SC, I, SD, A-Special	See Part 704 of the NYS ECL

External annual loadings (concentration and flow) to Onondaga Lake through its tributary streams of oxygen demanding materials, sediments, bacteria, metals, dissolved salts, plant nutrients are monitored. Monitoring is conducted throughout the year and the program is designed to capture high flow and storm events along with baseline conditions. These data are also used for general surveillance to evaluate compliance with the County's pretreatment program. The trends in Onondaga Lake and Tributary water quality over time and in response to major reductions in point source loadings will be assessed through statistical evaluations of the long-term data set developed for this system. An annual report summarizing the results of the current year's data acquisition program and the statistical analyses of trends in external loading and lake response is prepared each year. Data are archived in a database.

The annual Onondaga Lake Monitoring program was expanded in 1994 to include water quality sampling at key locations in the Seneca/Oneida/Oswego river system. The purpose of the County's river monitoring program is to define ambient water quality conditions in the River system, between Cross Lake and Three Rivers, determine compliance with the water quality standards, evaluate the assimilative capacity of the Seneca River, and identify the impacts of the Baldwinsville Seneca-Knolls WWTP, Wetzel Road WWTP, Oak Orchard WWTP and the Onondaga Lake Outlet on River water quality.

In January 1998, Onondaga County signed an Amended Consent Judgment (ACJ) committing to a phased 15-year program of upgrades and improvements to the County's wastewater collection and treatment system. The County's long-term monitoring program was evaluated and modified to ensure that the data collected would be adequate to evaluate the response of the lake, streams, and river to the planned improvements to the Combined Sewer Overflows (CSOs) and Metro. This process of evaluation and modification was a collaborative effort of Onondaga County, its technical advisors, New York State Department of Environmental Conservation (NYSDEC), the Environmental Protection Agency (EPA), and Atlantic States Legal Foundation (ASLF). Modifications were made to focus the monitoring program on a

series of hypotheses related to the effectiveness of the County's improvements to the wastewater collection and treatment system.

A revised monitoring program, known as the Ambient Monitoring Program (AMP) was initiated in August 1998. The effectiveness of the improvements to the County's wastewater system can be measured in terms of (1) compliance with water quality standards and guidance values, and (2) restoration of a balanced ecological community of plants and animals. A significant change in the annual monitoring program was the greatly expanded focus on the biology of the aquatic system including the status of the fish community, macroinvertebrates, rooted aquatic plants, algae, and zooplankton, in addition to tracking the physical and chemical variables.

The November 2009 fourth stipulation to the Amended Consent Judgment calls for modifications to the AMP designed to "enhance monitoring of the tributary water quality in the tributaries impacted by CSOs, to determine the effectiveness of the gray and green infrastructure projects….". These projects have been designed to mitigate the impacts of the Combined Sewer Overflows (CSOs). The AMP Modifications workplan, revised final dated December 2011, outlines an enhanced tributary event based sampling program for Onondaga Creek and Harbor Brook. Appendix D (2012 Enhanced Tributary Sampling Program) contains information to be implemented in 2012, as part of the AMP design modifications required by the ACJ.

II. TECHNICAL DESIGN

The monitoring program described above discusses the full matrix of water quality issues and parameters of concern to Onondaga County.

A. INTRODUCTION

The Onondaga County Department of Water Environment Protection (OCDWEP) has monitored the water quality of Onondaga Lake and its tributaries since 1970.

Refer to Appendix A Year 2012 Water Quality Program-Ambient Monitoring Program (non-event sampling schedule).

Water samples for analysis will be collected and analyzed according to EPA requirements for Water Planning and Management (40 CFR 136, 1991 or latest version) and EPA 600/4-82-029. Sampling and analysis will be consistent with New York State's Environmental Laboratory Approval Program (ELAP). The OCDWEP Environmental Laboratory is certified by New York State (ELAP #10191) and the National Environmental Laboratory Accreditation Conference (NELAC).

B. ONONDAGA LAKE

Onondaga Lake will be sampled from April 5 through December 13, 2012, according to the calendar included in Appendix A Year 2012 Ambient Monitoring Program (non-event sampling schedule). The parameters to be sampled and their schedules are also detailed.

Samples will be collected from the locations identified as "South Deep" and "North Deep" stations.

The exact sampling location will be at the mooring buoys deployed at the South and North Deep stations as listed below.

The coordinates of the monitoring stations are as follows:

South Deep:	43° 04.670' N	Latitude
	76° 11.880' W	Longitude
North Deep:	43° 05.930' N	Latitude
	76° 13.730' W	Longitude

Studies have shown that sampling from these basins will reflect the condition of the remainder of the lake.

In-situ data for pH, Dissolved Oxygen (DO), Temperature, Specific Conductance, and Oxidation-Reduction Potential (ORP) will be collected at half-meter intervals throughout the water column using either a YSI 600 or a YSI 6600 in-situ monitoring sonde. Calibration and instrument calibration drift checks will be conducted before and after each sampling event.

Samples will be collected using a submersible pump and a Wildco Horizontal Beta sampler, depending on the sample parameter. However, samples of bacteria will be collected in sterile containers. When pumping, sufficient time will be allowed in order to evacuate the pump lines of all previous samples. In addition, all sample containers will be rinsed with sample water, unless they are pre-preserved. Composite samples will be collected on a volumetric basis (i.e., the proportions of samples collected at the series of depths are composited equally using a Wildco Horizontal Beta sampler). Compositing will be accomplished using a sample-splitting churn. Samples will be thoroughly mixed and poured-off from the churn. All sampling equipment used on Onondaga Lake is dedicated for this purpose only.

Other field data to be collected include Secchi disk transparency and light availability. Light availability data are collected at 20-cm intervals from the water surface to a depth at which light is 1% of surface illumination, as noted during the sampling event, using a LiCor datalogger.

In addition to the above, OCDWEP partially funds the gauging stations on Onondaga Lake and its tributaries in conjunction with the United States Geological Survey. Flow data are used to calculate loading rates.

C. TRIBUTARIES

Onondaga Lake tributaries are sampled throughout the year, according to the calendar included as Appendix A Year 2012 Ambient Monitoring Program (non-event sampling schedule). The parameters to be sampled and their schedules are detailed in Appendix C Year 2012 Ambient Monitoring Program (Tributary Sampling Program).

In-situ data for pH, Dissolved Oxygen, Temperature, Specific Conductance, and Oxidation-Reduction Potential will be collected using a YSI sonde. Calibration and calibration drift checks will be conducted before and after each sampling event.

Tributary samples will be collected using the depth-integrated sampling technique from each location, except for at the Allied East Flume - Manhole #015, Sawmill Creek, Onondaga Lake Outlet, Harbor Brook at Hiawatha Boulevard, Harbor Brook at Bellevue Avenue, and Ley Creek monitoring sites. The Allied East Flume, Bloody Brook, and Sawmill Creek samples are taken as described in Attachment A, sections 8, 12, 13 and 14 respectively. A vertical Kemmerer Bottle sampler will be used at the Onondaga Lake Outlet, Harbor Brook at Hiawatha Boulevard, and Ley Creek monitoring sites. Samplers and sample containers are rinsed prior to dispensing sample water for analysis into the sample containers. Bacteria samples will be collected in sterile containers. All sampling equipment used on the tributaries is dedicated for this purpose. Stage gauge measurements will be taken to record the water surface elevation during each sampling event.

D. RIVER

River samples will be collected using grab techniques. During 2012, river sampling will be continued with a reduction in the frequency and number of locations. Although the same suite of parameters will be measured as in previous years, one (1) annual sampling event is recommended each year, sometime during the months of July through September at six (6) monitoring locations during low flow conditions. A Beta sampler will be utilized for sample collection. Samplers and sample containers are rinsed prior to dispensing sample water for analysis into the sample containers.

The station will be sampled for analytical parameters at 1-meter below the water surface and 1-meter above the channel bottom in order to evaluate density stratification effects on water quality.

Measurements taken during the sampling events will also include vertical profiles of the field parameters to define possible stratification. In-situ data for pH, Dissolved Oxygen, Temperature, Specific Conductance, and Oxidation-Reduction Potential will be collected at half-meter intervals throughout the water column using a YSI sonde. Calibration and calibration drift checks will be conducted before and after each sampling event. Samples will be collected for laboratory analysis in accordance with Appendix I of the Year 2012 Ambient Monitoring Program.

III. PROGRAM ORGANIZATION AND RESPONSIBILITY

The responsibilities and qualifications of the key Program Team members are discussed below. Members of this Team have the experience and capabilities to conduct all aspects of the program and to effectively interact and communicate with NYSDEC staff.

A. RESPONSIBILITIES

Ms. Jeanne C. Powers, Sanitary Engineer III

Ms. Powers has worked as a Sanitary Engineer for the County since 1987. She has supervised field technician and engineering staff in several process control engineering related projects. Ms. Powers will be responsible for overall monitoring program management, budgetary control, coordinating and overseeing the work of program sub-contractors. In addition, she has administered day-to-day activities of the County's annual Onondaga Lake monitoring program from 1995 to the present, including contract administration.

Mr. Jeff Noce, Laboratory Director

Mr. Noce will be responsible for the general administration of the analytical elements of the program. He will assist other members of the team on analytical issues and ensure compliance with proper analytical protocol. He will also ensure dissemination of analytical results in a timely and efficient manner to facilitate completion of schedule work tasks.

Mr. Noce has 30 years of experience in analytical chemistry with OCDWEP. For 22 of those years as a supervisor in charge of nutrient, organic and solids analysis with the Department. Since 2003, Mr. Noce has been involved in the administrative aspects of the lab, first as Senior Chemist and then as Laboratory Director.

Ms. Janaki Suryadevara, Sanitary Engineer II

Ms. Suryadevara has worked as a Sanitary Engineer for the County since 1993. Ms. Suryadevara coordinates the County's water quality programs and will be responsible for scheduling the Onondaga Lake, tributary and river sampling events and developing QA/QC procedures for sample collection. Ms. Suryadevara will be responsible for coordinating the review and preparation of the Annual Lake Ambient Monitoring Program Report, oversight and design of the field program, coordinating field and laboratory efforts, and for supervision of the technician staff performing field sampling.

Mr. Chris Gandino, Sanitary Engineer II

Mr. Gandino will coordinate the County's biological monitoring programs, which include monitoring of the fishery, macroinvertebrates, macrophytes, and zebra mussels on Onondaga Lake, its tributary streams, and the Three Rivers system. He is also responsible for biological program design and implementation.

Onondaga Lake Technical Advisory Committee (OLTAC):

In addition to the team referenced above, the County will utilize a Technical Advisory Group composed of experts in several disciplines to discuss results and implications of the annual program. Current members, their areas of technical expertise, affiliation, and addresses are as follows:

1. Dr. Charles T. Driscoll - Aquatic Chemistry
   Department of Civil and Environmental Engineering
   220 Hinds Hall
   Syracuse University
   Syracuse, NY 13244

2. Dr. Edward L. Mills - Aquatic Food Web; Zebra Mussel Dynamics
   Cornell University, Emeritus
   3167 Ray Road
   Canastota, N.Y. 13032

3. Dr. Elizabeth Moran - Limnology
   EcoLogic, LLC.
   Atwell Mill Annex, Suite S-2
   132 ½ Albany Street
   Cazenovia, N.Y. 13035

4. Dr. Lars Rudstam - Fisheries
   Cornell University Biological Field Station
   900 Shackelton Point Road
   Bridgeport, N.Y. 13030-9747

5. Dr. Kenton Stewart - Physical Limnology
   University of Buffalo, Emeritus
   199 Crown Royal Drive
   Williamsville, N.Y. 14221

6. Dr. William Walker, Jr. - Limnological and Statistical Modeling
   1127 Lowell Road
   Concord, MA 01742

B. SAMPLING SCHEDULE

2012 Non-Event Water Quality Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
April 2012			
April 3/Tuesday	Onondaga Lake	Double Lake Quarterly (w/Lake Special Weekly)	E & G
April 5/Thursday	Tributary	Tributary Bacteria	C
April 9/Monday	Onondaga Lake	Lake Special Weekly	G
April 10/Tuesday	Tributary	Tributary Biweekly	C
April 12/Thursday	Tributary	Tributary Bacteria	C
April 17/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
April 19/Thursday	Onondaga Lake	Lake Bacteria	G
April 23/Monday	Onondaga Lake	Lake Special Weekly	G
April 24/Tuesday	Tributary	Tributary Biweekly	C
April 26/Thursday	Tributary	Tributary Bacteria	C
May 2012			
May 1/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
May 3/Thursday	Tributary	Tributary Bacteria	C
May 7/Monday	Onondaga Lake	Lake Special Weekly	G
May 8/Tuesday	Tributary	Tributary Biweekly	C
May 10/Thursday	Tributary	Tributary Bacteria	C
May 15/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
May 17/Thursday	Tributary	Tributary Bacteria	C
May 21/Monday	Onondaga Lake	Lake Special Weekly	G
May 22/Tuesday	Tributary	Tributary Biweekly	C
May 24/Thursday	Onondaga Lake	Lake Bacteria	G
May 30/Wednesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
June 2012			
June 4/Monday	Onondaga Lake	Lake Special Weekly	G
June 5/Tuesday	Tributary	Tributary Quarterly Extended	C
June 7/Thursday	Tributary	Tributary Bacteria	C
June 12/Tuesday	Onondaga Lake	Double Lake Quarterly (w/Lake Special Weekly)	E & G
June 14/Thursday	Tributary	Tributary Bacteria	C
June 18/Monday	Onondaga Lake	Lake Special Weekly	G
June 19/Tuesday	Tributary	Tributary Biweekly	C
June 20/Wednesday	Onondaga Lake	Lake Bacteria	G

2012 Non-Event Water Quality (Continued)
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
June 25/Monday	Tributary	Tributary Bacteria	C
June 26/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
July 2012			
July 2/Monday	Onondaga Lake	Lake Special Weekly	G
July 5/Thursday	Tributary	Tributary Biweekly	C
July 9/Monday	Tributary	Tributary Bacteria	C
July 10/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	E & G
July 12/Thursday	River*	River Annual	I
July 16/Monday	Onondaga Lake	Lake Special Weekly	G
July 17/Tuesday	Tributary	Tributary Biweekly	C
July 19/Thursday	Tributary	Tributary Bacteria	C
July 23/Monday	Tributary	Tributary Bacteria	C
July 24/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
July 30/Monday	Onondaga Lake	Lake Special Weekly	G
July 31/Tuesday	Tributary	Tributary Biweekly	C
August 2012			
August 6/Monday	Tributary	Tributary Bacteria	C
August 7/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
August 13/Monday	Onondaga Lake	Lake Special Weekly	G
August 14/Tuesday	Tributary	Tributary Biweekly	C
August 16/Thursday	Tributary	Tributary Bacteria	C
August 21/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
August 23/Thursday	Tributary	Tributary Bacteria	C
August 27/Monday	Onondaga Lake	Lake Special Weekly	G
August 28/Tuesday	Tributary	Tributary Biweekly	C
August 29/Wednesday	Onondaga Lake	Lake Bacteria	G
September 2012			
September 5/Wednesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
September 6/Thursday	Tributary	Tributary Bacteria	C
September 10/Monday	Onondaga Lake	Lake Special Weekly	G
September 11/Tuesday	Tributary	Tributary Quarterly Extended	C
September 17/Monday	Tributary	Tributary Bacteria	C

2012 Non-Event Water Quality (Continued)
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
September 18/Tuesday	Onondaga Lake	Double Lake Quarterly (w/Lake Special Weekly)	E & G
September 20/Thursday	Onondaga Lake	Lake Bacteria	G
September 24/Monday	Onondaga Lake	Lake Special Weekly	G
September 25/Tuesday	Tributary	Tributary Biweekly	C
September 27/Thursday	Tributary	Tributary Bacteria	C
October 2012			
October 2/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
October 4/Thursday	Tributary	Tributary Bacteria	C
October 8/Monday	Onondaga Lake	Lake Special Weekly	G
October 9/Tuesday	Tributary	Tributary Biweekly	C
October 11/Thursday	Onondaga Lake	Lake Special Weekly	G
October 16/Tuesday	Onondaga Lake	Lake South Deep Biweekly (w/Lake Special Weekly)	E & G
October 18/Thursday	Tributary	Tributary Bacteria	C
October 22/Monday	Onondaga Lake	Lake Bacteria	G
October 23/Tuesday	Tributary	Tributary Biweekly	C
October 25/Thursday	Tributary	Tributary Bacteria	C
October 30/Tuesday	Onondaga Lake	Lake South Deep Biweekly	E
November 2012			
November 1/Thursday	Tributary	Tributary Bacteria	C
November 6/Tuesday	Tributary	Tributary Quarterly Extended	C
November 13/Tuesday	Onondaga Lake	Lake South Deep Biweekly	E
November 15/Thursday	Tributary	Tributary Bacteria	C
November 20/Tuesday	Tributary	Tributary Biweekly	C
November 26/Monday	Tributary	Tributary Bacteria	C
November 27/Tuesday	Onondaga Lake	Lake South Deep Biweekly	E
December 2012			
December 4/Tuesday	Tributary	Tributary Biweekly	C
December 6/Thursday	Tributary	Tributary Bacteria	C
December 11/Tuesday	Onondaga lake	Lake South Deep Biweekly	E
December 13/Thursday	Tributary	Tributary Bacteria	C
December 18/Tuesday	Tributary	Tributary Biweekly	C
December 20/Thursday	Tributary	Tributary Bacteria	C

2012 Non-Event Water Quality (Continued)
Sampling Schedule (April 2012 - March 2013)

DATE/DAY	PROGRAM	EVENT	APPENDIX
January 2013			
January 3/Thursday	Tributary	Tributary Biweekly	C
January 8/Tuesday	Onondaga Lake	Lake Winter**	F
January 16/Wednesday	Tributary	Tributary Biweekly	C
January 21/Monday	Tributary	Tributary Bacteria	C
January 24/Thursday	Tributary	Tributary Bacteria	C
January 29/Tuesday	Tributary	Tributary Biweekly	C
February 2013			
February 4/Monday	Tributary	Tributary Bacteria	C
February 5/Tuesday	Onondaga Lake	Lake Winter**	F
February 7/Thursday	Tributary	Tributary Bacteria	C
February 12/Tuesday	Tributary	Tributary Biweekly	C
February 21/Thursday	Tributary	Tributary Bacteria	C
February 26/Tuesday	Tributary	Tributary Biweekly	C
March 2013			
March 5/Tuesday	Onondaga Lake	Lake Winter**	F
March 7/Thursday	Tributary	Tributary Bacteria	C
March 12/Tuesday	Tributary	Tributary Biweekly	C
March 18/Monday	Tributary	Tributary Bacteria	C
March 21/Thursday	Tributary	Tributary Bacteria	C
March 26/Tuesday	Tributary	Tributary Quarterly Extended	C

*** One (1) River sampling event some time during the months of July through September to target low flows**
(at or less than 500cfs at Baldwinsville); sampling event date may be altered.

**** Lake Winter dates are tentative and will depend on weather conditions/extent of ice cover on lake.**

C. DATA VALIDATION

1. Results of laboratory analyses are submitted to the program team members within four weeks of collection.

2. Interim product: monthly data summaries (paper and diskette) will be compiled with codes flagging any limitations to data usability identified during the data validation process. Data validation will occur within four weeks of receipt of laboratory data.

D. DATA SUMMARIES

Data summaries: within three months of receipt of a complete set of validated data, a data summary will be compiled.

1. Calculate means, medians, and averages of lake data.

2. Compare measured lake concentration to ambient water quality standards.

3. Calculate means, medians of concentrations of tributary water quality data.

4. Compare measured tributary concentration to compliance with ambient water quality standards.

E. ANNUAL REPORT PREPARATION

The "draft" report will be compiled within five months of receipt of complete set of validated data.

Annual Results -

1. Tables of Year 2012 results (concentrations and loads in lake and tributaries).

2. Statistical comparisons of Year 2012 results to the long-term data set.

Trend Analysis -

3. The trend analysis for the tributary and lake data, which is an important step in tracking progress towards lake restoration, using the most recent ten years of data, will be completed. The standard methodology developed by Dr. William Walker, Jr. will be used to apply the seasonal Kendall test to the lake datasets.

Compliance -

4. The report will include a section on the water quality conditions and compliance with

the ambient water quality standards for the water body segment measured in the tributaries, Onondaga Lake, and the Seneca River. The report will include a summary analysis of the Metro discharge with the SPDES permit.

Loading -

5. External loading of materials to the lake will be calculated once USGS discharge records are received. In mid-2004, Dr. William Walker, Jr. refined his program used to estimate loading to Onondaga Lake. The improved estimation technique, called "Method 5", was developed in conjunction with the compilation of the OCDWEP long-term integrated water quality database and supporting software. The new technique was developed to support estimation of daily loads, to support development of monthly and seasonal lake mass balances, and to improve the accuracy and precision of the annual load estimates. Method 5 differs from AUTOFLUX Method 2 in several ways. Data are stratified by flow regime (similar to AUTOFLUX Method 2) and are also stratified by season using a multiple regression technique. Conditions during the unmonitored period are projected using a residual interpolation method that includes a flow derivative term.

Lower Trophic Levels -

6. Phytoplankton identification and enumeration will be completed and key findings of the lower trophic levels analysis will be evaluated and included as part of the integrated assessment of water quality conditions and ecosystem response.

7. Zooplankton density, species composition, size, and biomass will be determined and evaluated.

IV. FIELD SAMPLE COLLECTION & PRESERVATION

A. Field sampling techniques are consistent with those described in the following U.S. Government publications:

1. EPA 600/4-82-029 (September 1982)

2. 40 CFR 136 (March 1991)

3. EPA 821-R-95-034 (Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels).

B. Field QC consists of replicates and equipment rinsate blanks as specified in ELAP protocol.

C. Sample preservation requirements:

Due to the variety of possible sample types, only generalizations can be made. Preservatives are added in compliance with the analytical protocols (reference Attachment C – Analytical Methodologies). Analysis begins as soon as possible. A complete chain-of-custody record is maintained on each sample to provide a history of sample handling from collection to analysis.

Table 1 indicates the criteria for sample collection and preservation. All samples are aqueous.

TABLE 1 - SAMPLE COLLECTION AND PRESERVATION				
ANALYTE	**VOLUME**	**CONTAINER**	**PRESERVATION**	**MAXIMUM HOLDING TIME**
Biological				
Coli, Fecal	125 mL	P	Cool ≤6° C	8 Hrs.
E. Coli	125 mL	P	Cool ≤6° C	8 Hrs.
Chlorophyll *a*	2000 mL	P	Cool ≤6° C	After Filtration (frozen 28 days)
Phaeophytin *a*	2000 mL	P	Cool ≤6° C	
Phytoplankton	500 mL	P	Lugol's solution, Cool ≤6° C	
Zooplankton	1000 mL	P	Ethanol (70% by Volume), Cool ≤6° C	
Inorganic Tests				
Biochemical Oxygen Demand	1/2 Gallon	P	Cool ≤6° C	48 Hrs.
Cyanide, Total	1000 mL	P	Cool ≤6° C, NaOH to pH > 12, 0.6g ascorbic acid	14 Days
Kjeldahl and Organic Nitrogen	1000 mL	P	Cool ≤6° C, H_2SO_4 to pH < 2	28 Days
Ammonia-N	1000 mL	P	Cool ≤6° C, H_2SO_4 to pH < 2	28 Days
Total Phosphorus	1000 mL	P	Cool ≤6° C, H_2SO_4 to pH < 2	28 Days
Soluble Reactive Phosphorus	125 mL	P	Filter and Cool ≤6° C	48 Hrs.
Total Dissolved Phosphorus	125 mL	P	Filter and Cool ≤6° C, H_2SO_4 to pH < 2	28 days
All Metals				
Arsenic	1000 mL	P	HNO_3 to pH<2	6 Months
Cadmium	1000 mL	P	HNO_3 to pH<2	6 Months
Calcium	1000 mL	P	HNO_3 to pH<2	6 Months
Chromium (GFA)	1000 mL	P	HNO_3 to pH<2	6 Months
Copper	1000 mL	P	HNO_3 to pH<2	6 Months
Iron	1000 mL	P	HNO_3 to pH<2	6 Months
Lead (GFA)	1000 mL	P	HNO_3 to pH<2	6 Months
Magnesium	1000 mL	P	HNO_3 to pH<2	6 Months
Manganese	1000 mL	P	HNO_3 to pH<2	6 Months
Nickel	1000 mL	P	HNO_3 to pH<2	6 Months
Potassium	1000 mL	P	HNO_3 to pH<2	6 Months

TABLE 1 - SAMPLE COLLECTION AND PRESERVATION
(Continued)

ANALYTE	VOLUME	CONTAINER	PRESERVATION	MAXIMUM HOLDING TIME
Sodium	1000 mL	P	HNO_3 to pH<2	6 Months
Selenium	1000 mL	P	HNO_3 to pH<2	6 Months
Zinc	1000 mL	P	HNO_3 to pH<2	6 Months
Mercury	1000 mL	P	HNO_3 to pH<2	28 Days
Mercury – Low Level	250 mL	G	1% HCl to pH<2	28 Days
Organic Carbon, Total	1/2 Gallon	P	Analyze within 24 hours or Cool ≤6°C H_2SO_4 to pH < 2	28 Days
Organic Carbon, Filtered Total	1/2 Gallon	P	Analyze within 24 hours or Cool ≤6°C H_2SO_4 to pH < 2	28 Days
Inorganic Carbon, Total	1/2 Gallon	P	Cool ≤6°C	48 Hours
Phenols	1000 mL	G	Cool ≤6°C, H_2SO_4 to pH < 2	28 Days
Solids, Total	1/2 Gallon	P	Cool ≤6°C	7 Days
Solids, Total Suspended	1/2 Gallon	P	Cool ≤6°C	7 Days
Solids, Total Volatile	1/2 Gallon	P	Cool ≤6°C	7 Days
Solids, Total Suspended	1/2 Gallon	P	Cool ≤6°C	7 Days
Volatile	1/2 Gallon	P	Cool ≤6°C	7 Days
Solids, Total Dissolved	1/2 Gallon	P	Cool ≤6°C	7 Days
Silica - Dissolved	1/2 Gallon	P	Cool ≤6°C	28 Days
Sulfate	1/2 Gallon	P	Cool ≤6°C	28 Days
Sulfide	300 mL	G	Cool ≤6°C add zinc acetate plus sodium hydroxide to pH > 9	7 Days
Specials				
T-Alkalinity	500 mL	P	Cool ≤6°C (no air bubbles present)	14 Days

All samples are aqueous.
Containers: P = Plastic; G = Glass

V. FIELD SAMPLING PROCEDURES

A. ONONDAGA LAKE

1. Metals

i. Samples are collected as discrete grabs and composited volumetrically.

ii. The Wildco Beta sampler is used for sample collection. The sampler is rinsed in lake water prior to use in order to ensure cleanliness. Samples are mixed in a churn, which has also been rinsed in lake water. The sample bottle is rinsed with the composite sample prior to pouring-off from the churn into the one-liter plastic bottle, and filled to the shoulder.

iii. Parameters to be analyzed biweekly include:

Ca, Na, Mg, Mn, Fe

iv. Parameters to be analyzed quarterly include:

Cd, Cr, Cu, Ni, Pb, Zn, As, Se, K

v. Quarterly metals samples will be collected using modified trace metals sampling techniques for sample collection. This sampling methodology is described in EPA Method 1669 (Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria). The sample crew incorporates as much of this procedure as possible given the field conditions during the sampling event.

vi. All samples are preserved by adding Nitric Acid to pH < 2, and cooling to $\leq 6^{o}C$.

2. Mercury

i. Special samples for Total and Methyl Mercury will be collected at 3m and 18m depths in 500-ml Teflon bottles using the "clean hands-dirty hands" technique for sample collection. The Teflon® Dunker used shall be pre-cleaned and stored in accordance with the procedures contained in the OCDWEP SOP titled "Onondaga Lake Sampling Preparation", document number 00077. Use of the Teflon® Dunker will be in accordance with the procedures contained in the OCDWEP SOP titled "Onondaga Lake Sampling Methodology", document number 00085. The dirty hands sampling technician will be responsible for handling the Teflon® Dunker and pouring the sample. The clean hands sampling technician shall only touch the sample container and cap.

ii. A separate equipment rinseate blank for the Teflon Kemmerer Water Sampler will be collected for special low-level mercury analysis.

iii. A field blank will also be collected at the sampling site, prior to sample collection. This will consist of reagent water, supplied by the contract laboratory, processed through the sampling device.

iv. The analysis of samples for the determination of Total Mercury will be achieved by Cold Vapor Atomic Fluorescence (CVAFS) Spectrometry. The methodology is described by Fitzgerald and Gill (1979), Bloom and Crecelius (1983), Gill and Fitzgerald (1985); Bloom and Fitzgerald (1988), Method 1631 (USEPA, 1995).

3. Conventionals

i. "Conventional" discrete samples are collected at 0m, 6m, 12m, and 18m depths using a submersible pump.

ii. The pump is allowed to flow freely for a minimum of two minutes prior to filling sample bottles in order to evacuate the hoses of all previous samples. Sample bottles are also rinsed with lake water collected from the appropriate depth prior to filling.

iii. One gallon plastic or gallon sample bottles are filled to the shoulder and then cooled to ≤6^{o}C (no further preservation is required). Note: TOC & TOC-F are taken from NP bottle.

iv. "Conventional" parameters include:

TS, TSS, TDS, SiO_2-diss, TOC, TIC

v. A second "conventional" composite sample for both the upper mixed layer (UML) and the lower water layer (LWL) is collected as grabs and composited volumetrically. (See Page 23 - **Composite Sample collection**).

vi. The Wildco Beta sampler is used for sample collection. The sampler is rinsed in lake water prior to use in order to ensure cleanliness. Samples are mixed in a churn, which has also been rinsed in lake water. The sample bottle is rinsed with the composite sample prior to pouring-off from the churn into the half-gallon plastic sample bottles filled to the shoulder and then cooled to ≤6^{o} C (no further preservation is required).

vii. Composite Parameters include:

NO_2, NO_3, Cl, SO_4, Turbidity (UML only).

4. TKN, NH_3-N & TP

i. Samples are collected in one liter disposable plastic bottles from 0m, 3m, 6m, 9m, 12m, 15m, and 18m depths. Samples are collected via the submersible pump, in a manner consistent with that described above for "conventionals."

ii. Determine Cl_2 residual with a LaMotte Test Kit. If Cl_2 residual is measured, add

30% Sodium Thiosulfate drop-wise; 1 drop/1 ppm Cl_2, then add 1 drop excess.

iii. Preservation: Adjust pH < 2 with H_2SO_4, cool to ≤6 °C.

Example: Cl_2 measures 2.5 ppm - add 4 drops Sodium Thiosulfate - then H_2SO_4 to pH 1.5 - 2.0.

iv. Org-N results are calculated by subtracting the results of analyses of samples for Total Kjeldahl Nitrogen (TKN) and Ammonia Nitrogen (NH_3-N).

v. This sample will also be analyzed for Total Phosphorus (TP).

5. Soluble Reactive Phosphorus (SRP)

i. SRP samples are collected at 0m, 3m, 6m, 9m, 12m, 15m, 18m depths using a submersible pump.

ii. The pump is allowed to flow freely for a minimum of two minutes prior to filling sample bottles in order to evacuate the hoses of all previous samples. Sample bottles are also rinsed with lake water at the appropriate depth prior to filling.

iii. The sample will be filtered on site.

iv. Collect sample in a new disposable container.

v. Place a previously washed 0.45-micron filter into filter apparatus.

vi. Filter sample into the SRP container (250-ml plastic disposable) leaving a small airspace.

vii. Discard filter and rinse apparatus.

NOTE: When sample turbidity prevents using one filter to fill container; remove clogged filter, replace with another washed filter and continue filtration. Under extreme conditions of algal density (i.e., when filter clogs yielding less than 20 ml filtrate) sample may be pre-filtered using a washed glass-microfiber filter, and filtered into a clean container before final filtration with a 0.45 micron filter.

viii. The 250-ml plastic disposable sample bottles are then cooled to ≤6^{o}C (no further preservation is required).

6. Total Dissolved Phosphorus (TDP)

i. TDP samples are collected at 0m, 3m, 6m, 9m, 12m, 15m, 18m depths using a submersible pump.

ii. The pump is allowed to flow freely for a minimum of two minutes prior to filling sample bottles in order to evacuate the hoses of all previous samples. Sample bottles are also rinsed with lake water at the appropriate depth prior to filling.

iii. The sample will be filtered on site.

iv. Collect sample in new disposable container.

v. Place a previously washed 0.45-micron filter into filter apparatus.

vi. Filter sample into the TDP container (250-ml plastic disposable) leaving a small airspace.

vii. Discard filter and rinse apparatus.

NOTE: When sample turbidity prevents using one filter to fill container; remove clogged filter, replace with another washed filter and continue filtration. Under extreme conditions of algal density (i.e., when filter clogs yielding less than 20 ml filtrate), sample may be pre-filtered using a washed glass-microfiber filter, and filtered into a clean container before final filtration with a 0.45 micron filter.

viii. Preservation: Adjust pH < 2 with H_2SO_4.

ix. The 250-ml plastic disposable sample bottles are then cooled to ≤6^{o}C.

7. Chlorophyll-*a*

i. Chlorophyll-*a* samples are collected as depth-integrated tube samples through the standard depth of 0-3m of the water column year round. A 3/4" tygon tubing is used as the sample collection device.

ii. Samples are analyzed for chlorophyll-*a* and phaeophytin-*a* content.

Equipment Requirements: 3/4” Tygon Tube compositing apparatus
Chlorophyll Bottle
YSI Unit
Secchi disc

Bottle Requirements: (1) 2 liter Amber Bottle

iii. Lower the tube sampler to the 3m depth (Step 1). Place a stopper in the end of the tube (Step 2). Rinse the sample bottle with the sample water and pour out (Step 3). Repeat Steps 1 and 2 pull the tube from the water and pour the entire tube contents into the dedicated carboy. Repeat tube composites until sufficient volume is collected. Use only a full tube composite. Thoroughly mix sample prior to pouring off into container.

8. Zooplankton (Net Haul)

i. A net haul sample is obtained for zooplankton analysis.

Equipment Requirements: 0.5 Meter Wildco Beta Plankton Net with 80 um mesh 80 um sieve and Mechanical flowmeter

(RIGO Type 5571-A)

Bottle Requirements: (1) 1000-ml bottle
(2) 500 ml containers of 95% Ethanol/Alka-Seltzer

Collect samples as follows: 0-15 Meters (during each event)
0-6 Meters (during the thermally stratified period)

ii. Record the flowmeter dials, and place the net into the water to allow the sample bucket to fill with water. Allow the net to sink to a depth of 15 meters. Draw the net to the surface at a rate of 0.5 meter per second or less and record the final flowmeter dials. Carefully wash all the residual sample clinging to the net into the quick disconnect bucket. Filter as much water as possible. Pour the entire sample into the 80 um sieve and filter further until you have a slurry of sample. Pour the entire sample into the 1000-ml plastic jar and rinse any residual into the jar with wash bottle. Place a quarter tablet of Alka-Seltzer into the jar and wait for zooplankton movement to stop. Add 70% by volume of 95% reagent grade non-denatured ethanol. (More ethanol is better.) Example: 150-ml sample requires 350-ml ethanol. The same procedure should be followed for the sample to be collected at the 6 meter depth. Record the depth and flowmeter reading on the chain of custody form.

An "efficiency" reading will be recorded two times per year. This will entail performing a vertical tow with a netless ring and flowmeter at a known depth (Note: a netless ring will be kept in the boat at all times). This will also ensure that the depth being sampled is accurately being sampled by the net tow. Extreme caution should be used for samples collected during conditions of strong winds and high current, to minimize the error in the flowmeter readings and to prevent the net from floating to the surface.

Refer to the flowmeter Standard Operating Procedure (SOP) for flowmeter operation and calibration checks.

Note: The UML composite depth shall be determined by the temperature profile.

9. Phytoplankton

i. Phytoplankton samples are obtained by OCDWEP for analysis.

Equipment Requirements: (1) 500 ml Bottle
Dedicated Carboy

3/4" Tygon Tube
Secchi Disk
YSI Unit

Sampling Requirements: 0-3 meter Composite

ii. Record a Secchi Disk Reading.

iii. The composite sample is collected using the tube composite sampler from 0-3 meters in the water column.

iv. Preserve the samples with enough Lugols Solution to turn the sample iodine color (maroon in Color), approximately 5 to 7 mls. per 100-mls of sample.

10. Sulfide

i. Samples for analysis of sulfide ion content are collected from 12m, 15m, 18m depths only when anoxic conditions are present at these depths. The Wildco Beta sampler is used in order to ensure minimum mixing and air entrainment into the sample.

ii. Samples are poured from the Wildco Beta sampler into a rinsed Boston round clear glass jar (8-oz capacity) with a conical insert screw closure and low-density polyethylene poly-seal liner. Samples are poured down the side of the bottle to minimize turbulence. The bottle is filled to the top and then stopped, being careful not to enclose any air bubbles.

iii. Preservation: 2ml of Zn acetate is added to the bottle prior to the addition of sample. After sample addition, pH is adjusted to >9 with NaOH, container is topped off with sample to exclude air from the container, then cooled to ≤6^{o}C.

11. T-Alk

i. T-Alk samples are to be analyzed for Total Alkalinity as $CaCO_3$.

ii. T-Alk samples are collected as UML and LWL composites as described above for metals samples.

iii. T-Alk samples are poured-off from the churn into a rinsed 500-ml plastic bottle. The bottle is carefully stopped in order to exclude air and then cooled to ≤6^{o}C.

12. Fecal Coliform

i. A Fecal Coliform sample is collected at just below the water surface (depth <1m). Two sterile 125-ml plastic containers will be used.

The first container will be filled from the source (just below the water surface, depth <1m). The second container (disposable), pre-preserved with Sodium Thiosulfate crystals will be filled from the first container leaving a small airspace

to enable the sample to be shaken, and then cooled to ≤6°C. This is the sample to be delivered to the laboratory for analysis. Samples will be checked for residual chlorine using a LaMotte "DPD Chlorine Test Kit."
******Sample volumes for this parameter are crucial. Fill the bottle to just above the shoulder of the bottle leaving a small (approximately 2.5 cm) airspace to enable sample to be shaken. Do no allow the water to rise above the threads of the bottle. Samples will be analyzed for E. Coli and Fecal Coliform.***

Composite Sample collection:

The "UML" (Upper Mixed Layer) and "LWL" (Lower Water Layer) composite samples collected during the sampling events will be made by mixing samples from discrete depths according to the following field protocol:

(a) Late fall, winter, and early spring (October 1 - May 31) when the lake waters are not strongly stratified.

i. The default UML during this period of the year is 0, 3, 6-m.

ii. The default LWL during this period of the year is defined as 9, 12, 15, and 18-m.

(b) Summer stratification period (June 1 - September 30)

i. The UML composite shall always include samples collected at 0 and 3-m depths. Inclusion of water collected at 6 m in the composite shall be evaluated based on the temperature profiles measured during the sampling event to define the metalimnion which includes the thermocline (defined as the region where water temperature changes at least 1 degree C per meter).

ii. The composite sample of the LWL will typically include water collected at depths of 12, 15, and 18-m during this period. The inclusion of the 12-m depth in the composite of the lower waters should be reviewed during each sampling event. Because the 9-m depth is consistently in the metalimnion (or "transition zone") during this period, water from this depth will not be included in either composite sample.

- The Thermocline is the area at which the temperature gradient is steepest during the summer; usually this gradient must be at least 1°C per meter. A rule of thumb is that the Thermocline exhibits a temperature change of approximately 1°C per meter.

- Record the field YSI profile to define depths of UML, Transition zone, and LWL prior to composite sample collection.

- Once the Thermocline depth is determined, samples are collected as grabs from the discrete sample depths, 0m, 3m, 6m, 9m, 12m, 15m, and 18m depths using a Wildco Beta sampling device. The Thermocline depth should not be included with either composite sample (UML or LWL). The Wildco Beta sampler is rinsed in lake water prior to use in order to ensure cleanliness. Samples are mixed in a churn, which has also been rinsed in lake water. The sample bottle is rinsed with the composite sampler prior to

pouring-off from the churn into the sample bottle.

B. ONONDAGA LAKE TRIBUTARIES

The procedures used for the collection of samples from Onondaga Lake Tributaries are as follows:

1. All tributaries are sampled using the depth-integrated sampling technique, except the Allied East Flume – Manhole #015, Sawmill Creek, Harbor Brook at Bellevue and Bloody Brook monitoring stations. For streams with low velocity and depositional conditions, the vertical kemmerer water sampler is used (Ley Creek @ Park Street and Harbor Brook @ Hiawatha Boulevard sampling sites) – Refer to Attachment A - Tributary Field Sampling Procedures.

2. The Onondaga Lake Outlet is sampled at depths of 2 feet (0.6m) and 12 feet (3.7m) using the Kemmerer tube-sampling device from mid-channel. The sample for Fecal Coliform will be collected from mid-channel just below the water (depth <1m).

3. Most sample bottles are rinsed in sample water prior to filling, and preserved according to the instructions detailed above.

   Depending on the depth of water at each station, a suspended (deep water) or hand-held sampler (wadeable) may be used. The depth-integrated sampling device is designed to accumulate a water-sediment sample from a stream vertical at such a rate that the velocity in the nozzle is nearly identical with the stream velocity. Judgment will be used to select the number and location of transects. The sampling procedures for this monitoring program will follow the protocol outlined in the New York State DEC Division of Water Bureau of Watershed Assessment & Research Program Plan for Rotating Intensive Basin Studies Water Quality Section (1997-1998). Procedures by sampling site are outlined in Attachment A.

4. Mercury: Special samples for Mercury will be collected in 250 mL glass bottles using the "clean hands-dirty hands" technique as described in EPA Method 1669. The dirty hands sampling technician will be responsible for handling the sample container and pouring the sample. The clean hands sampling technician shall only touch the sample container and cap. A field blank will also be collected at the sampling site, prior to sample collection. This will consist of reagent water, supplied by the laboratory, and processed through the sampling device. Analysis will be conducted by OCDWEP Environmental Laboratory using USEPA Method 1631 E, 2001). Sampling equipment to be used for each tributary sampling site will be evaluated based on flow and access to the sites. Sampling options include using an Extended Pole with Stainless Steel Claim, Teflon Dunker and Hand Operated Pump with Pre-cleaned Tubing.

   NOTE: A dedicated dunker with only silicone end seals will be utilized for the trace metals quarterly sampling events (except Mercury).

C. ENHANCED TRIBUTARY SAMPLING

The procedures used for the collection of samples from Onondaga Lake Tributaries for the enhanced tributary sampling program is as follows:

1. All tributary samples will be collected as a modified depth integrated samples (three transect locations, three depths per location) using the Kemmerer water sampler until such time as the County demonstrates to NYSDEC satisfaction that the streams are well-mixed, laterally and with depth, during the high flow events.

2. Tributary samples will be collected in accordance with the following schedule:

   a) Samples will be collected at the following frequency: 0-1 hour, 2 hours, 4 hours, 6 hours and 8 hours.

3. Most sample bottles are rinsed in sample water prior to filling, and preserved according to the instructions detailed above in Table 1.

4. Fecal Coliform

   A Fecal Coliform sample is collected using two (2) sterile 125-ml plastic containers.

   The first container will be filled from the source. The second container (disposable), pre-preserved with Sodium Thiosulfate crystals will be filled from the first container leaving a small airspace to enable the sample to be shaken, and then cooled to ≤ 6^{o} C. This is the sample to be delivered to the laboratory for analysis. Samples will be checked for residual chlorine using a LaMotte "DPD Chlorine Test Kit."
   ******Sample volumes for this parameter are crucial. Fill the bottle to just above the shoulder of the bottle leaving a small (approximately 2.5 cm) airspace to enable sample to be shaken. Do not allow the water to rise above the threads of the bottle. Samples will be analyzed for Fecal Coliform.***

D. RIVER

1. The River samples are collected using a rinsed Wildco Beta sampler at 1 meter below the water surface and 1 meter above the sediment at each of the buoy stations.

2. All sample bottles are rinsed in sample water prior to filling, and preserved according to the instructions detailed above.

VI. QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

A. FIELD DUPLICATES

1. One field duplicate will be collected by using a separate sample collected for each parameter analyzed for Onondaga Lake, its tributaries, and the Seneca River. These are collected as separate samples taken from the same site at the same time. These provide a check on sampling equipment and precision techniques.

2. For Onondaga Lake, all field duplicates will be collected at the 6m sampling depth except for F. Coli (<1m), and Sulfide (15m).

   For the Onondaga Lake Tributaries, the sampling site for field duplicate sample collection is rotated for the different sampling events.

   For the Seneca River, two field duplicates will be collected at Buoy 316 during each sampling event (at the 1-meter below the water surface and 1-meter above the river sediment depths).

   Some field duplicates are identified only as quality control “blind” duplicate samples, which are unknown to laboratory personnel. These “blind” duplicate samples will be collected four times a year for the Onondaga Lake and Tributary sampling events.

B. EQUIPMENT RINSEATE BLANKS

1. Equipment rinseate blanks will be collected for the submersible pump and churn used on Onondaga Lake. Blank samples will be collected prior to collecting water quality samples from Onondaga Lake and analyzed for all parameters. This schedule complies with the minimum frequency of one field blank per 20 samples.

2. Equipment rinseate blanks will be collected for the churn and dunker used for the Onondaga Lake Tributaries and analyzed for all parameters. Blank samples will be collected prior to the collection of water quality samples from any of the tributaries. This schedule also complies with the minimum frequency of one field blank per 20 samples.

3. Equipment rinseate blanks will be collected for the stainless-steel pail used for the storm event monitoring program and analyzed for all parameters. Blank samples will be collected prior to the collection of water quality samples from any of the sample sites.

C. SAMPLE CONTAINERS:

1. The containers currently used for metals are certified as Class 3000 bottles washed under EPA protocol "C". In addition to receiving a Certificate of Analysis for each

bottle lot, all pre-cleaned sample containers will be checked by our laboratory by lot to insure that they are clean. This will be performed by delivering a minimum of (1) one, but as many as five (5), randomly selected containers from each lot received by the OCDWEP Lab. These containers will be empty with an appropriate label, Chain - Of-Custody form and copy of the sample container lot Certificate-Of-Analysis. The laboratory will fill the container with deionized water, preserve the sample with nitric acid and analyze it immediately for total cadmium, chromium, copper, nickel, lead, zinc, arsenic, mercury, manganese, and iron. All results must be less than or equal to the Minimum Reportable Limit (MRL). If the results meet this criteria, the sample containers in the lot will be released for use in AMP sampling events. If results do not meet this criteria, an additional sample container will be checked for each container that failed. If these results meet the criteria, the sample containers in the lot will be released for use in AMP sampling events. If there is a second failure, the sample containers in the lot will not be used for AMP sampling events.

2. Each sampling event (Lake or Tributary), will use containers from one specific lot (i.e., sample containers from different lots will not be mixed during each sampling event). The sample lot # will be recorded on the C-O-C forms for the respective samples to insure this.

3. Mercury sampling bottles for quarterly tributary sampling events are purchased from a commercial supplier and each lot certified to be clean. Bottles from the lot are tested as bottle blanks and demonstrated to be free of mercury. All purchased bottles come double bagged in new polyethylene zip-type bags and stored in wooden or plastic boxes until use.

VII. SAMPLE CUSTODY

A. FIELD SAMPLE CUSTODY

1. When samples are delivered to the OCDWEP Laboratory for analysis following sample collection, the original C-O-C forms are submitted to the Laboratory.

2. For samples sent to a contract laboratory for analysis, two copies of an Engineering and Laboratory Services (ELS) Contract Laboratory C-O-C form will be used. The original C-O-C form will be maintained by the OCDWEP Laboratory, one copy will be shipped to the contract laboratory with the samples, for analysis. The contract laboratory will retain one copy.

3. Attachment B is a typical example of a C-O-C form. The "Remarks" area is used to record specific considerations associated with sample acquisition such as sample type, container type, sample preservation methods, and analyses to be performed. The original copy of this record follows the samples to the laboratory. The laboratory maintains the completed original and also scans the record into a computer.

B. LABORATORY SAMPLE CUSTODY

1. The field team leader notifies the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. This notification will include information concerning the number and type of samples to be delivered as well as the anticipated date and time of arrival.

2. The laboratory sample program meets the following criteria:

   The laboratory has designated a sample custodian who is responsible for maintaining custody of the samples and for maintaining all associated records documenting that custody.

3. Upon receipt of the samples, the custodian will check the original chain-of-custody documents and compare them with the labeled contents of each sample container for correctness and traceability. The pH of preserved samples is checked at the time of sample receipt. The sample custodian signs the chain-of-custody record and records the date and time received.

4. Care is exercised to annotate any labeling or descriptive errors. In the event of discrepant documentation, the laboratory will immediately contact the field team leader as part of the corrective action process. A qualitative assessment of each sample container is performed to note any anomalies, such as broken or leaking bottles. This assessment is recorded as part of the incoming chain-of-custody procedure.

5. The samples are stored in a secured area at a temperature of approximately ≤6°C until analyses are to commence.

6. A laboratory chain-of-custody record accompanies the sample or sample fraction through final analysis for control. These forms are scanned by the lab into the computer (Adobe PDF format) and placed in a centrally located directory.

7. A copy of the chain-of-custody form will accompany the laboratory report and will become a permanent part of the program records.

C. FINAL EVIDENCE FILES

Final evidence files include all originals of laboratory reports and are maintained under documented control in a secure area.

A sample or an evidence file is under custody if:

- it is in your possession;
- it is in your view, after being in your possession;
- it was in your possession and you placed it in a secure area; and
- It is in a designated secure area.

VIII. FIELD EQUIPMENT CALIBRATION PROCEDURES/MAINTENANCE

A. YSI SONDES

1. Calibration procedures for the YSI 600 & 6600, which are used to monitor water quality parameters in Onondaga Lake, are included as Attachment D. Calibration data including the date of calibration, the results of calibration, the technician's initials, and the results of the post-use instrument calibration for drift checks are maintained in a bound notebook.

2. The YSI units (sondes) are calibrated no more than 24-hours prior to each day of use. If the DO membrane is replaced, the unit is allowed to stabilize overnight. Calibration is typically performed in the morning before use. A calibration check is performed after use to ensure that calibration drift is acceptable.

3. Temperature calibration is set by the factory and, reportedly, does not require frequent recalibration.

4. Depth is calibrated in air, just above the water surface, as 0 meters.

5. Preventative Maintenance:

   i. Dissolved oxygen membranes are checked and replaced as needed after each use.

   ii. The pH reference probe and the temperature probes are cleaned with 1:1 HCl and a cotton swab after each use.

   iii. The pH probe calibration solution is replaced once per day.

   iv. For long term storage, the sondes are stored clean and dry in a case in order to prevent physical damage. For short term storage, the sondes are stored in a calibration cup with tap water.

   v. Watertight connectors are lubricated when necessary in order to ensure a waterproof connection, which will prevent faulty readings.

B. SECCHI DISK

Taped depth markings for the Secchi disk are calibrated annually.

C. UNDERWATER ILLUMINATION

Data on Light attenuation are collected at 20-cm intervals from water surface to the depth at which light is 1% of surface illumination, as noted during the sampling event, using a LiCor datalogger, to provide sufficient detail.

D. WILDCO BETA SAMPLE TUBES

1. The Wildco Beta sample tubes are cleaned in DI water after each use. Prior to use, the tubes are rinsed in Onondaga Lake water.

2. Depth markings are calibrated annually.

E. SUBMERSIBLE PUMP

1. The submersible pump is cleaned using DI water after each use. Prior to use, the pump and hoses are rinsed in Onondaga Lake water.

2. Hoses for the submersible pumps are replaced annually or as needed.

3. Depth markings are calibrated annually.

IX. ANALYTICAL PROCEDURES

A. INTRODUCTION

Appropriate use of analytical data generated under the great range of analytical conditions encountered in environmental analyses requires reliance on the quality control practices incorporated in the methods and procedures used by the Onondaga County Department of Water Environment Protection Environmental Laboratory (OCDWEP). Attachment C lists the methodologies utilized for the analysis of water quality samples. As a participating member of the New York State Department of Health Environmental Laboratory Approval Program (ELAP), this laboratory uses only those methods and equipment certified by NYS to generate data. Inaccuracies can result from many causes, including unanticipated matrix effects, equipment malfunctions, and operator error. Therefore, the QA/QC aspects of this laboratory are indispensable. The data acquired from QA/QC procedures is used to estimate and evaluate the information content of analytical data and to determine the necessity of corrective action procedures. The means used to estimate information content are also an important part of the ELAP program to which we adhere.

This section defines the QA/QC procedures and components that are mandatory in the performance of analysis performed by the OCDWEP laboratory, and indicates the QA/QC information which must be generated with the analytical data.

B. CHEMICALS AND REAGENTS

1. Reagent grade water

Reagent grade water in the OCDWEP environmental laboratory consists of DI water purified by means of mixed bed deionization. The processed water is required to attain a minimum resistivity of 10 mSiemen. A final pass through another mixed bed deionization filter at point of use maintains the highest quality possible (18 mS output). Actual Conductivity is determined daily. The date, conductivity @ 25°C, and analyst's initials are recorded in a tabular format in a bound notebook.

To monitor the quality of reagent grade water for bacteriological use, the following tests are performed:

TABLE III - REAGENT GRADE WATER TESTS

Parameter	Frequency	Acceptable
Free Residual Chlorine	Monthly	None acceptable
Standard Plate Count	Monthly	<500 colonies/ml
Heavy Metals (Pb,Cd,Cu,Cr,Ni,Zn)	Yearly	<0.05 mg/l per metal <0.1 mg/l total
Suitability Test	Yearly	Ratio between 0.8-3.0

2. Reagents

Only American Chemical Society (ACS) grade or better chemicals are used. Chemicals are discarded within manufacturer's expiration date or 3 years, whichever comes first. Date of receipt is recorded on each container.

3. Standard Solutions/Titrants

Anhydrous reagent chemicals are oven dried @ 100-105°C for at least 2 hours. Standard solutions or titrants not prepared from a primary standard are standardized against a primary standard at the frequency specified by the method or every 6 months if no frequency is specified. Standard solutions or titrants are not kept longer than 1 year. The date prepared and the expiration date appear on the container, along with title of standard or titrant, concentration, and preparer's initials. In a bound notebook, the preparation date, title of solution, concentration, manufacturer and lot number of reagent grade chemical(s) used, quantity prepared, expiration date, preparer's signature and, if appropriate, drying times & temperatures, tare and net weight, citation of preparation of primary standard, standardization titers and calculations are recorded.

4. Bench or Shelf Reagents

These are non-standardized solutions prepared by laboratory personnel. All of the pertinent information listed for standard solutions is recorded on both bottle label and in a bound notebook.

C. MICROBIOLOGY: CHEMICALS AND REAGENTS

1. Bacteriological Media

Dehydrated media is discarded within six months when opened and stored in a dessicator, or within manufacturer's expiration date, if unopened. If opened, each new lot is compared to an existing lot that has been found acceptable. The date, name of media, lot #'s of control and test media, results of comparison, and analyst's initials are recorded in a tabular format in a bound notebook. On each bottle of media, dates of receipt and opening and discard date are recorded. Media is prepared according to method instructions. Sterilized glassware is used in the preparation of media. Date, name of medium, gross, tare, and net weights, volumes used, quantity prepared, pH of finished medium, and preparer's initials are recorded.

2. Autoclaving

The appropriate sterilization times @ 121°C and a pressure of 15-pounds per square inch for various materials are determined as follows:

Membrane filters and pads	10 min.
Carbohydrate containing media (Lauryl tryptose, BGB broth, etc.)	15 min.
Contaminated material, discarded cultures	30 min.
Membrane filter assemblies (wrapped to include all glass/plastic ware used to filter samples)	45 min.
Dilution water in screw-cap bottles	30 min.
Rinse water (200-1000-ml)	≥ 30 min.

3. Bacti Glassware

Every batch of glassware is checked after washing for detergent with 4-5 drops of bromthymol blue indicator, added to 4-ml of final rinse water from randomly chosen items of glassware; a neutral indication allows glassware use. The date, description of glassware, indicator reaction and analyst's initials are recorded in a tabular format in a bound notebook.

Each batch of sterilized bacti sample bottles is checked for sterility by aseptically adding 25-ml of tryptic soy broth into a randomly chosen sample bottle. After 24 hrs. of incubation @ 35°C +/- .5°C, the sample is checked for growth. The date, batch identifier, turbidity check, disposition of the batch, and analyst's initials are recorded in tabular form in a bound notebook.

4. Prepared Media Shelf Life

The following table indicates the holding times for bacteriological media prepared in advance:

TABLE IV - HOLDING TIMES BACTERIOLOGICAL MEDIA

Medium	Holding Time
MF Agar in screw-caps flasks	2 weeks @ 4°C
Confirmation Broth in capped tubes	@ Room Temperature for 3-months
Poured agar plates with tight-fitting Covers in sealed plastic bags	2 Weeks @ 4°C

5. Membrane Filter Sterility Blanks

a. The sterility of each lot number of membranes is verified by checking for growth after 1 membrane is placed in 50-ml of tryptic soy broth for 24 hrs. @ 35°C+/- 0.5°C incubation. The date, lot number, check for turbidity, and analysts initials are recorded.

b. At the beginning and end of each membrane filter series, a sterility check is performed. The date, # of samples analyzed during run, counts for blanks and analyst's initials are recorded in a tabular format in a bound notebook.

6. Negative and Positive Controls

a. Prior to the first use of a medium, each prepared, ready-to-use lot of medium and each batch of medium prepared in the laboratory shall be tested. Tests will consist of using at least one pure culture of a known positive reaction and at least one negative culture control, as appropriate to the method.

D. CALCULATIONS AND CHARTS

1. Reference Sample

A chart is constructed as follows:

a. The measured values and dates of analysis of the reference sample are tabulated;

b. When at least 20 reference samples have been tabulated, compute the mean: x;

c.. Using the mean, compute the standard deviation (SD), as in the following example using the formula:

$$SD = \sqrt{\frac{\Sigma (x - \overline{x})^2}{N-1}}$$

Where: x = the measured value of an individual reference sample

$\overline{x}$ = the mean of the measured values

N = the number of data points

$(x - \overline{x})^2$ = the sum of the squares of all the differences of the mean and measured values.

Example:

	Date	X	$(X - \bar{X})$		$(X - \bar{X})^2$	
1.	4-25-96	207	(207 - 207 = 0)	0	(0 x 0 = 0)	0
2.	5-03-96	214	(214 - 207 = +7)	+7	(7 x 7 = 49)	49
3.	5-10-96	200	(200 - 207 = -7)	-7	(7 x 7 = 49)	49
4.	5-17-96	210	(210 - 207 = +3)	+3	(3 x 3 = 9)	9
5.	6-10-96	219	(219 - 207 = +12)	+12	(12 x 12 = 144)	144
6.	6-10-96	190	(190 - 207 = -17)	-17	(17 x 17 = 289)	289
7.	6-18-96	203	etc.	-4	etc.	16
8.	6-27-96	210	"	+3	"	9
9.	7-03-96	204	"	-3	"	9
10.	7-11-96	207	"	0	“	0
11.	7-19-96	207	"	0	"	0
12.	8-01-96	201	“	-6	“	36
13.	8-10-96	204	“	-3	“	9
14.	8-17-96	200	“	-7	“	49
15.	8-27-96	221	“	+14	"	196
16.	9-03-96	205	"	-2	"	4
17.	9-11-96	210	"	+3	"	9
18.	9-20-96	201	“	-6	“	36
19.	9-30-96	217	"	+10	“	100
20.	10-10-96	210	“	+3	“	9
N=20		Total X = 4140				= 1022

Example

N = 20

$\sum (X - \overline{X})^2 = 1022$

$SD = \sqrt{(X - \overline{X})^2 / N-1}$

$SD = \sqrt{1022 / 19}$

SD= 7.33

2. Determine the warning limits

Determine the warning limits (WL), and the control limits (CL) as in the following example using the formulas:

$WL = \overline{X} \pm 2SD$

$CL = \overline{X} \pm 3SD$

Where $\overline{X}$ = the previously computed mean

SD = the standard deviation

WL = 207± (2 x 7.33)

The warning limits (WL) in the example, are 221.66 for the upper warning limit and 192.34 for the lower warning limit.

CL = 207± (3 x 7.33)

The control limits (CL) in the example are 228.99 for the upper control limit and 185.01 for the lower control limit.

3. Construct a control chart

Construct a control chart as done below for the example. The measured values of the reference samples are then plotted in the chart.

4. Percent Recovery

The percent recovery, P is calculated as follows:

$P = 100 (M - B)/T$

Where: T = the target value, i.e. the known concentration of analyte spiked into the sample aliquot.

M = the measured concentration of analyte in the spiked sample aliquot.

B = the background concentration of the unspiked sample aliquot.

The percent recovery data are used to construct a control chart with control limits with acceptance limits as follows:

a. The percent recoveries and analysis dates of the spiked samples are tabulated.

b. When a minimum of five percent recoveries have been tabulated, compute P (the mean percent recovery).

c. Compute SD, the standard deviation (see section on reference standard for example).

5. Surrogate Standard

The percent recovery, P, is calculated as follows:

$$P = 100 (M/T)$$

Where: M = the measured value

T = the target value, (i.e. the known value of surrogate spiked into the sample)

A tabulation of percent recoveries is maintained for each surrogate. The tabulation includes the analysis date, the percent recovery and the control limits for P. Control limits, using a minimum of 5 data points for each surrogate standard are calculated as follows:

$$CL = X \pm 3SD$$

Where: CL = the control limits

X = the mean percent recovery

SD = the standard deviation (see section on reference standard for example)

Compute WL, the warning limits, and CL, the control limits as follows:

$$WL = X \pm 2SD$$

$$CL = X \pm 3SD$$

The computed limits are recorded on the tabulation or control chart.

6. Duplicate Analysis

The percent relative difference between duplicate analyses is determined as follows:

$$\%RPD = [(X_1 - X_2) / (X_1 + X_2) / 2] \times 100$$

X_1 = the greater of the measured values

X_2 = the lower of the measured values

A tabulation of duplicates is maintained for each analyte listing dates of analysis, X_1, X_2, R, and the acceptance limit for RPD. The acceptance limit is established using the following equation:

$$UCL = 3.27 \times RPD$$

Where: UCL = the acceptance limit

RPD = the average %RPD range for a minimum of 20 sets of duplicates in a specified concentration range.

X. LABORATORY CALIBRATION/EQUIPMENT MAINTENANCE PROCEDURES

A. LABORATORY EQUIPMENT

1. Analytical Balance

a. Analytical balances are serviced and calibrated internally by a qualified service organization 1/year and a dated certification sticker is provided.

b. Analytical balances are checked daily in two ranges with Class S weights. The ranges selected reflect the routine use of the balance. For example, the analytical balance used principally for evaporating dishes and aluminum dishes would need Class S weights having target values of bracketing the expected weights of the dishes. The date, target reading, actual reading, and analyst's initials are recorded in a bound notebook.

2. pH meter

pH meters are calibrated daily using standard buffers and a two point calibration. This consists of creating a slope using standard pH buffers of pH 4.0 and 10.0. The slope is then checked using a standard buffer of pH 7.0, with an acceptable reading of + /- 0.05 pH units. The date, pH buffer target values, set points, actual readings, and analyst's initials are recorded in a tabular format in a bound notebook.

3. Conductivity meter and cell

a. The conductivity cell constant is determined annually using a 0.01-M potassium chloride solution. The date, resistance readings, average resistance, temperature, calculations, and analyst’s initials are recorded in a bound notebook.

b. The conductivity meter and cell is calibrated daily with a 0.001 M potassium chloride solution. An acceptable reading is +/- 20% of target value. The date, target value, actual reading, temperature, and analyst's initials are recorded in a tabular format in a bound notebook.

4. Dissolved Oxygen Meter

The dissolved oxygen meter and probe is calibrated daily using air calibration. The calibration is checked against the Winkler method. This consists of filling two bottles with aerated distilled water; checking the DO value of each bottle using the calibrated DO meter, and then determining the DO value of each bottle using the Winkler method. The DO values of the two methods are then compared. The dates, titers, DO values, average DO, and analyst's initials are recorded in a tabular format in a bound notebook.

5. Turbidimeters

The turbidimeter is calibrated per manufacturer's recommendation using a certified secondary gelex standard with each use. The date, target and observed values, and the analyst's initials are recorded in a tabular format in a bound notebook.

6. Thermometers

a. The OCDWEP environmental laboratory possesses an NIST (National Institute of Standardized Temperature) traceable, factory-certified thermometer, which is checked at the various temperatures required by a variety of analytical requirements. Correction factors and adjustments to correction factors, new correction factors and analysts initials are recorded in a tabular format in a bound notebook.

b. Each working thermometer has a dedicated use, and is calibrated annually at the temperature of interest using the NBS thermometer. The date, thermometer designation, calibration temperature, correction factor, and the analyst's initials are recorded in a bound notebook.

7. Refrigerators

Laboratory refrigerators maintain a temperature of 1° to 5°C. These temperatures are checked once daily. An NIST certified thermometer with 1°C graduations is used. The date, times, temperature readings and analyst's initials are recorded in tabular format in a bound notebook.

8. Bacteriological Incubators

a. The air bath incubators maintain a temperature of 35°+/- 0.5°C. A thermometer with graduations of 0.1°C is used. Temperatures are taken twice a day and the same data is recorded.

b. The water bath incubator maintains a temperature of 44.5°+/- 0.2°C. A thermometer with graduations of 0.1°C is used. The same temperature reading schedule and data recording is used as for the air bath incubator.

9. Ovens

Ovens are maintained at the target temperature of interest during use. Temperatures are checked at the beginning and end of each use. A dedicated thermometer with graduations of 1°C is used. The date, target temperature, time and temperature at the start and end of each cycle, oven use, and analysts initials are recorded in a tabular format in a bound format.

10. Autoclave

Autoclave maintains sterilization temperature and pressure during the sterilization cycle and completes the entire cycle within 45 minutes when a 10-12 min. sterilization period is used. A separate calibrated thermometer is used in combination with a sterilization indicator. The date,

time material is placed in autoclave, time of sterilization period, time material was removed, description of sterilized material and analyst's initials are recorded.

11. Automated Analyzer

For instruments at this level of sophistication, the procedures for ensuring correct analytical results are too lengthy for this manual, and the USEPA/ELAP instructions should be followed for specific information. Good general laboratory procedures (GLP) are followed in the daily operation of this instrument; including, but not limited to:

a. Daily calibration for each analyte of interest.

b. Instrument blank for each analyte.

c. Method blank, duplicates, spikes, reference, and check standards are utilized daily for each analyte.

12. Atomic Absorption Spectrophotometer

For instruments at this level of sophistication, the procedures for ensuring correct analytical results are too lengthy for this manual, and the USEPA/ELAP instructions should be followed for specific information. Good general laboratory procedures (GLP) are followed in the daily operation of this instrument; including, but not limited to:

a. Daily calibration for each analyte of interest.

b. Instrument blank for each analyte.

c. Method blank, duplicates, spikes, reference, and check standards are utilized daily for each analyte.

13. Inductively Coupled Plasma (ICP) Spectrophotometer

For instruments at this level of sophistication, the procedures for ensuring correct analytical results are too lengthy for this manual, and the USEPA/ELAP instructions should be followed for specific information. Good general laboratory procedures (GLP) are followed in the daily operation of this instrument; including, but not limited to:

a. Daily calibration for each analyte of interest.

b. Instrument blank for each analyte.

c. Method blank, duplicates, spikes, reference, and check standards are utilized daily for each analyte.

14. TOC Analyzer

For instruments at this level of sophistication, the procedures for ensuring correct analytical

results are too lengthy for this manual, and the USEPA/ELAP instructions should be followed for specific information. Good general laboratory procedures (GLP) are followed in the daily operation of this instrument; including, but not limited to:

a. Daily calibration for each analyte of interest.

b. Instrument blank for each analyte.

c.. Method blank, duplicates, spikes, reference, and check standards are utilized daily for each analyte.

B. LABORATORY QUALITY CONTROL DOCUMENTATION REQUIREMENTS

1. Standard Curves

Standard curves are prepared as specified in QA/QC manuals. All standard curves are dated and labeled with method, analyte, standard concentrations, and instrument responses.

A best-fit, straight line is drawn on graphed curves: the axis is labeled. The correlation coefficient is calculated. An acceptable correlation coefficient is 0.995 or greater.

Instrument response for samples is less than the highest standard. The lowest standard is at the method reporting limit.

If a specific method does not provide guidance in the preparation of a standard curve, the following guidelines are followed. For manual colorimetric methods, a blank and five standards that lie on the linear portion of the curve are used. A new curve is prepared each time an analysis is run. At each use, the curve is checked with a blank and a high standard. The high standard selected is greater than the expected sample concentrations. For automated colorimetric methods, a blank and a minimum of five standards are used. A new curve is prepared for each run. Instrument response is checked with a QC reference sample after each 10 samples. Low level standards are freshly prepared for each run.

2. Method Blank

A method blank consists of laboratory-pure water, which is processed and analyzed as if it were a sample. A method blank is run daily or with each batch of samples. Samples are related to the method blank by means of a date or batch identifier. Where applicable, the blank is calculated as a sample and a tabulation of blank results for each analyte with the date run and its appropriate acceptance criteria is maintained. Acceptance criteria for a method blank is a result less than the Minimum Reportable Limit (MRL) only.

3. Instrument Blank

An instrument blank consists of laboratory water, which is analyzed without adding reagents, filtering, etc. It is used for instrument set-up and no readings are recorded.

4. Trip Blank - Special

Trip blanks are required when analyzing volatile compounds in water. A trip blank is a sample of laboratory-pure water contained in a sample bottle appropriate to the analyte to be determined. Trip blanks are present but unopened at the sampling site and shipped to the laboratory with the environmental samples taken. A trip blank is included with samples collected at each sampling site. The trip blank is analyzed only when samples from a specific sampling site are positive for the analyte of interest. If reportable levels of the analyses of interest are demonstrated to have contaminated the field blank, resampling is required.

5. Reference Sample

A reference sample is prepared by spiking a known amount of analyte into an appropriate solvent. The concentrate or quality control sample is preferably obtained from an external source. When necessary, a sample prepared in-house is prepared independently of the calibration standard. A reference sample is analyzed with every tenth sample or monthly samples if fewer than ten samples per month are analyzed. Environmental samples are tied to the reference standard by means of a date or batch identifier.

Data generated by the analysis of reference standard are used to construct a control chart and control limits established. Instructions for constructing a control chart and computing limits are to be found later in this section.

Should a result fall outside the control limits, the analysis is out of control and immediate action is taken to determine the cause of the outlying result. Data generated on the same day as the outlying result are regarded as unreliable and the analyses repeated after corrective action has been taken and the procedure is back in control.

A new control chart with freshly computed control limits is generated annually. The last 20 reference standard data points for the previous year are used to compute the new control limits.

6. Spiked Recovery

Spiked recovery for an environmental sample is determined by dividing the sample into two aliquots of the same sample. The first aliquot is analyzed as usual. The second aliquot is spiked with a known concentration of the analyte of interest. The spike should be approximately 10 times the method's standard deviation (at the level of interest). A spiked environmental sample is analyzed when appropriate at a frequency of 1 spiked sample for every 20 samples or 1 spiked sample per month if fewer than 20 samples per month are analyzed. Samples are related to the spiked recovery date by means of a date or batch identifier.

Data generated by the analysis of spiked samples are used to calculate the percent recovery. The percent recovery data is used to construct a control chart and tabulation and limits established. Instructions for constructing a chart or tabulation and computing limits are to be found later in this section.

A new control chart of tabulation, the analysis is regarded as out of control and immediate action is taken to determine the cause of the outlying result. Data generated on the same day as the outlying result are regarded as unreliable and the analysis repeated after corrective action has been taken and the procedure is back in control. A new control chart or tabulation with freshly computed limits is generated annually.

7. Duplicate Analysis

A duplicate analysis is required only when a sample yields a positive result. A minimum of 10 percent of all positive samples for a given analyte is analyzed in duplicate. The range between the duplicates is tabulated and acceptance limits established. Instructions for the tabulation and the computation of limits are to be found later in this section.

A new tabulation with a freshly computed acceptance limit is generated annually.

8. External QA/QC

The OCDWEP laboratory is a NYSDOH-ELAP certified laboratory. Part of this program consists of a biannual inspection by a NYS Laboratory Inspector, who spends one or more days at each facility checking all aspects of the operation. In addition, performance evaluations are conducted twice per year. This consists of unknown samples sent to the laboratory to be analyzed and the results reported back to ELAP. The laboratory is required to submit results for each parameter that we are certified for, including bacteriology, metals, nutrients, etc.

The USEPA also uses the results from this program to satisfy the requirements of the SPDES permit program that regulates the various wastewater treatment plants in the OCDWEP system.

9. Internal QA/QC

In addition to the above, the OCDWEP laboratory conducts an internal QA/QC program consisting of unknowns that are generated periodically by the OCDWEP staff and given to technicians as “typical” samples, occurring without the analysts' knowledge. The object of this is to ensure that “typical” samples are analyzed using the same care as the “official” samples.

C. LABORATORY QUALITY CONTROL REQUIRED - BY PARAMETER

Inorganic Analytes		
Sub-Category or Analytical Group	**QC Measure Record Acquired**	**Frequency**
Demand/Residue		
TOC	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 20th sample or monthly if less than 20 samples per month are analyzed.
	Duplicates Tabulation Of all positive samples	On positive samples only, a minimum of 10% of all samples.
Mineral		
Alkalinity and Hardness	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
All other analyses except pH	Reference Sample Chart	Every 10^{th} sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 20^{th} sample or monthly if less than 20 samples per month are analyzed.
	Duplicates Tabulation	On positive samples only, a minimum of 10% of all samples.

Sub-Category or Analytical Group	QC Measure Record Acquired	Frequency
Nutrient		
All nutrient analyses	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 20th sample or monthly if less than 20 samples per month are analyzed.
	Duplicates Tabulation	On positive samples only, a minimum of 10% of all samples.
Wastewater Metals		
ICP (same as Flame)	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Duplicates Tabulation	On positive samples only, a minimum of 10% of all samples.
Flame Method	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Duplicates Tabulation	On positive samples only, a minimum of 10% of all samples.
Furnace Method	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Post only if Dupes are $\pm$15%.
	Duplicates Tabulation	Double matrix spiked every 10th sample.
Mercury	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Post only if Dupes are $\pm$15%.
	Duplicates Tabulation	Double matrix spiked every 10th sample.

Sub-Category or Analytical Group	QC Measure Record Acquired	Frequency
Miscellaneous Analytes		
Oil & Grease	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
Cyanide, Phenols, and Silica - Dissolved	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 20th sample or monthly if less than 20 samples per month are analyzed.
	Duplicates Tabulation	On positive samples only, a minimum of 10% of all samples.
Organic Analytes		
Organic Purgeables		
Priority Pollutants by GC	Laboratory Blank Tabulation	Daily or with each batch run.
	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Surrogate Standard Tabulation	All samples.
Organic Extractables		
Priority Pollutants and Pesticides by GC	Laboratory Blank Tabulation	Daily or with each batch run.
	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.

Sub-Category or Analytical Group	QC Measure Record Acquired	Frequency
	Spiked Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Surrogate Standard Tabulation	All samples.
Solid Waste Metals		
All Methods	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Duplicates Tabulation	On positive samples only, a minimum of 10% of all samples.
All Other Analytes		
Inorganic	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Spiked Sample Chart	Every 20th sample or monthly if less than 20 samples per month are analyzed.
	Duplicates Tabulation	On positive samples only, a minimum of 10% of all samples.

Sub-Category or Analytical Group	QC Measure Record Acquired	Frequency
All Other Analytes		
Organic	Laboratory Blank Tabulation	Daily or with each batch run.
	Duplicates Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
	Matrix Check	Daily or with each batch run.

XI. PROGRAM ASSESSMENTS

OCDWEP has designed several means of assessing whether the goals of the data acquisition program are being met. Both the field and laboratory components of the Ambient Monitoring Program will be assessed on an ongoing basis, with formal checkpoints each month.

The program team reviews the workplan with key field and laboratory personnel. An annual calendar is put together, noting field sampling days. Weekly coordination meetings are held with field and laboratory personnel in attendance. Any significant activities or problems identified in either the field or laboratory component of the program are discussed. A formal list of action items is kept from these weekly meetings.

Data are received from the laboratory on a monthly basis and are reviewed. Charge balances (summing the milliequivalent of the major anions and cations) of the inorganic data are performed to screen for data quality. Relative percent difference between field replicates is calculated.

A field audit will be conducted during the Year 2012 monitoring season. Members of the project team will accompany the field sampling team and observe sample collection and field data acquisition. A formal report of the field assessment will be maintained in the OCDWEP lake files. A laboratory audit will also be scheduled. The procedures for sample handling and analysis will be evaluated whether the criteria defined in the workplan are being consistently implemented.

XII. DATA QUALITY ASSESSMENT

Choices made in design of the sampling program (spatial and temporal), field sampling procedures, laboratory procedures, and data evaluation and interpretation can greatly influence the ability to draw conclusions. In this section, we describe the quantitative and qualitative decisions made to ensure that the data quality is adequate to meet the needs of this program. Data quality will be assessed using EPA's 40 CFR 30.503 standard criteria; precision, accuracy, representativeness, completeness, and comparability. In addition, a field audit will be performed to assess field procedures and sample handling. QA/QC methods for field and analytical procedures are those mandated by the New York State Department of Health Environmental Laboratory Approval Program (ELAP).

A. PRECISION

The plan to monitor and control the precision and accuracy of analytical measurements is described in the section on analytical procedures. Precision of field samples will be assessed through a program of field replicate analyses: one replicate per sample delivery group, or twenty samples. For routine lake and tributary monitoring, one sampling depth (lake) and station (tributary) will be sampled in duplicate for the complete suite of parameters.

B. ACCURACY

Accuracy, or how close the reported concentrations of concern are to “true” values, can be difficult to assess. The laboratory analytical program describes how this data quality indicator is monitored through a program of audit samples. A second approach Onondaga County has implemented is a validation program, using an outside expert in limnology and statistics to audit the results. The data validation program cannot be a final arbiter of what values in a data set are true, but it can help test for outliers and systematic differences between researchers that warrant further investigation. In addition, ELAP Laboratories require proficiency samples.

C. REPRESENTATIVENESS

Representativeness refers to the degree to which the samples acquired reflect the nature of the underlying population. Any monitoring program relies on the results of a limited number of samples drawn from a much larger underlying population to provide information regarding the nature of that larger population. The sampling program described in this document has been designed to accommodate the known temporal and spatial variability of the lake and its tributaries. Onondaga Lakes undergoes thermal stratification.

This requires both temporal and spatial adjustments to the annual monitoring program. Water quality analyses and data manipulation reflects the nature of the lake's stratification. Samples are taken at 3m intervals that span the thermal regime. Upper Mixed Layer (UML) results are separated from the Lower Water Layer (LWL) results in the calculations of annual and growing season (5/15 - 9/15) means and medians. Trends in concentrations during both the mixed and stratified periods are calculated. The primary sampling station in the Year 2012 Monitoring Program is a point in the southern lake basin (South deep). This station has been sampled throughout the 36 years of lake

monitoring. Four times each year, Onondaga County monitors a second station (designated North Deep) to determine whether water quality results differ. Tributary monitoring is on a bi-weekly basis. Judgment will be used to select the number and location of transects to collect water samples in the tributaries. Samples of the Lake Outlet are obtained at 2-feet and 12-feet depths to accommodate the density stratification that has been documented to occur in the Seneca River under low-flow conditions.

D. COMPARABILITY

Documentation of procedures and results of the monitoring program have been maintained by OCDWEP since 1968. Our goal is for data generated during the Year 2012 program to be comparable to the historical data. To meet this goal, we are committed to fully documenting the sampling and analytical procedures used, including any special modifications necessary to maximize precision, accuracy, or sensitivity in the lake water matrix.

E. COMPLETENESS

We are fortunate to have an extensive database of Onondaga Lake water quality to provide guidance regarding optimal sampling design with respect to variability of the measured parameters. An analysis of the reduction on the coefficient of variation achieved by different sampling strategies for the lake indicates that a monthly sampling program is adequate for most parameters (Walker 1992). Other parameters associated with short-term fluctuations in algal populations such as Chlorophyll-*a* require more frequent (weekly) monitoring from May through September.

Non-parametric statistics has been selected to indicate trends in water quality over time. The seasonal Kendall test allows us to differentiate seasonal variations within years from changes between years. The non-parametric statistics will maintain their power even with occasional missing values. Our goal for Year 2012 is to complete and validate 100% of the planned samples.

F. FIELD AUDIT

A technical advisor, to assess the field procedures and sample handling will perform an annual field audit. The audit findings and recommendations will be forwarded to the NYSDEC and also included in the annual monitoring report.

G. EQUIPMENT RINSEATE BLANKS

Wildco Beta Dunker, Churn, and Pump QA/QC equipment rinseate blanks will be collected for each of the AMP sampling events, as appropriate.

XIII. DATA REVIEW AND VALIDATION

Data will be screened for both technical defensibility (were procedures followed, were the laboratory control limits for precision and accuracy observed and usability, are the sample results sufficient to allow inferences regarding the nature of the underlying population?). Both of these criteria are important to meet the objectives of the lake-monitoring program.

Technical defensibility includes evaluation of the following:

a. Internal laboratory quality control: blanks, spikes, replicates, and standard curves;

b. Chain-of-custody complete; and

c. Holding times for all parameters met in accordance with analytical method.

Data usability includes evaluation of the following:

a. Charge balance of major anions and cations;

b. Results of field replicates; and

c. Statistical evaluation of outliers.

XIV. DOCUMENTATION

A. FIELD AND LABORATORY DATA

Field and laboratory data are stored both on the Laboratory Information Management System (LIMS) and on paper copy to be filed at OCDWEP. Data may be retrieved at any time from either of these sources.

B. LABORATORY REPORTS

Samples are delivered to the laboratory along with chain of custody forms on the date of sampling. YSI sondes' field data are delivered to the laboratory by the next day. Laboratory reports are finalized and delivered to the program manager and field supervisor within 30 days of the sample date.

C. PRELIMINARY DATA VALIDATION

Preliminary data validation is performed within 30 days of receipt of final laboratory data.

D. TREND ANALYSIS

Statistical trend analysis of the data will be performed. The non-parametric seasonal Kendall test will be performed on the lake and tributary data to test for long-term trends and changes in lake water quality in response to the major reductions in external loading.

E. ANNUAL TRIBUTARY LOADS

The flow-weighted concentrations of the constituents will be summarized. Dr. Walker's refined program used to estimate loading to Onondaga Lake will be used. The improved estimation technique, called "Method 5", was developed in conjunction with the compilation of the OCDWEP long-term integrated water quality data base and supporting software. The new technique was developed to support estimation of daily loads, to support development of monthly and seasonal lake mass balances, and to improve the accuracy and precision of the annual load estimates. Method 5 differs from AUTOFLUX Method 2 in several ways. Data are stratified by flow regime (similar to AUTOFLUX Method 2) and are also stratified by season using a multiple regression technique. Conditions during the unmonitored period are projected using a residual interpolation method that includes a flow derivative term.

F. ANNUAL REPORT

At the end of the monitoring year, data are compiled and manipulated into a report of analyses computation and evaluation of the ambient monitoring program.

XV. QAPP – SUMMARY OF REVISIONS

1. Section II.B Page 8-11: Updated Non-Event Based Water Quality Sampling Schedule (April 2012-March 2012)
2. Added Section V.C – Enhanced Tributary Program Sampling Procedures.
3. Attachment C Analytical Methodologies List, Page 76-78 - Updated to reflect 2011 Minimum Reporting Limit (MRL), accuracy, and precision values.
4. Clarified Fecal Coli sampling procedures to indicate bacteria samples are collected just below the water surface (depth <1m) for Onondaga Lake and Tributary sampling programs, per Coliform sampling procedures.

ATTACHMENTS

Attachment A: Tributary Field Sampling Procedures – by sampling site

Attachment B: Chain-Of-Custody Form (Example)

Attachment C: Analytical Methodologies - 2011 AMP

Attachment D: YSI 600/6600 Calibration Procedures

Attachment E: YSI 600/6600 Maintenance Procedures

Attachment F: YSI 600/6600 Operation Procedures

ATTACHMENT A:

Tributary Field Sampling Procedures

1. Ninemile Creek Rt. 48 Bridge Sampling Procedure

Equipment Requirements:	Bridge Crane and Bomb Sampler Sample Compositing Churn Coli Sampler In-situ parameters - See YSI Standard Operating Procedure (SOP).
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Divide the stream into 5 equal transects.

Step 2: Locate the area in the stream with the highest velocity.

Step 3: Lower the sampler to the water surface and allow the sampler to orient to the stream flow direction. Lower and raise the sampler at a rate of 1 foot per second. Record the number of repetitions (Dips) to fill 75% of the sample bottle. Be careful not to disturb the stream bottom.

Step 4: Pour the water sample into the churn and rinse out the churn thoroughly.

Step 5: Perform the same number of trips and dips at all 5 transect locations. Record the number of trips that will be needed to collect sufficient sample volume and the amount of water needed to keep the churn wet.

Step 6: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 7: Collect a Coliform sample just below the water surface (depth <1m), per the Coliform Sampling Procedure.

Step 8: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 9: Place samples on ice.

Step 10: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 11: Record sample information and USGS stage gage reading on the Chain-of-Custody and record all field observations on the field sheets. Should the gage house not be accessible, provisional readings may be taken from the USGS Internet site.

2. Onondaga Creek at Dorwin Avenue Sampling Procedure

Equipment Requirements:	Bridge Crane and Bomb Sampler Sample Compositing Churn Coli Sampler In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Divide the stream into 5 equal transects.

Step 2: Locate the area in the stream with the highest velocity.

Step 3: Lower the sampler to the water surface and allow the sampler to orient to the stream flow direction. Lower and raise the sampler at a rate of 1 foot per second. Record the number of repetitions (Dips) to fill 75% of the sample bottle. Be careful not to disturb the stream bottom.

Step 4: Pour the water sample into the churn and rinse out the churn thoroughly.

Step 5: Perform the same number of trips and dips at all 5 transect locations. Record the number of trips that will be needed to collect sufficient sample volume and the amount of water needed to keep the churn wet.

Step 6: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 7: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 8: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 9: Place samples on ice.

Step 10: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 11: Record sample information and USGS stage gage readings on the Chain-of-Custody and record field observations on the field sheets. Should the gage house not be accessible, provisional readings may be taken from the USGS Internet site.

3. Onondaga Creek at Kirkpatrick Street Sampling Procedure

Equipment Requirements:	Bridge Crane and Bomb Sampler Sample Compositing Churn Coli Sampler In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Divide the stream into 5 equal transects.

Step 2: Locate the area in the stream with the highest velocity.

Step 3: Lower the sampler to the water surface and allow the sampler to orient to the stream flow direction. Lower and raise the sampler at a rate of 1 foot per second. Record the number of repetitions (Dips) to fill 75% of the sample bottle. Be careful not to disturb the stream bottom.

Step 4: Pour the water sample into the churn and rinse out the churn thoroughly.

Step 5: Perform the same number of trips and dips at all 5 transect locations. Record the number of trips that will be needed to collect sufficient sample volume and the amount of water needed to keep the churn wet.

Step 6: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 7: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 8: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 9: Place samples on ice.

Step 10: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 11: Record sample information and USGS stage gage readings on the Chain-of-Custody and record field observations on the field sheets.

4. Harbor Brook at Velasko Road Sampling Procedure

Equipment Requirements:	Hand Held Depth Integrated Sampler Sample Compositing Churn Coli Sampler In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Divide the stream into 3 equal transects.

Step 2: Locate the area in the stream with the highest velocity.

Step 3: Lower the sampler to the water surface and orient the nozzle to the stream flow direction. Lower and raise the sampler at a rate of 1 foot per second. Record the number of repetitions (Dips) to fill 75% of the sample bottle. Be careful not to disturb the stream bottom.

Step 4: Pour the water sample into the churn and rinse out the churn thoroughly.

Step 5: Perform the same number of trips and dips at all 3 transect locations. Record the number of trips that will be needed to collect sufficient sample volume and the amount of water needed to keep the churn wet.

Step 6: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 7: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 8: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 9: Place samples on ice.

Step 10: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 11: Record sample information and USGS stage gage reading on the Chain-of-Custody and record field observations on the field sheets.

5. Harbor Brook at Hiawatha Boulevard Sampling Procedure

Equipment Requirements:	Vertical Kemmerer Bottle Sampler Sample Compositing Churn Coli Sampler In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Divide the stream into 3 equal transects.

Step 2: Set the sampler and lower the sampler into the water until fully submerged.

Step 3: Pour the water sample into the churn and rinse out the churn thoroughly. Fill the churn with water samples.

Step 4: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 5: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 6: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 7: Place samples on ice.

Step 8: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 9: Record sample information and USGS stage gage reading on the Chain-of-Custody and record field observations on the field sheets. Should the gage house not be accessible, provisional readings may be taken from the USGS Internet site.

6. Ley Creek at Park Street Sampling Procedure

Equipment Requirements:	Vertical Kemmerer Bottle Sampler Sample Compositing Churn Coli Sampler In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Divide the stream into 3 equal transects.

Step 2: Set the sampler and lower the sampler into the water until fully submerged.

Step 3: Pour the water sample into the churn and rinse out the churn thoroughly. Fill the churn with water samples.

Step 4: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 5: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 6: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 7: Place samples on ice.

Step 8: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 9: Record sample information and USGS stage gage reading on the Chain-of-Custody and record field observations on the field sheets. Should the gage house not be accessible, provisional readings may be taken from the USGS Internet site.

7. Tributary 5A Sampling Procedure

Equipment Requirements:	Hand Held Depth Integrated Sampler Sample Compositing Churn Coli Sampler In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669.

Step 1: Divide the stream into 3 equal transects.

Step 2: Locate the area in the stream with the highest velocity.

Step 3: Lower the sampler to the water surface and allow the sampler to orient to the stream flow direction. Lower and raise the sampler at a rate of 1 foot per second. Record the number of repetitions (Dips) to fill 75% of the sample bottle. Be careful not to disturb the stream bottom.

Step 4: Pour the water sample into the churn and rinse out the churn thoroughly.

Step 5: Perform the same number of trips and dips at all 3 transect locations. Record the number of trips that will be needed to collect sufficient sample volume and the amount of water needed to keep the churn wet.

Step 6: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 7: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 8: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 9: Place samples on ice.

Step 10: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 11: Record sample information on the Chain-of-Custody and record field observations on the field sheets.

8. East Flume - Manhole #015 Sampling Procedure

Equipment Requirements:
- Vertical Kemmerer Bottle Sampler
- Sample Compositing Churn
- Marsh McBirney Flowmate flowmeter - Model 2000
- Coli Sampler
- Insitu parameters - See YSI 600 SOP

Bottle Requirements:
- (1) 1 L clear plastic pre-cleaned (Metals)
- (1) 1/2 gallon plastic (T-Cn)
- (1) 1 L white plastic pre-cleaned (NP)
- (1) 1/2 gallon plastic (Conv)
- (1) 500ml boston round plastic (T-Alk)
- (2) 125ml sterile plastic (Coli)
- (2) 125ml round plastic (SRP/TDP)
- (1) 250ml glass (LL Hg)

Step 1: Lower the sampler into pipe, until fully submerged in flow channel.
Step 2: Pour the water sample into the churn and rinse out the churn thoroughly. Fill the churn with water samples.
Step 3: Record (on field sheet) the number of dips needed to achieve the required volume of < or = to 75% of bottle capacity.
Step 4: Collect field data with the YSI 600. Place sonde into churn, and let unit stabilize. Remove sonde when reading has been logged.
Step 5: Fill the required bottles from the churn. The Chain of Custody form will specify what bottles need to be filled for that event.
Step 6: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.
Step 7: Preserve samples as per the OCDWEP ETS Field Preservation Guide. Check for proper pH.
Step 8: Place samples on ice.
Step 9: Obtain flow measurements with the Marsh McBirney Flowmate with flow sensor placed at depths that are 20%, 60% and 80% of the pipes depth. Record water velocites at $V_{20\%}$ $V_{60\%}$,and $V_{80\% \text{ and}}$ and calculate volumetric flow rate.

9. Metro Effluent Sampling Procedure

Equipment Requirements:	1-Quart glass grab jar Sample Compositing Churn Coli Sampler Bucket (for sonde use)
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Use a 1-Qt. glass jar in a grab polyethylene sampling apparatus on a rope. Collect sample from the Final Effluent (IC#789) Grab location.

Step 2: Pour the water sample into the churn and rinse out the churn thoroughly. Fill the churn with 12 (1-qt.) grab samples.

Step 3: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 4: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 5: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 6: Place samples on ice.

Step 7: Collect field data with the YSI. Place sonde in a sample bucket/sample compositing churn.

Step 8: Record sample information on the Chain-of-Custody and record field observations on the field sheets.

10. Lake Outlet Sampling Procedure

Equipment Requirements: Vertical Kemmerer Bottle Sampler (Dunker)
Coli Sampler
Sample Compositing Churn
In-situ parameters - See - YSI SOP

Bottle Requirements:

Lake Outlet 2-ft.(0.6m)	**Lake Outlet 12-ft. (3.7m)**
(1) 1-L plastic pre-cleaned (metals)	(1) 1-L plastic pre-cleaned (metals)
(1) 500-ml boston round plastic (t-alk)	(1) 500-ml boston rnd. plastic (t-alk)
(1) 125-ml plastic (coli)	(1) ½-gallon plastic (t-Cn)
(2) 250-ml round plastic (srp/tdp)	(2) 250-ml round plastic (srp/tdp)
(1) ½-gallon plastic (t-Cn)	(1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP)
(1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP)	
(1) 2 liter amber bottle (Chlorophyll-*a*)	(1) 2 liter amber bottle (Chlorophyll-*a*)
(1) 250 mL glass bottle (Hg) using	(1) 250 mL glass bottle (Hg) using
"clean hands-dirty hands" technique	"clean hands-dirty hands" technique
as described in EPA Method 1669	as described in EPA Method 1669

Step 1: Locate the sampling location at mid-channel.

Step 2: Collect one sample from the required sampling depth to rinse the churn.

Step 3: Collect three samples at a depth of 2 feet and deposit the samples in the Churn.

Step 4: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn.

Step 5: Repeat steps 2, 3 and 4 for the 12-foot sample. If a field duplicate is required at either location, collect that sample using the same protocol. Rinse the Churn with water from the corresponding depth prior to sampling.

Step 6: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 7: Preserve the samples as per Section IV (Table 1-Sample Collection and Preservation).

Step 8: Place the samples on ice.

Step 9: Collect field data with the YSI. The sonde should be placed at mid-channel. In-situ data will be recorded at .5 meter increments and at .6 m and 3.7 m.

Step 10: Record sample information on Section IV (Table 1-Sample Collection and Preservation) and record all field observations on the field sheets.

NOTE: The sampling site has been moved to the downstream site of the one-lane pedestrian bridge.

11. Metro Bypass Sampling Procedure

Equipment Requirements: 1-Quart glass grab jar
Sample Compositing Churn
Coli Sampler

Bottle Requirements: (1) 1-L plastic pre-cleaned (metals)
(1) ½-gallon plastic (t-Cn)
(1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP)
(1) ½-gallon plastic (conv)
(1) 500-ml boston round plastic (t-alk)
(2) 125-ml sterile plastic (coli)
(2) 250-ml round plastic (srp/tdp)
(1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Use a 1-Qt. glass jar in a grab can on a rope. Collect samples from the Metro Bypass sampling location and pour into a dedicated carboy.
Step 2: Ensure sample is completely mixed prior to pouring sample from the carboy into the sample containers.
Step 3: The Field Sheet will specify what bottles need to be filled for that event.
Step 4: Collect a Coliform sample as per the Coliform Sampling Procedure.
Step 5: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.
Step 6: Place samples on ice.
Step 7: Collect field data with the YSI. Place sonde in a sample bucket.
Step 8: Record sample information on the Chain-of-Custody and record field observations on the field sheets.

12. Bloody Brook at Onondaga Lake Parkway Sampling Procedure

Equipment Requirements:	1-Quart glass jar Sample Compositing Churn Coli Sampler In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals) (1) ½-gallon plastic (t-Cn) (1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP) (1) ½-gallon plastic (conv) (1) 500-ml boston round plastic (t-alk) (2) 125-ml sterile plastic (coli) (2) 250-ml round plastic (srp/tdp) (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669

Step 1: Use a 1 Qt. glass jar in a grab can on a rope. Collect sample from the Blood Brook Creek bridge grab location.

Step 2: Pour the water sample into the churn and rinse out the churn thoroughly. Fill the churn with 12-15 (1qt.) grab samples.

Step 3: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the churn. The Chain-of-Custody form will specify what bottles need to be filled for that event.

Step 4: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 5: Preserve samples as per Chain-of-Custody and check samples for the appropriate pH.

Step 6: Place samples on ice.

Step 7: Collect field data with the YSI.

Step 8: Record sample information on the Chain-of-Custody and record field observations on the field sheet. Record the USGS Staff Gage Reading.

13. Sawmill Creek at Onondaga Lake Recreational Path Sampling Procedure

Equipment Requirements:	1-Quart glass jar
	Sample Compositing Churn
	Coli Sampler
	In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals)
	(1) ½-gallon plastic (t-Cn)
	(1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP)
	(1) ½-gallon plastic (conv)
	(1) 500-ml boston round plastic (t-alk)
	(2) 125-ml sterile plastic (coli)
	(2) 250-ml round plastic (srp/tdp)

Step 1: Use a 1-Qt. glass jar at the downstream side of the Path, dip jar into stream flow as near to center of stream as possible, to collect samples.

Step 2: Pour the water sample into the churn and rinse out the churn thoroughly. Fill the churn with 12 (1-qt) grab samples.

Step 3: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling. The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 4: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 5: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 6: Place samples on ice.

Step 7: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 8: Record sample information and USGS stage gage reading on the Chain-of-Custody and record field observations on the field sheets.

14. Harbor Brook at Bellevue Avenue Sampling Procedure

Equipment Requirements:	1-Quart glass jar
	Sample Compositing Churn
	Coli Sampler
	In-situ parameters - See YSI SOP
Bottle Requirements:	(1) 1-L plastic pre-cleaned (metals)
	(1) ½-gallon plastic (t-cn)
	(1) 1-L white plastic pre-cleaned (TKN, NH_3-N, TP)
	(1) ½-gallon plastic (conv)
	(1) 500-ml boston round plastic (t-alk)
	(2) 125-ml sterile plastic (coli)
	(2) 250-ml round plastic (srp/tdp)

Step 1: Use a 1-Qt. glass jar in a grab can on a rope. Collect sample from the Harbor Brook at Bellevue Avenue bridge location. Dip jar into stream flow as near to center of stream as possible, to collect samples.

Step 2: Pour the water sample into the churn and rinse out the churn thoroughly. Fill the churn with 12 (1-qt) grab samples.

Step 3: When churning, the disk should touch the bottom on every stroke, and the stroke should be as long as possible without breaking the water surface. The churning rate should be about 9 inches per second (faster rates could introduce air into the sample). Churn for about 10 strokes before subsampling.

Step 4: The first subsample should be the one that requires the largest volume. Fill the required bottles from the Churn. The Field Sheet will specify what bottles need to be filled for that event.

Step 5: Collect a Coliform sample just below the water surface (depth <1m), as per the Coliform Sampling Procedure.

Step 6: Preserve samples as per Section IV (Table 1-Sample Collection and Preservation) and check samples for the appropriate pH.

Step 7: Place samples on ice.

Step 8: Collect field data with the YSI. Place sonde at mid-channel and mid-depth.

Step 9: Record sample information and USGS stage gage reading on the Chain-of-Custody and record field observations on the field sheets.

ATTACHMENT B:

Chain-Of-Custody Form (Example)

CHAIN OF CUSTODY RECORD	Sample Number		
ONONDAGA COUNTY DEPARTMENT OF WATER ENVIRONMENT PROTECTION Engineering and Laboratory Services Division (Revision: Sept 2007 – COC_62002Dbaseportraitmod.DOC)		Project Name	
		IC/FC #	
		Sewer#/WCode	
Origin of Sample (i.e., Name of Industry, Treatment Plant, Hauler, etc.)		Invoice#	
		DEC Permit	
		Req. By	

CATEGORY:		AMP	IND	TP	WHC	SPECIAL	QA/QC
CONTRACT LABORATORY - LIST NAME:							

Start Date	End Date	Pickup Date	Start Time	End Time	Samp Type	Bottle #	Container Type	Initial	Preserved YES	Preserved NO	SAMPLE NOTES (Lab) Receipt Temp

			Field pH		Meter #			Chlorine Residual	

Bottles/Comp		Aliquot/Bottle		Sample Interval		Sampler ID		Refrig/Iced	
Preservation Checklist	Oxidizer Present?		Oxidizer Removed?		PreKit#	FLOW (Date/Time)	>1.	2.	
	Yes	No	Yes	No	Initials	2nd Reading			
NH3-N						1st Reading			
TKN						TOTAL			
Color Interference?			If yes, added [		] drops Na Thio	UNITS			

MATRIX: Solid WasWater SurWater PotWater | Remarks (sample / collection details):

SPLIT WITH (Name/Title/Date):

PARAMETERS AS LISTED IN ANNUAL SCHEDULE? YES NO → If NO, List Parameters below for all samples:

Lab Comments:

CHAIN OF CUSTODY (Print Name, Signature, Title, Date of Possession)

1.
2.
3.
4.
5.
6.

Attachments included? YES / NO If yes, list pages: Page ____ of ____.

ATTACHMENT C:

Analytical Methodologies

ANALYTICAL PROCEDURES FOR WATER QUALITY ANALYSES
2011 AMBIENT MONTIORING PROGRAM

Parameter	Code	Methods *	Minimum Reportable Limit (mg/L)	Accuracy (%)	Precision (%)
Bio Oxy Demand 5-day	BOD5	2:(5210 B)	2.0	106	10.1
Carbon. Bio Oxy Demand 5-day	CBOD5	2:(5210 B)	2.0	103.0	11.3
Total Alk as CaCO3	ALK-T	2:(2320 B)	1.0	98.1	1.3
Total Organic Carbon	TOC	2:(5310B)	0.5	99.5	1.4
Total Organic Carbon - Filtered	TOC-F	2:(5301B)	0.5		
Total Inorganic Carbon	TIC	2:(5301B)	0.5	98.4	1.3
Total Kjeldahl Nitrogen as N	TKN	3:(10-107-06-2-D)	0.15	96.9	8.2
Low Ammonia Nitrogen as N	NH3-N	2:(4500-NH3-H)	0.01	93.3	4.1
Organic Nitrogen as N	ORG-N	3:(10-107-06-2-D)	0.01		
Nitrate as N	NO3	3:(10-107-04-1-C)	0.01	101.2	2.4
Nitrite as N	NO2	3:(10-107-04-1-C)	0.01	100.2	3.0
Total Phosphorus (Manual)**	TP	2:(4500-P E))	0.003	97.1	6.1
Total Dissolved Phosphorus	TDP	2:(4500-P E)	0.003	97.1	6.1
Soluble Reactive Phosphorus	SRP (OP)	2:(4500-P E)	0.001	99.0	7.0
Silica	SiO2	2:(4500-Si-D)	0.5	103.2	12.3
Sulfates	SO4	6:(426 C)	10.0	99.4	4.8
Total Sulfides	S=	1:(376.1)	0.2		
Total Solids	TS	2:(2540 B)	10.0		
Total Volatile Solids	TVS	2:(2540 E)	10.0		
Total Suspended Solids	TSS	2:(2540 D)	1.0		
Total Volatile Suspended Solids	VSS	2:(2540 E)	1.0		
Total Dissolved Solids	TDS	2:(2540 C)	20.0	99.7	15.0
Arsenic - furnace	As - GFA	4:(200.9)	0.002	101.5	4.4
Total Cadmium-furnace	Cd - GFA	4:(200.9)	0.0008	102.8	4.2
Total Calcium	Ca	2:(3111B)	1.0	100.1	1.3
Total Chromium	Cr	4:(200.7)	0.008(0.002)*	103.5	2.7
Chloride- Lachat	Cl	3:(10-117-07-1-B)	1.0	102.8	2.0
Residual Chlorine	CL2 RES	1:(330.4)	0.1		
Total Copper	Cu	4:(200.7)	0.01(0.0025)*	102.6	3.7

ANALYTICAL PROCEDURES FOR WATER QUALITY ANALYSES
2011 AMBIENT MONTIORING PROGRAM (CONTINUED)

Parameter	Code	Methods *	Minimum Reporting Limit (mg/L)	Accuracy (%)	Precision (%)
Total Cyanide	CN-T	3:(10-204-00-1-A)	0.003	98.2	7.3
Total Iron	Fe	4:(200.7)	0.04	105.1	2.9
Total Lead - furnace	Pb - GFA	4:(200.9)	0.002	98.9	4.4
Total Magnesium	Mg	2:(3111B)	0.1	100.8	1.6
Total Manganese	Mn	4:(200.7)	0.02	104.3	2.6
Total Low Level Mercury	Hg	7:(1631E)	0.0000005	101.6	4.4
Total Mercury (Cold Vapor)	Hg	1:(245.2)	0.00002	101.8	4.0
Selenium - furnace	Se - GFA	4:(200.9)	0.002	97.9	4.0
Total Sodium	Na	2:(3111B)	3.0	101.6	2.1
Total Nickel	Ni	4:(200.7)	0.015(0.00375)*	102.0	2.9
Potassium	K	2:(3111B)	0.020	100.0	3.0
Total Silver	Ag	4:(200.7)	0.01	102.4	2.8
Total Zinc	Zn	4:(200.7)	0.02(0.005)*	104.0	2.7
Turbidity		2:(2130B)	0.1	97.1	2.9
Conductivity	COND	2:(2510B)	-		
Dissolved Oxygen - Field	DO - Field	1:(360.1)	0.1		
Dissolved Oxygen - Lab	DO - Lab	1:(360.1)	-		
Dissolved Oxygen - Winkler	DO - Winkler	1:(360.2)	-		
pH	pH	1:(150.1)	-		
Temperature	TEMP	1:(170.1)	-		
Phaeophytin *a*	PHEO-A	2:(10200 H.2)	0.2 (mg/m3)		
Chlorophyll *a*	CHLOR-A	2:(10200 H.2)	0.2 (mg/m3)		
Enterococci	ECOCCI	5:(1600)	1.0 (cells/100mL) MPN		
E. Coliform	ECOLI-Colilert	2:(9223 B)	1.0 (cells/100mL) MPN		
Fecal Coliform	FCOLI-MF	2:(9222 D)	1.0 (cells/100 mL)		

Methods listed are applicable for all matrices of water, wastewater, and surface waters.

* Indicates method has a lower level of detection due to sample concentration.

**Started in August 2000 for all AMP samples.

1: Indicates USEPA Methods for Chemical Analysis of Water and Waste 1979.

2: Indicates Standard Methods (18th Edition).

3: Indicates Lachat Instruments QuickChem Methods: Approved for use by USEPA - NYSDOH - ELAP.

4: Indicates USEPA "Methods for the Determination of Metals in Environmental Samples" Supplement 1, May 1994.

5: Enterolert EPA 1997.

6: Indicates Standard Methods (15th Edition).

7: Indicates USEPA Method 1631, Revision E, August 2002.

ATTACHMENT D:

YSI 600/6600 Calibration Procedures

YSI 600 & 6600 Calibration

The YSI 600 & 6600 sonde units are calibrated in the OCDWEP Laboratory located at the Henry Clay Boulevard Facility (HCBF). All calibration solutions e.g. (20^0C DI water; pH buffers 7,10; Conductivity KCl buffers 0.01N & 0.02N) are purchased and supplied with a certificate of analysis and stored in the laboratory. The YSI 600 & 6600 are calibrated no more than 24 hours prior to use on the day that it is used in the field. Post-calibration checks are conducted after use, on the same day (to the extent possible or the following day), on all calibrated parameters. All calibration records are maintained in a bound book.

Dissolved Oxygen (DO) Calibration

1. Bring the DI water bucket, which can be found in the 20^0C walk-in incubator room, to the ELS Field Staging Room. Place the sonde unit (with attached weighted probe guard) into the 20° C DI water bucket. Allow the unit to stabilize in the bucket for 10 minutes.

2. Record the current barometric pressure (from the MDS 650). Record the mm of Hg value in the bound calibration notebook.

3. The DI water in the bucket should be well stirred, and the YSI 600 or 6600 should be temperature stabilized before proceeding with DO calibration.

4. Once stable, record in the calibration log book the DO and temperature value on the display unit. Collect two Winkler bottle DO samples from the DI water bucket, and turn these samples over to the laboratory technician responsible for DO analysis.

5. The DO concentration is determined in each of the two bottles using the Winkler method. Record each result and the average value of the two DO concentrations in the calibration logbook.

6. If the concentration results of the two bottles, using the Winkler method, are greater than 0.2 ppm different, the DO concentrations should be determined again.

7. If the "average Winkler DO" value is not within five-hundredths (0.05) of the value on the display unit, then it is necessary to calibrate the YSI 600 or 6600, using the "average Winkler DO" value.

8. Select **"Sonde Menu,"** then **"Calibrate,"** then **"DO %"** on the display unit. Enter the calculated barometric pressure **"mm/Hg."** The display will then return to the data display screen, with the option **"calibrate"** highlighted. Record the displayed DO value as the initial reading. Then select "enter"; the calibration will stabilize and be completed. Record the new displayed value in the logbook as the calibrated value. Select the highlighted option **"continue"** by pressing "enter". For calibration to a DO Winkler value, select **"DO mg/L"**, enter the average Winkler DO value. The display will then return to the data display screen, with the option **"calibrate"** highlighted. Record the displayed DO value as the initial reading. Then select "enter"; the calibration will stabilize and be completed. Record the new displayed value in the logbook as the calibrated value. Select the highlighted option **"continue"** by pressing "enter". The DO is now calibrated.

9. After use in the field, conduct the post-calibration procedure repeating steps 1 through 5 as listed above. The difference between the displayed DO value recorded in the log book and the "average Winkler DO" is the drift, which should be recorded in the log book.

pH Calibration

1. Remove the weighted probe guard from the sonde unit and screw on the calibration cup. Rinse the cup with DI water. Thoroughly mix the container of pH 6 buffer, making sure the solution is dated, and fresh. Rinse the probes in the calibration cup with pH 6 buffer, then fill the cup with the buffer until all probes are submerged. Allow the readings to stabilize for approximately 90 seconds.

2. Select **"Sonde Menu,"** then **"Calibrate,"** then **"pH,"** then **"2 point cal"** on the display unit. Enter the first pH buffer for calibration (pH 6.00). The display will then return to the data display screen, with the option **"calibrate"** highlighted. Record the displayed pH value as the initial reading. Then select "enter", the calibration will stabilize and be completed. Record the new displayed value in the logbook as the calibrated value. Select the highlighted option **"continue"** by pressing "enter".

3. Rinse the cup with DI water. Thoroughly mix the container of pH 10 buffer, making sure the solution is dated, and fresh. Rinse the probes in the calibration cup with pH 10 buffer, then fill the cup with the buffer until all probes are submerged. Allow the readings to stabilize for approximately 90 seconds.

4. Next, enter the second pH buffer for calibration (pH 10.00). The display will then return to the data display screen, with the option "**calibrate**" highlighted. Record the displayed pH value as the initial reading. Then select "enter", the calibration will stabilize and be completed. Record the new displayed value as the calibrated pH in the logbook. The display will show "**continue**" highlighted, select "enter" to continue with options.

5. Next, put the display unit in run mode. Rinse the cup with DI water. Thoroughly mix the container of pH 7.00 buffer, making sure the solution is dated, and fresh. Rinse the probes in the calibration cup with pH 7.00 buffer, then fill the cup with the buffer. All probes should be submerged. Allow the readings to stabilize for approximately 90 seconds. Record the value on the display unit. This value should be recorded in the logbook as the check value. (Target value +/- 0.05 Standard Units)

6. After use in the field, conduct the post-calibration procedure by repeating steps 1 and 3. The displayed value should be recorded as the "after use" value. The difference between the "after use" value and the "calibrated" value is the drift. Record this value in the logbook.

Conductivity Calibration

1. Rinse the calibration cup twice with DI water, then once with the 0.02N KCl solution. Fill the calibration cup with the 0.02N KCl solution such that the conductivity block is fully submerged. Tap the sonde unit to dislodge any possible air bubbles.

2. Select **"Sonde Menu,"** then **"Calibrate,"** then **"conductivity,"** then **"sp. cond."** Enter the value 2.76 mS/cm for calibration of (0.02N KCl). The display will then return to the data display screen, with the option **"calibrate"** highlighted. Record the displayed sp.cond. value as the initial reading. Then select "enter", the calibration will stabilize and be completed. Record the new displayed value in the logbook as the calibrated value. Select the highlighted option **"continue"** by pressing "enter". The display will then continue with options. Advance to **"sonde run."**

3. Rinse the calibration cup twice with DI water, then once with the 0.01N KCl solution. Fill the calibration cup with the 0.01N KCl solution such that the entire conductivity block is fully submerged. Tap the sonde unit to dislodge any possible air bubbles.

4. Record the displayed conductivity value in the logbook as the “initial reading”.

5. After use in the field, conduct the post-calibration procedure by repeating steps 1 and 3. The displayed value for each solution should be recorded as the “after use” value. The difference between the “after use” value and the “calibrated value” (for 0.02N KCl) and “initial value” (for 0.01N KCl) should be recorded as the drift.

Depth Calibration

1. Calibration of depth should occur in the field, immediately prior to use. Suspend the sonde unit by holding the cable, such that the probes are just above the water surface. Select **“Sonde Menu,”** then **“Calibrate”**, then **“Pressure-ABS”** on the display unit. Enter the calibrated value (0.0 meters). The display will then return to the data display screen, with the option **"calibrate"** highlighted. Select "enter", the calibration will stabilize and be completed. Select the highlighted option **"continue"** by pressing "enter". The display will then continue with options. Advance to **"sonde run.”**

Battery Voltage Evaluation

1. Internal battery voltage is shown on the display unit. Batteries are replaced when the battery voltage indicator is down to 1/4 charge. Replace with four C cell batteries.

Temperature Calibration

1. The temperature sensor is factory calibrated.

2. Quarterly calibration checks are performed by the OCDWEP Lab.

ORP Calibration

The ORP sensor is factory calibrated. However, it is possible to calibrate or check the sensor using a standard Zobel’s solution. This calibration will be done quarterly.

2. Rinse the calibration cup twice with DI water, then once with the Zobel's solution. Fill the calibration cup with the Zobel's solution such that the ORP probe is fully submerged.

3. Select **“Sonde Menu,”** then **“Calibrate,”** then **“ORP”**. Record the temperature of the unit and enter the correct value for Zobel's solution which corresponds to the temperature value at 5ºC (See instrument manual for table). The display will then return to the data display screen, with the option **"calibrate"** highlighted. Record the displayed ORP value as the initial reading. Then select "enter", the calibration will stabilize and be completed. Record the new displayed value in the logbook as the calibrated value. Select the highlighted option **"continue"** by pressing "enter". The display will then continue with options. Advance to **"sonde run.”**

Turbidity Calibration (6600 Sondes Only)

1. The Turbidity sensor is calibrated as needed for each use. A three- point calibration is performed at the office or in the field.

2. Rinse the calibration cup twice with DI water. (Note: Presence of air can cause erroneous readings. DI water should be allowed to stand prior to calibration.)

3. Carefully fill the calibration cup with DI water by pouring the DI water gently onto the side of the calibration chamber to reduce air bubbles. Place the calibration cup/chamber with a black cover on the countertop. Approximately two to three inches of water will be sufficient.

4. Carefully place the sonde on top of the calibration cup. Loosely screw the cap on. Be sure that the sonde is stable and not going to fall over.

5. Select **"Sonde Menu"**, then **"Calibrate".** Scroll down to select **"Optic T-Turbidity".** Press Enter. Scroll to" **3- point calibration**". Press the "enter" key.

6. At this point, press the ESC and Enter key simultaneously. The screen will then ask if you want to **Uncal**. Select yes. The display will return to the calibration value screen.

7. The display will then ask for a calibration value, enter 0.0. Press the "enter" key. The unit will stabilize and display "Calibrate" and "Clean Optics". Scroll to "**clean optics**". When complete, scroll to "**calibrate**". When the display is stable, press the enter key. Unit will display "**Continue**" and press the enter key.

8. Rinse the calibration cup with 10 NTU standard. Check the expiration date on the standard prior to use. (**NOTE:** If you are limited on standard volume, the probes must be clean and dry prior to immersing in the standard.) Fill calibration cup with 10 NTU standard. Pour the standard gently onto the side of the calibration cup to prevent air bubbles. Be sure to use the black chamber cover. The standard should not be shaken or agitated. Again the sonde is placed on top of the chamber loosely. Follow the keypad instructions. The black turbidity probes are 6136 probes. The 10 NTU standard is adjusted to a value of 11.2 NTU. If the turbidity probe is gray in color the NTU standard value would be 10.0. Enter the second point **11.2** value. Press the "enter "key.

9. Rinse the calibration cup with 100 NTU standard. Check the expiration date on the standard prior to use.

10. Fill calibration cup with 100 NTU standard. Follow the keypad instructions. Again if the turbidity probe is black, it is a 6136 probe and the 100 NTU standard value is adjusted to 123 NTU. Enter third point **123** value. Press the "Enter" key.

10. Calibration is complete. Press **ESC** to go back to main screen.

ATTACHMENT E:

YSI 600/6600 Maintenance Procedures

YSI 600 & 6600 Maintenance

General Maintenance

1. After use, the YSI 600 / YSI 6600 units are stored clean and dry in the Field Support Staging room at the HCBF. Batteries are replaced on the 650 MDS when the battery voltage indicator is down to 1/4 charge. Replace with four C cell batteries.

2. The cable is cleaned and recoiled, clean and lubricate the rubber connectors. Store the sonde unit with ~ 1 inch of tap water in storage cup.

3. Check the Dissolved Oxygen (DO) membrane after each use and replace as needed. Avoid over stretching the membrane, invert sonde unit several times, check for trapped air bubbles under the membrane.

4. Rinse pH bulb with tap water to remove any film or debris. If good readings are not established, soak the probe in a dishwashing liquid solution for 10-15 minutes. A cotton swab can be used gently to clean the bulb, if needed.

Quarterly Maintenance

1. If the sonde does not have a good response time, soak the pH electrode in a 1:1 HCl solution for 30 - 60 minutes. Remove and rinse the electrode with water. If biological contamination is present soak the probe in a 1 to 1 dilution of chlorine bleach. Then rinse the probe in clean tap water for one hour, swirl occasionally.

2. Clean the Conductivity block and electrodes with a dishwashing liquid solution.

3. Maintain the ORP sensor in the same manner as the pH probe.

4. The depth sensor port should be inspected for blockages or build-ups of mineral or biological matter. A syringe can be used to flush out the ports with tap water.

5. The temperature sensor is factory set and requires no calibration, however, it should be checked against a certified laboratory thermometer quarterly. Wipe down the temperature sensor with a clean cloth.

6. The function of the Redox (ORP) sensor can be checked quarterly against a standard Zobel's solution.

Special Maintenance on the 6600 Sonde Units

1. The Turbidity optical sensor should be cleaned, as needed, using the attached wiper mechanism. The wiper should be changed as needed.

ATTACHMENT F:

YSI 600/6600 Operation Procedures

YSI 600 & 6600 Operation

Tributary Field Sampling

1. Transport the YSI 600 or 6600 sonde unit along with the 650 MDS in the carry case, with the storage cap secured. Be sure to keep the cable coiled neatly and secure the unit such that it does not slide in the cab of the vehicle. When using the unit in the field, set the case on a plastic crate, keeping it off the ground and clean.

2. Before lowering the sonde unit, attach the weighted probe guard. Throughout the day, and in between sampling sites, the probe guard may be removed and the storage cup is replaced.

3. Lower the sonde unit into the stream at mid-stream & mid-depth. This method should be used at all sampling locations except for the following sites. At the **Lake Outlet** sampling site collect a mid-channel profile along the bridge, obtain readings at half-meter increments and at 0.6 meters and 3.7 meters (corresponding to the sample depths of 2' and 12'). At **East Flume** sampling site, lay the sonde unit in front of the v-notch weir.

4. When securing the sonde unit cable to a railing be sure not to overly bend it, as that could damage the coaxial **cable**.

5. Log the data after approximately 2 minutes or when the readings appear stable. Record data by: selecting **"sonde run"** from the 650 Main Menu, then **select "log one sample"** from the 650 column, selecting **"enter"**. Choose a file name and select **"ok."** The display will tell you that the sample is logged. Note that the sonde unit will take longer to stabilize in cold weather.

Lake Sampling

1. Transport the YSI 600 or 6600 sonde unit along with the 650 MDS in the carry case, with the storage cap secured to the sonde unit. Be sure to keep the cable coiled neatly and secure the unit such that it does not slide in the cab of the vehicle.

2. Before lowering the sonde unit, attach the weighted probe guard. Throughout the day, and in between sampling sites, the probe guard may be removed and the storage cup is replaced.

3. Record data at every 0.5 meter increment, starting at the surface to the bottom. Log the data after approximately 2 minutes or when **the** readings appear stable. To record data for the event select **"sonde run"** from the 650 Main Menu, then **select "log one sample"** from the 650 column, selecting **"enter"**. Choose a file name and select **"ok."** The display will tell you that the sample is logged. Note that the sonde unit will take longer to stabilize in cold weather.

River Sampling

1. Transport the YSI 600/6600 sonde unit along with the 650 MDS in the carry case, with the storage cap secured to the sonde unit. Be sure to keep the cable coiled neatly and secure the unit such that it does not slide in the cab of the vehicle. When using the unit in the field, set the case on a plastic crate if possible, keeping it off the deck of the boat.

2. Before lowering the sonde unit, attach the weighted probe guard. Throughout the day it is advisable to keep the sonde unit in a tub of river water. This allows for quicker usage and reduces the need for frequent removal of the probe guard.

3. Record data at every 0.5 meter increment, starting at the surface to the bottom. Be sure to log a data reading at 1 meter below the surface and 1 meter above the bottom, to correspond to water sample collection depths. Record the data after approximately 2 minutes or when the readings appear stable. Record data as described above.

Data Download

1. Connect the YSI 650 display unit to the interface cable on the designated computer. Turn the YSI 650-display unit on.

2. On the computer; access **EcoWatch** from the Windows menu, by selecting the icon.

3. On the YSI 650 select **"file"** from the main menu, then select **"upload to PC,"** then choose the file you wish to transfer.

4. On the computer select the **"sonde icon on the tool bar,"** the file transfer status will be displayed on the computer. After the file has been transferred select **"file"**, then **"open"** from the main tool bar and choose the file you wish to open. The new file will be opened in the EcoWatch software and can now be exported as a text file. In the file menu system on the computer, select **"export"**, then **"CDF/WMF."** Now give the file to be exported a text file name, such as: 05-22-02, in the Q:\AMP\2012\Tribs\Biweekly\ directory. Select **"export"** on the computer. The transfer will be completed.

5. Open *Excel* from the Windows menu, open Q:\AMP\2012\Tribs\Biweekly\ then choose the file type as **"All Files,"** then selected text file e.g. 05-22-02. In order to import this file into *Excel* two options must be **selected**. The first drop down box selection should be **"delimited"**, then choose **"Next"**, the second drop down box selection should be **"comma"**, be sure to click off **"tab"**, then choose **"finish"**.

6. Save the file in *Excel*. Select **"Save as"**. For a lake file save as: Q:\AMP\2012\Lake\Biweekly\05-22-02SD. Be sure to select the **"File Type"** as **"Microsoft Excel Workbook."** Open *Excel* from the Windows menu and open the desired file. Manipulate the data to fit the data format.

ATTACHMENT 2

QUALITY ASSURANCE PROGRAM PLAN

ONONDAGA LAKE FISH SAMPLING PROGRAM (2012)

AMBIENT MONITORING PROGRAM

Prepared for the NYSDEC

Prepared by:

Onondaga County
Department Of Water Environment Protection

June 2012

TABLE OF CONTENTS

1.0 INTRODUCTION/PURPOSE

As part of the Onondaga Lake Ambient Monitoring Program the Onondaga County Department of Water Environment Protection has prepared a Quality Assurance Program Plan (QAPP) for the Onondaga Lake Fish Sampling Program for 2012. This document provides written documentation of the QAPP associated with a baseline fisheries investigation that was initiated in 2000, and subsequent revision or modifications to the program.

The County's long-term monitoring program includes assessment of physical, chemical, and biological attributes of the aquatic resource. The baseline Onondaga Lake Fisheries Monitoring Program, and subsequent annual efforts, are expected to address the goal of the *Ambient Monitoring Program* to assess progress towards "swimmable and fishable" conditions in Onondaga Lake by monitoring fish reproductive success and changes in the structure of the fish community.

Background

The Onondaga Lake fish sampling program was developed in consultation with expert technical advisors in limnology, engineering, statistics, and fisheries. In addition, Ichthyological Associates, Inc assisted with the development of the original document, and Ecologic, LLC assisted with the development of the original document and subsequent revisions. The 2012 lake fisheries program is summarized in Table 1.

Development of the QAPP

OCDWEP (formerly OCDDS), Ichthyological Associates, Inc. (IA), and EcoLogic, LLC (EcoLogic) staff met on August 15, 2000 to review the schedule and services to be provided for the AMP. Following those discussions, IA/EcoLogic began a series of meetings with OCDWEP technical staff to document procedures used for the Onondaga Lake 2000 Fisheries AMP. The meetings included interviews of OCDWEP staff involved in each aspect of the program. Following initial interviews IA/EcoLogic staff observed field collections of ongoing program and reviewed data entry requirements for each program. Following the initial interviews and review of the *Onondaga County Ambient Monitoring Program: Year 2000 Onondaga Lake Fish Sampling Program* (EcoLogic 2000), IA/EcoLogic prepared the initial draft of the QAPP for review and comment by the OCDWEP.

The purpose of the QAPP is to mesh field collection procedures and data requirements into a comprehensive document that provides a template for field, laboratory, and data management methods. The QAPP is meant to supplement in-house training of OCDWEP technicians and provide a framework from which trained staff can conduct consistent field surveys. The QAPP is considered to be a living document. That is, as changes are made in the Onondaga Lake Fisheries AMP, revisions will be made to the QAPP to reflect those changes.

Changes or revisions to the QAPP may include:

- intensity of the sampling program;

- incorporation of new elements to the program, or deletion of specific;
- revisions, clarifications, and improvements to methodologies; and
- incorporation of new methodologies into the program.

Thus the QAPP serves multiple purposes. It provides annual documentation of Standard Operating Procedures (SOPs), although more formal and detailed SOPs have developed for in-house training and documentation purposes. It also provides a framework of data forms designed to ensure collection and entry of data, and a framework for training of OCDWEP's staff via consistent mentoring by more senior, experienced staff through the structure of the QAPP.

The QAPP for the Onondaga Lake fish sampling program has been divided into chapters, with each chapter representing a major field component of the AMP. Each chapter provides a purpose and description of the component, the procedures for sampling that component, appropriate data sheets, maps, and descriptions of stations and station codes. The February 2012 version of the QAPP, incorporates program modifications to the 2011 fisheries assessment program.

Table 1. Summary of Year 2012 Onondaga Lake Fish Community AMP Sampling Plan.

Component	Methodology and Gear	Sampling Objectives	Location and Number of Samples	Timing	Changes
Pelagic Larvae	Modified double oblique Miller high-speed trawl, with flow meter attached, collected during the day in the pelagic zone.	Determine species richness.	- 4 double oblique tows in each basin (North and South) per event. -Tows will sample water depths from the surface to approximately 5.0-5.5 meters. -Total No. of events =8 -Total No. of samples =64	-Daytime -Bi-weekly. -April (when water temps. are 7-8 ºC) through end of July.	- Pelagic larvae sampling deleted in 2012.
Littoral Larvae	Larval fish seine swept for 10m in littoral zone.	Determine community structure, and species richness.	-5 strata with 3 sites in each strata and 1 sweep at each site. -No. of Sites = 15 -Total No. of events = 2 -Total No. of samples = 30	-Daytime Twice per year -Mid May -Early July	-Reinstate larval seine program
YOY-Juvenile Fish	50’ x 4’ x 1/4” bag seine swept into shore in the littoral zone.	Determine community structure and species richness.	-5 strata with 4 sites in each strata and 1 sweep at each site. -No. of Sites = 20 -Total No. of events = 5 -Total No. of samples = 100	-Daytime -Every 3 weeks. -Mid July - October.	-Deleted first event. (Late June early July) -Additional sample location in each strata
YOY-Juvenile Fish	Boat mounted electrofisher in the littoral zone at night.	Determine community structure and species richness	-One transect in each strata. -Total No. of events = 1 -Total No. of samples = 5	Night-time. -Once per year;. late July	-Supplement juvenile fish sampling program with boat electrofishing.
Nesting Fish	Lake wide nest survey.	Document spatial distribution and species composition	-Entire perimeter of lake divided into 24 equal length sections. -Total No. of events = 1 -Total No. of samples = 24	-Once in June when water temperature is between 15° and 20 °C.	-No Change from previous year.
Adult Fish- Littoral Zone	Boat mounted electrofisher in the littoral zone at night.	Determine community structure, species richness, CPUE, and relative abundance.	-Entire perimeter of lake shocked in 24 contiguous transects. -Alternating all-fish/gamefish transects. -Total No. of events = 2 -Total No. of samples = 48	-Night-time. -Twice per year; Spring and Fall. -Spring and Fall. - Water temp. between 15º and 21 ºC.	-No Change from previous year.
Adult Fish- – Littoral Profundal Zone	Experimental gill nets of standard NYSDEC dimensions.	Determine community structure, and species richness.	-Two nets per strata. -Nets set on bottom, perpendicular to shore at a water depth of 3-10m for two hours. -Total No. of events = 2 -Total No. of samples = 20	--Night-time. -Twice per year, within one week of littoral electrofishing.	-Set nets at night. -One additional sample location in each strata -Set nets perpendicular to shore

Angler Census	Angler diary program.	Determine catch rates, species composition.	-Recruit diary participants at fish & game clubs and fishing organizations.	-Issued annually and collected at end of fishing season (fall).	-Discontinue angler diary program in 2012 due to lack of interest and participation by anglers.

2.0 STAFF TRAINING

The OCDWEP has approached the AMP under the self-monitoring element that is central to the Federal Clean Water Act. OCDWEP has acquired a staff with a wide range of academic education supplemented by experience gained by working for state fisheries agencies, universities, and environmental consulting and research firms. This staff of scientists and technicians are supported by maintenance and operation personnel that provide the skills to build, construct, maintain, and modify gear needed to conduct the fisheries surveys. This expertise allows the OCDWEP to successfully train and mentor qualified individuals to provide a high level of quality to the data of the fisheries program. As with any long-term monitoring program, individuals will advance in their careers, retire, or move to new locations. This matriculation will require periodic in-house training of new individuals. The QAPP is integral to this training. Its use and understanding will provide each individual with an easy to understand document to ensure day-to-day and year-to-year consistency of the Onondaga Lake Fish Sampling Program.

In addition to the QAPP and SOPs, the County, conducts annual audits for each biological monitoring component. The audits are intended to ensure that the field technicians conducted their work in a professional manner and comply with the procedures outlined in the QAPP and SOPs. In addition, the audits determine if any observation would jeopardize the quality of the data (technique, field logs, training, etc.). The biological monitoring component to be audited annually includes the littoral larval seining, juvenile seining, adult electrofishing, and adult gill nets.

Thus the use of the QAPP in conjunction with the formal Standard Operating Procedures (SOPs) and internal audits for the biological monitoring program activities, the *Onondaga County Ambient Monitoring Program: Onondaga Lake Fish Sampling Program (2012)*, and subsequent programs, will provide OCDWEP with a successful fisheries assessment program.

3.0 LITTORAL LARVAE – LARVAL SEINE

3.1 Procedures

Littoral larval samples will be collected during two sampling events occurring in mid-May and early July. Three randomly selected sites within each of five strata encompassing the littoral zone of the lake were selected in 2000 (last sampled in 2003) and are revisited for each sampling event (Figure 1: Location of Larval Seine Sites in Onondaga Lake, Appendix A1). These sites are physically marked on the shoreline and their coordinates documented with a GPS unit. One sample will be collected at each sampling site for a total of 15 samples collected from Onondaga Lake during each sampling event.

3.1.1 Pre-field:

Step 1. Review QAPP to determine overall needs of programs
Step 2. Assemble field data sheet packet and equipment.
Step 3. Examine equipment for needed repairs.
Step 4. Print labels and pre-label sample jars.
Step 5. Check calibration of water quality (WQ) meter.
Step 6. Review weather reports.

3.1.2 Field:

Step 1. Proceed to appropriate station and record WQ meter number, facility code/location, date, time, and WQ data at surface.
Step 2. Stretch the seine out on shore and remove any material lodged in mesh. Check for holes and repair if necessary.
Step 3. Bring net to the beginning of the sampling site (previously selected and marked).
Step 4. Walk seine (out of water) off shore until 1-m depth is reached, and deploy it perpendicular to the shoreline being sure to remove any twists.
Step 5. With net stretched, both technicians in unison sweep the net perpendicular to the shoreline for a distance of 10 m. A sample will be rejected if the net must be lifted or stopped to dislodge a snag.
Step 6. When 10 m is reached, both ends of the net (lead line only) are lifted in unison to a horizontal position with the float line.
Step 7. Walk net to shore and carefully place net into a tub large enough to handle the entire net and provide suitable room for wash down.
Step 8. With the net in the tub, stretch a portion of the net out and wash all material on it into the tub with lake water filtered with a 541-micron wash bucket.
Step 9. Repeat step 2
Step 10. Pour the entire contents of the tub into a 541-micron wash bucket and place contents into a sample jar and preserve it with 10% buffered formalin.
Step 11. Review data sheets for completeness before proceeding to next station.

3.1.3 End of Sample Day

Step 1 Review field notes for completeness and QAPP sign offs.
Step 2. Submit original data sheets and field notes for duplication.
Step 3. Write down needed equipment repairs.

3.1.4 End of Sample Event

Step 1. Log original data sheets/notes into OCDWEP Hardcopy File System.
Step 2. Submit duplicate copy of data sheets/notes for data entry.

3.1.5 Field Data Sheet Packet

The following items should be included in the field data sheet packet for this sampling activity.

Facility code/station description (Table 2, Appendix A1)
Station data sheet (Table 3, Appendix A1)
Map showing location of sampling stations (Figure 1, Appendix A1)
List of fish species codes/names
Sample labels
Chain-of-custody forms (as appropriate)

Appendix A1 contains examples of the station data sheet, individual fish data sheet, bulk fish data sheet, map of sampling stations, list of facility codes/station description, and list of species codes/names appropriate for use in sampling littoral larval fish.

4.0 LITTORAL YOUNG-OF-YEAR (YOY)/JUVENILE FISH – BAG SEINE

4.1 Procedures

Littoral YOY/juvenile fish will be collected using a bag seine (seine dimension - 50' x 4' x 1/4") approximately every three (3) weeks mid July to October, resulting in a total of five (5) sampling events. Three (3) randomly selected sites within each of five (5) strata encompassing the littoral zone of the lake were selected in 2000 and are revisited for each sampling event (Figure 2: Location of Juvenile Seine Sites in Onondaga Lake, Appendix A2). These sites are physically marked on the shoreline and their coordinates documented with a GPS unit. One (1) additional sample (with little or no aquatic vegetation) will be randomly collected in each strata for a total of twenty (20) samples collected from Onondaga Lake during each sampling event.

4.1.1 Pre-field:

Step 1. Review QAPP to determine overall needs of programs.

Step 2. Assemble: field data sheet packet and equipment.

Step 3. Examine equipment for needed repairs.

Step 4. Check calibration of water quality (WQ) meter.

Step 5. Review weather reports for sampling feasibility.

4.1.2 Field:

Step 1. Proceed to appropriate station and record WQ meter number, facility code/location, date, time, and WQ data at the near surface. Standard water quality parameters include temperature, Dissolved Oxygen (percent saturation and concentration), salinity, conductivity, pH, and ORP.

Step 2. Stretch the seine out on shore and remove any material lodged in the mesh. Check for holes and repair if necessary.

Step 3. Bring net to the marked site location. (Note: Sites have been previously selected and marked by OCDWEP staff).

Step 4. Walk one end of the seine off shore until full length of net is deployed perpendicular to the shoreline.

Step 5. Check the bag section of the seine to make sure it is fully deployed and not tangled.

Step 6. With one person holding the in-shore brail stationary, a second person sweeps the offshore brail to shore. A third person walks behind the bag end of the seine to dislodge the seine if it becomes stuck. A sample will be rejected if the leadline of the seine must be lifted or the seine must be fully stopped in order to dislodge the snag. In this case, the site will be returned to later during the sampling event to collect the sample.

Step 7. As the offshore brail approaches shore, the two brails will be worked together, and the seine will be beached while being careful to maintain the integrity of the bag section of the seine and keeping the leadline on bottom.

Step 8. Immediately upon retrieval of the seine all fish will be picked and placed in holding tanks. Care shall be taken to sort through captured debris (algae mats and macrophytes) in order to retrieve all fish. In the event adult fish are captured, they should be identified to species, counted, released back into the lake, and noted as such on the data forms. Representative adult bass and other selected game fish should be tagged with a numbered floy tag, measured and sampled for scales (scales are only collected in the fall) prior to release. The tag number, scale envelope number, and other related information should be recorded on the appropriate data form.

Step 9. Stretch the seine out on shore and remove any material lodged in the mesh. Check for holes and repair if necessary.

Step 10. Stretch out seine to dry while processing samples.

Step 11. A minimum of 30 random individuals in each life stage (YOY and juvenile) and species should be measured (total length in mm). Remaining fish should be mass-counted based on life stage (YOY, juvenile, adult). YOY sunfish should be grouped as "*Lepomis* sp." All other individuals should be identified to species. All fish should be returned to the lake after completing measurements.

Unknown species should be noted as such on the data forms by number (for example *Unknown Species No.1* and *Unknown Species No. 2*) and placed in a formalin-filled, labeled jar and identified later in the laboratory (wear Nitrile gloves, safety glasses, and a full face shield during this operation).

Step 12. Review data sheets for completeness before proceeding to next station.

4.1.3 End of Sample Day

Step 1. Review field notes for completeness and QAPP sign offs.

Step 2. Submit original data sheets and field notes for duplication.

Step 3. Write down needed equipment repairs and report to supervisor.

4.1.4 End of Sample Event

Step 1. Log original data sheets/notes into OCDWEP Hardcopy File System.

Step 2. Submit duplicate copy of data sheets/notes for data entry.

4.1.5 Field Data Sheet Packet

The following items should be included in the field data sheet packet for this sampling activity.

- Facility code/station description (Table 4, Appendix A2)
- Station data sheet (Table 5, Appendix A2)
- Individual fish data sheet (Table 6, Appendix A2)
- Bulk fish data sheet (Table 7, Appendix A2)
- Map showing location of sampling stations (Figure 2, Appendix A2)
- List of fish species codes/names (Table 8, Appendix A2)
- Sample labels.
- Scale envelopes.

Appendix A2 contains examples of the station data sheet, individual fish data sheet, bulk fish data sheet, map of sampling stations, list of facility codes/station description, and list of species codes/names appropriate for use in sampling littoral YOY and juvenile fish.

5.0 JUVENILE FISH – BOAT ELECTROFISHING

5.1 Procedures

Boat electrofishing stations were determined in 2000 by dividing the lake's littoral zone into twenty-four (24) approximately equal length transects that encompass the entire perimeter of the lake (Figure 3: Location of Juvenile Electrofishing Transects in Onondaga Lake, Appendix A3). Five (5) of these transects will be randomly selected (one in each strata) and utilized for this sampling event. The beginning and ends of each transect are designated by GPS coordinates. Time spent electrofishing at each transect will be recorded during each sampling event to allow for standardization of catch per unit effort.

Boat electrofishing for juvenile fish will be conducted, in late July to early August. During the sampling event, fish will be collected during the night along five (5) randomly selected transects distributed around the perimeter of the lake (one in each strata), resulting in collection of a total of five (5) boat electrofishing samples/transects for the year.

5.1.1 Pre-field:

Step 1. Review QAPP to determine overall needs of programs.

Step 2. Assemble: field data sheet packet and equipment.

Step 3. Examine equipment for needed repairs.

Step 4. Check calibration of water quality (WQ) meter.

Step 5. Review weather reports for sampling feasibility.

Step 6. Notify the OCDWEP Metro Board operator of proposed night sampling event.

5.1.2 Field:

Step 1. Proceed to predetermined transect location and record facility code/location, date, time, and WQ data taken at near surface depth. Standard water quality parameters include temperature, Dissolved Oxygen (percent saturation and concentration), salinity, conductivity, pH, and ORP.

This event will require four technicians, two (2) will collect fish with nets at the front of the electrofishing boat, one (1) will be the data recorder, and one (1) will drive and operate the generator/pulsator.

Step 2. Record start of sample data: time of day, starting seconds on pulsator, and actual GPS coordinates.

Step 3. Place boat into forward gear at idle speed. Start the generator, activate electrofisher and begin collection of fish. The two netting technicians will maintain the foot pedal,that activates the electrofisher, in the "on" position for the entire transect.

Gizzard shad and alewives occurring in large schools or un-boardable quantities may be estimated without actually collecting each fish (this will minimize catch mortality and will prevent under estimating significant quantities of "missed/non-boarded" fish. However, these "missed/non-boarded" fish shall be noted in the bulk fish section of the field sheet as an "estimate". Gizzard shad and alewives that are boarded, but are in excess of the 30 individuals initially counted and measured, shall be individually counted (not measured) and noted in the bulk fish section of the field sheets as a "count". Because of the difficulty in differentiating small shad and alewives from one another, if a school of small clupeids (shad/alewives) is encountered, a sample of the school should be netted, brought on board and identified. After positive identification the number of fish in the school can be estimated.

For all other species, missed fish shall be estimated, and recorded in the bulk fish section of the field sheets as an "estimate". Since the two netting technicians will be maintaining a mental tally of "missed/non-boarded" fish, this data should be recorded immediate following the completion of each transect to minimize loss of semi-quantifiable data.

Step 5. Record electrofisher data: voltage, amps, and pulse width. Monitor settings and displays throughout the transect.

Step 6. Maintain the boat electrofisher on course approximately parallel with the shore in one meter of water at approximately idle speed (the motor tilt will need to be adjusted to maintain appropriate speed). The boat may be slowed down in order to try and capture a rare fish that is initially missed by the netters. However, all attempts should be made to keep the boat moving slowly forward in approximately one meter of water for the majority of the transect.

Note: All attempts are made to maintain the monitoring depth of one (1) meter. However, the natural variation of the depth contours or abrupt drop offs (natural or man-made) may result in short periods of shallower or deeper monitoring.

Step 7. When the end of the transect is reached, turn off electrofisher unit, and return boat to neutral.

Step 8. Record time, GPS coordinates, and miscellaneous collection notes (missed/non-boarded fish, estimates, counts, etc.)

Step 9. Proceed to approximately the mid-transect location to work up collected fish.

Step 10. Fish whose numbers were estimated should be entered in the bulk fish section of the field form first to prevent omissions.

Then, collected fish should be identified to species, measured for length (nearest mm), and, for the largemouth and smallmouth bass samples only, measured for weight (nearest gram).

For samples in which small to moderate numbers of fish are collected (less than 30), all fish should be measured. In samples in which high numbers (greater than 30) of one or more species are collected, random sub-samples of the abundant species will be measured, and the remaining individuals of those species need only be counted and listed in the bulk fish data sheet. This will result in some samples having both individual fish data and bulk fish data. Fish not measured individually should be mass-counted. Unknown species should be noted as such on the data forms by number (for example unknown species 1 and unknown species 2) and placed in a formalin-filled, labeled jar and identified later.

Step 11. Review data sheets for completeness before proceeding to next station.

5.1.3 End of Sample Day

Step 1. Notify Metro Board of safe return from field.

Step 2. Review field notes for completeness and QAPP sign offs.

Step 3. Submit original data sheets and field notes for duplication.

Step 4. Write down needed equipment repairs and report to supervisor.

5.1.4 End of Sample Event

Step 1. Log original data sheets/notes into OCDWEP Hardcopy File System.

Step 2. Submit duplicate copy of data sheets/notes for data entry.

5.1.5 Field Data Sheet Packet

The following items should be included in the field data sheet packet for this sampling activity.

- Facility code/station description (Table 9, Appendix A3).
- Station data sheet (Table 10, Appendix A3).

- Individual fish data sheet (Table 11, Appendix A3).
- Bulk fish data sheet (Table 12, Appendix A3).
- List of fish species codes/names (Table 13, Appendix A3).
- Map showing location of sampling stations (Figure 3, Appendix A3)
- Sample labels.

Appendix A3 contains examples of the station data sheet, individual fish data sheet, bulk fish data sheet, map of sampling stations, list of facility codes/station description, and list of species codes/names appropriate for use in sampling juvenile fish.

6.0 NESTING SURVEY

6.1 Procedures

Nesting survey transects were determined in 2000 by dividing the lake's littoral zone into twenty-four (24) approximately equal length transects that encompass the entire perimeter of the lake (Figure 4: Location of Nesting Survey Transects in Onondaga Lake, Appendix A4). These transects are utilized for each annual event, and these are the same transects used for the adult fish boat electrofishing events. The beginning and ends of each transect are designated by GPS coordinates. Fish nests will be identified when possible and counted along these transects that are parallel to the shoreline. Date of the survey will be determined based on the time of year (June), water temperature (between 15 and 20ºC), water clarity (ability to see bottom in 2 m of water), weather conditions (sunny and calm), and observations of peak spawning activities of select gamefish.

6.1.1 Pre-field:

Step 1. Review QAPP to determine overall needs of program.

Step 2. Determine if bluegill, pumpkinseed and largemouth bass appear to be near peak spawn (typically observed during other lake sampling events).

Step 3. Determine if water visibility is at least 2 m (based on secchi disc readings).

Step 4. Assemble: field data sheet packet and equipment.

Step 5. Examine equipment for needed repairs.

Step 6. Check calibration of water quality (WQ) meter.

Step 7. Review weather reports for sampling feasibility.

6.1.2 Field:

Step 1. Proceed to appropriate transect and position boat at its start in 1 m of water. Record WQ meter number, facility code/location, date, time, and WQ data at the near surface. Standard water quality parameters include temperature, Dissolved Oxygen (percent saturation and concentration), salinity, conductivity, pH, and ORP.

Step 2. Post one technician on the bow of the boat with polarized glasses. This technician will serve as nest spotter. Position a second technician in the center of the boat.

This technician will serve as the data recorder. A third technician serves as the boat driver.

Step 3. Start boat and proceed parallel to shore keeping the boat in 1 m of water at all times. Speed of travel will be dependent on the nest spotters and nest density.

Step 4. The technician on the bow will count and report to the data recorder all nests observed, and when possible identify species on the nest. The observer shall report nest counts to the recorder every five (5) to ten (10) fish nest observed. An alternative method is to utilize a mechanical handheld counter.

Step 5. The driver will stop the boat at the end of the transect.

Step 6. Review data sheets for completeness before proceeding to next transect.

Step 7. Bring the boat to the beginning of the next transect and repeat steps 1 through 6.

6.1.3 End of Sample Day

Step 1. Review field notes for completeness and QAPP sign offs.

Step 2. Submit original data sheets and field notes for duplication.

Step 3. Write down needed equipment repairs and report to supervisor.

6.1.4 End of Sample Event

Step 1. Log original data sheets/notes into OCDWEP Hardcopy File System.

Step 2. Submit duplicate copy of data sheets/notes for data entry.

6.1.5 Field Data Sheet Packet

The following items should be included in the field data sheet packet for this sampling activity.

- Facility code/station description ((Table 14, Appendix A4).
- Station data sheet with list of fish species codes/names (Table 15, Appendix A4).
- Map showing location of sampling stations (Figure 4, Appendix A4).

Appendix A4 contains examples of the station data sheet, map of sampling stations, list of facility codes/station description, and list of species codes/names (located on station data sheet) appropriate for use in conducting a nest survey.

7.0 ADULT FISH – BOAT ELECTROFISHING

7.1 Procedures

Boat electrofishing stations were determined in 2000 by dividing the lake's littoral zone into twenty-four (24) approximately equal length transects that encompass the entire perimeter of the lake (Figure 5: Location of Adult Electrofishing Transects in Onondaga Lake, Appendix A5). These transects are utilized for each sampling event and do not change year to year. The beginning and ends of each transect are designated by GPS coordinates. Transects are divided into alternating all-fish/gamefish samples (odd number transects are always all fish and even numbered transects are always game fish only). In "all-fish" transects all species are netted, while in "gamefish only" transects only those species designated as gamefish by the County are netted (Appendix A7). Time spent electrofishing at each transect will be recorded during each sampling event to allow for standardization of catch per unit effort.

Boat electrofishing is conducted for two (2) sampling events, in the Spring and in the Fall based on surface water temperatures between 15 and 21° C. During each sampling event, fish will be collected during the night along the twenty-four (24) transects distributed around the perimeter of the lake, resulting in collection of a total of forty-eight (48) boat electrofishing samples/transects for the year (24 all-fish and 24 gamefish).

7.1.1 Pre-field:

Step 1. Review QAPP to determine overall needs of programs.

Step 2. Assemble: field data sheet packet and equipment.

Step 3. Examine equipment for needed repairs.

Step 4. Check calibration of water quality (WQ) meter.

Step 5. Review weather reports for sampling feasibility.

Step 6. Notify Onondaga County Sheriff's Office and the OCDWEP Metro Board operator of proposed night sampling event.

7.1.2 Field:

Step 1. Proceed to predetermined transect location and record facility code/location, date, time, and WQ data taken at near surface depth. Standard water quality parameters include temperature, Dissolved Oxygen (percent saturation and concentration), salinity, conductivity, pH, and ORP.

This event will require four technicians, two (2) will collect fish with nets at the front of the electrofishing boat, one (1) will be the data recorder, and one (1) will drive and operate the generator/pulsator.

Step 2. Determine if transect is for all fish or game fish (odd number transects are all fish and even numbered transects are game fish).

Step 3. Record start of sample data: time of day, starting seconds on pulsator, and actual GPS coordinates.

Step 4. Place boat into forward gear at idle speed. Start the generator, activate electrofisher and begin collection of fish. The two netting technicians will maintain the foot pedal, that activates the electrofisher, in the "on" position for the entire transect. For gamefish transects any fish that resembles one of the gamefish species should be boated. If the fish is identified as being a non-gamefish species while still in the net it may be immediately released.

For all-fish transects, an attempt should be made to collect all fish encountered, with the exception of common carp, or gizzard shad and alewives occurring in large schools or quantities incapable of boarding. The quantity of common carp within netting distance shall be counted (or estimated if in large numbers) and noted as a count (or estimate) in the bulk fish section of the field sheet.

Gizzard shad and alewives occurring in large schools or un-boardable quantities may be estimated without actually collecting each fish (this will minimize catch mortality and will prevent under estimating significant quantities of "missed/non-boarded" fish. However, these "missed/non-boarded" fish shall be noted in the bulk fish section of the field sheet as an "estimate". Gizzard shad and alewives that are boarded, but are in excess of the 30 individuals initially counted and measured, shall be individually counted (not measured) and noted in the bulk fish section of the field sheets as a "count". Because of the difficulty in differentiating small shad and alewives from one another, if a school of small clupeids (shad/alewives) is encountered, a sample of the school should be netted, brought on board and identified. After positive identification the number of fish in the school can be estimated.

For all other species, missed fish shall be estimated, and recorded in the bulk fish section of the field sheets as an "estimate". Since the two netting technicians will be maintaining a mental tally of "missed/non-boarded" fish, this data should be recorded immediate following the completion of each transect to minimize loss of semi-quantifiable data.

Step 5. Record electrofisher data: voltage, amps, and pulse width. Monitor settings and displays throughout the transect.

Step 6. Maintain the boat electrofisher on course approximately parallel with the shore in one meter of water at approximately idle speed (the motor tilt will need to be adjusted to maintain appropriate speed). The boat may be slowed down in order to try and capture a rare fish that is initially missed by the netters. However, all attempts should be made to keep the boat moving slowly forward in approximately one meter of water for the majority of the transect.

Note: All attempts are made to maintain the monitoring depth of one (1) meter. However, the natural variation of the depth contours or abrupt drop offs (natural or man-made) may result in short periods of shallower or deeper monitoring.

Step 7. When the end of the transect is reached, turn off electrofisher unit, and return boat to neutral.

Step 8. Record time, GPS coordinates, and miscellaneous collection notes (missed/non-boarded fish, estimates, counts, etc.)

Step 9. Proceed to approximately the mid-transect location to work up collected fish.

Step 10. Fish whose numbers were estimated should be entered in the bulk fish section of the field form first to prevent omissions.

Then, collected fish should be identified to species, measured for length (nearest mm), and, for the fall samples only, measured for weight (nearest gram).

Note: Individual fish weighing less than 100 grams will be weighed on the small scale.

If the small scale will not stabilize, multiple fish of the same species and size range may be bulk weighed and divided by the total number of fish to establish a relative weight (e.g. weigh all alewife between 140 mm and 160 mm – divide total weight of all alewife weighed by total number of alewife to establish a relative weight for each of the individual alewife). These weights shall be noted in the comment section of the individual fish data sheet as a “bulk weight”.

For samples in which small to moderate numbers of fish are collected (less than 30), all fish should be measured. In samples in which high numbers (greater than 30) of one or more species are collected, random sub-samples of the abundant species will be measured, and the remaining individuals of those species need only be counted and listed in the bulk fish data sheet. This will result in some samples having both individual fish data and bulk fish data. Fish not measured individually should be mass-counted based on life stage (YOY, juvenile, adult). Unknown species should be noted as such on the data forms by number (for example unknown species 1 and unknown species 2) and placed in a formalin-filled, labeled jar and identified later.

Step 11. Representative adult bass and other selected game fish should be tagged with a numbered floy tag and sampled for scales (fall only) prior to release. In addition, during the fall, select species (bluegill, pumkinseed, white perch, yellow perch, and gizzard shad) shall also be randomly sampled for scales prior to release.

On spiny-rayed species, including but not limited to largemouth bass, smallmouth bass, bluegill, pumpkinseed, white perch, walleye, yellow perch and black crappie, scales will be removed from left side of the body below the lateral line, near the tip of the depressed left pectoral fin. On soft-rayed species, including trout and salmon, scales will be removed from the middle region of the body above the lateral line, beneath the posterior end of the dorsal fin on the left side.

Fish that are tagged should appear to be in good health and not overly stressed from the capture experience. The tag number, scale envelope number, and other related information should be recorded on the appropriate data form. Any recaptured fish shall be recorded on the individual field sheet data form, and evaluated to determine the need for a replacement tag.

Step 12. Review data sheets for completeness before proceeding to next station.

7.1.3 End of Sample Day

Step 1. Notify Metro Board of safe return from field.

Step 2. Review field notes for completeness and QAPP sign offs.

Step 3. Submit original data sheets and field notes for duplication.

Step 4. Write down needed equipment repairs and report to supervisor.

7.1.4 End of Sample Event

Step 1. Log original data sheets/notes into OCDWEP Hardcopy File System.

Step 2. Submit duplicate copy of data sheets/notes for data entry.

7.1.5 Field Data Sheet Packet

The following items should be included in the field data sheet packet for this sampling activity.

- Facility code/station description (Table 16, Appendix A5).
- Station data sheet (Table 17, Appendix A5).
- Individual fish data sheet (Table 18, Appendix A5).

- Bulk fish data sheet (Table 19, Appendix A5).
- List of fish species codes/names (Table 20, Appendix A5).
- Map showing location of sampling stations (Figure 5, Appendix A5).
- Sample labels.
- Scale envelopes.

Appendix A4 contains examples of the station data sheet, individual fish data sheet, bulk fish data sheet, map of sampling stations, list of facility codes/station description, and list of species codes/names appropriate for use in sampling littoral adult fish.

8.0 ADULT FISH – Littoral Profundal Gill Net Sampling

8.1 Procedures

Gill net sampling will be conducted during two (2) sampling events, in Spring and Fall within one (1) week of the electrofishing events. During night-time hours, two (2) nets will be randomly set in each of the five (5) strata (Figure 6: Sample Locations Littoral Profundal Adult Fish Sampling (Gill Nets), Appendix A6). The nets will be set for two (2) hours perpendicular to shore in 3 to 10 meters of water, resulting in collection of a total of twenty (20) samples/sets during the year.

8.1.1 Pre-field:

Step 1. Review QAPP to determine overall needs of programs.

Step 2. Assemble: field data sheet packet and equipment.

Step 3. Examine equipment for needed repairs.

Step 4. Check calibration of water quality (WQ) meter.

Step 5. Review weather reports for sampling feasibility.

8.1.2 Field (Gill Net Setting):

Step 1. Proceed to a random monitoring location within one (1) of the five (5) stratums.

Step 2. Upon arrival locate 10 meters depth of water with depth finder and collect water quality data from 0 to 10 meters in 0.5 meter intervals. Log the depth and water quality data on the meter (all data will be downloaded at the end of the day). Standard water quality parameters include temperature, Dissolved Oxygen (percent saturation and concentration), salinity, conductivity, pH, and ORP. Record the GPS coordinates on the field data sheet.

Step 3. Rig gill net with appropriate anchors and buoys.

Step 4. Bring the boat perpendicular to shore in 3 meters of water

Step 5. With one technician on the bow of the boat lower the leading anchor to the bottom and pay out the net as the boat is slowly reversed. Pay out the net by handling the float-line and shaking out or spreading the mesh as the boat reverses to assure net deploys.

Step 6. After the full length if the gill net is set out, stretch the net as taut as possible, and drop the trailing anchor and record ending depth.

Step 7. Allow for two hours to elapse before retrieval.

8.1.3 Field (Gill Net Retrieval):

Step 1. Pull in the downwind buoy and anchor, and remove them from the net. Grasping the lead and floatlines together, slowly bring in the net.

Step 2. As fish are encountered remove them as fast as possible and place in a live well. Under ideal conditions and a light catch, the fish may be removed from the net as it is being retrieved. When large catches are encountered, remove only gamefish, all other fish can be removed after net is retrieved at a location secluded from public viewing.

Step 3. Record data on catch using the appropriate field forms, recording the following information:

- Species identification.
- Length (mm) total length.
- Weight (gram - fall sample only).
- Scale samples (only in fall samples on all bass).
- Condition of fish (dead or alive).
- Tag all game fish if healthy and record tag number.

Step 4. Repeat all steps (7.1.2 and 7.1.3) for the other four (4) locations.

8.1.4 End of Sample Day

Step 1. Review field notes for completeness and QAPP sign offs.

Step 2 Submit original data sheets and field notes for duplication.

Step 3. Write down needed equipment repairs and report to supervisor.

Step 4. Download water quality data.

8.1.5 End of Sample Event

Step 1. Log original data sheets/notes into OCDWEP Hardcopy File System.

Step 2. Submit duplicate copy of data sheets/notes for data entry.

8.1.6 Field Data Sheet Packet

The following items should be included in the field data sheet packet for this sampling activity.

- Facility code/station description (Table 21, Appendix A6).
- Station data sheet (Table 22, Appendix A6).
- Individual fish (Table 23, Appendix A6).
- Bulk fish (Table 24, Appendix A6).
- List of fish species codes/names (Table 25, Appendix A6).
- Map showing location of sampling stations (Figure 6, Appendix A6)
- Sample labels
- Scale envelopes

Appendix A6 contains examples of the station data sheet, individual fish data sheet, bulk fish data sheet, map of sampling stations, list of facility codes/station description, and list of species codes/names appropriate for use in sampling pelagic adult fish.

9.0 DEFORMITIES, EROSIONS, LESIONS, TUMORS, FUNGAL INFECTIONS, AND MALIGNANCIES (DELTFM) MONITORING

Tracking of DELTFM parameters will be conducted in conjunction with all fisheries sampling activities with the exception of larval fish sampling and the adult fish nesting survey. DELTFM parameters will be recorded for only individual juvenile fish (not the bulk counts). All captured fish will be screened for any visible abnormalities. The abnormalities will be recorded on the corresponding data sheet. The technicians will be required to record the following abnormalities on the data sheets:

Deformities – Any distorted form of the fish's anatomy.
Erosions – Wear marks, scares, or scrapes.
Lesions – Visible sores, or wounds.
Tumors – A localized swelling of tissue on or in the body that has no physical function.
Fungal Infections – Any visible fungal growth on the fish.
Malignancies – A growth that could be cancerous. (use field judgment).

10.0 CHRONOLOGY OF QAPP

The QAPP for the Onondaga Lake Fish Sampling Program is a living document in that it will be periodically updated to reflect changes in the monitoring program that are instituted to improve the efficiency of data collection, focus on a particular aspect of the fish community, or narrow or expand the scope of investigation. The periodic updating of the QAPP will provide a written record of sampling procedures over the entire life of the Onondaga Lake Fish Sampling Program. This February 2010 version of the QAPP is the ninth version/issue of the document.

The first version (Initial Draft) was submitted to OCDWEP on October 18, 2000 for review and comment by OCDWEP staff. Following review of the Initial Draft by OCDWEP, a meeting was held between IA and OCDWEP in which comments on the Initial Draft were provided. These comments, along with information gathered during data analysis and report preparation for the 2000 fish sampling program were incorporated into a second version of the document submitted to OCDWEP in July 2001. Annual revisions to the QAPP have incorporated various changes made to the fisheries assessment program.

The original QAPP, and subsequent revisions, have been reviewed by the NYSDEC, revised by OCDWEP as requested, and approved by the NYSDEC prior to implementation.

11.0 LITERATURE CITED

EcoLogic, LLC. *Onondaga County Ambient Monitoring Program: Year 2000 Onondaga Lake Fish Sampling Program. Prepared for Onondaga County Department of Drainage and Sanitation, Syracuse, NY. EcoLogic, LLC., Cazenovia, NY.*

OCDWEP *SOP For Fish Scale Age and Growth Determination (DOC No. BIO-001)*

OCDWEP	*SOP For Larval Fish Identification (DOC No. BIO-002)*
OCDWEP	*SOP For Fish Tagging (DOC No. BIO-003)*
OCDWEP	*SOP For Littoral-Profundal Zone Fixed Deep Water Gill Net Sampling (DOC No. BIO-006)*
OCDWEP	*SOP For Littoral Zone Electrofishing (DOC No. BIO-007)*
OCDWEP	*SOP For Littoral Zone Young-Of-Year and Juvenile Fish Bag Seine (DOC No. BIO-008)*
OCDWEP	*SOP For Fish Nesting Survey (DOC No. BIO-009)*
OCDWEP	*SOP For Littoral Zone Larval Fish Seine (DOC No. BIO-014)*

APPENDIX A1:

Table 2. Field Data Packet for Littoral Larval Fish Sampling

Facility Code and Station Description

Facility Code	Site Abbreviation	Site Description
2536	ST1LL1R1	Stratum 1 Larval Seine Site 1
2539	ST1LL2R1	Stratum 1 Larval Seine Site 2
2542	ST1LL3R1	Stratum 1 Larval Seine Site 3
2545	ST2LL1R1	Stratum 2 Larval Seine Site 1
2548	ST2LL2R1	Stratum 2 Larval Seine Site 2
2551	ST2LL3R1	Stratum 2 Larval Seine Site 3
2554	ST3LL1R1	Stratum 3 Larval Seine Site 1
2557	ST3LL2R1	Stratum 3 Larval Seine Site 2
2560	ST3LL3R1	Stratum 3 Larval Seine Site 3
2563	ST4LL1R1	Stratum 4 Larval Seine Site 1
2566	ST4LL2R1	Stratum 4 Larval Seine Site 2
2569	ST4LL3R1	Stratum 4 Larval Seine Site 3
2572	ST5LL1R1	Stratum 5 Larval Seine Site 1
2575	ST5LL2R1	Stratum 5 Larval Seine Site 2
2578	ST5LL3R1	Stratum 5 Larval Seine Site 3

Table 3. Station Data Sheet For Littoral Larval Fish Sampling

Onondaga County Department of Water Envrironment Protection
Onondaga Lake Fish Monitoring Program

LITTORAL LARVAL -- SEINE

Date: _____ **Stratum:** _____

Crew: _____ **Site:** _____

Time Start: _____ (Start Seining) **Time End:** _____ (Processing Fish) **Facility Code:** _____

GPS North: 43° _____ West: 76° _____ *(decimal minutes)*

Field Observations - Only Enter One (1) Option

Weather: _____
OVercast PartlyCloudy HaZy CLear RAining SNowing

Waves: *Calm / Swells / Whitecaps*

Water Clarity: *Poor / Moderate / Good*

Wind: _____ **from:** _____
0-5mph 5-10 10-15 >15 *N,SE,SSE, etc.*

Significant Rainfall in the Last 48 Hours?
Yes / No

Habitat and Substrate Observations - Include Only The Actual Physical Area Seined.

Habitat: Vegetation _____ Pct cover _____ Structure _____ Pct _____
Emergent Submerged Algae Debris None *overhead Veg. Rocks Logs Dropoff Manmade*
Pct Cover Codes: N=none 0=1-5% 1=6-25% 2=26-50% 3=51-90% 4=>90%

Substrate: *VeGetated Plant Debris MuD SIlt SAnd* Type _____ Pct _____
GRavel CObble BOulder BedRock CLay Type _____ Pct _____
ONcolites WasteBed ConcreTe MarL UNknown Type _____ Pct _____
Pct Cover Codes: N=none 0=1-5% 1=6-25% 2=26-50% 3=51-90% 4=>90%

Water Quality:	*Depth(m)*	*Temp('C)*	*DO(mg/l)*	*DO(%Sat)*	*Cond*	*pH*	*Redox*

Average Depth (m): _____ **Shoreline Length (m)** _____

Comments: *(Gear Condition, Unusual Weather or Conditions, Equipment or Sampling Problems, etc.)*

_____

_____

_____

_____

_____

Data Validity Classification: *Good / Conditional / Invalid*

# of Attached Data Sheets: Bulk Fish _____ Indiv. Fish _____

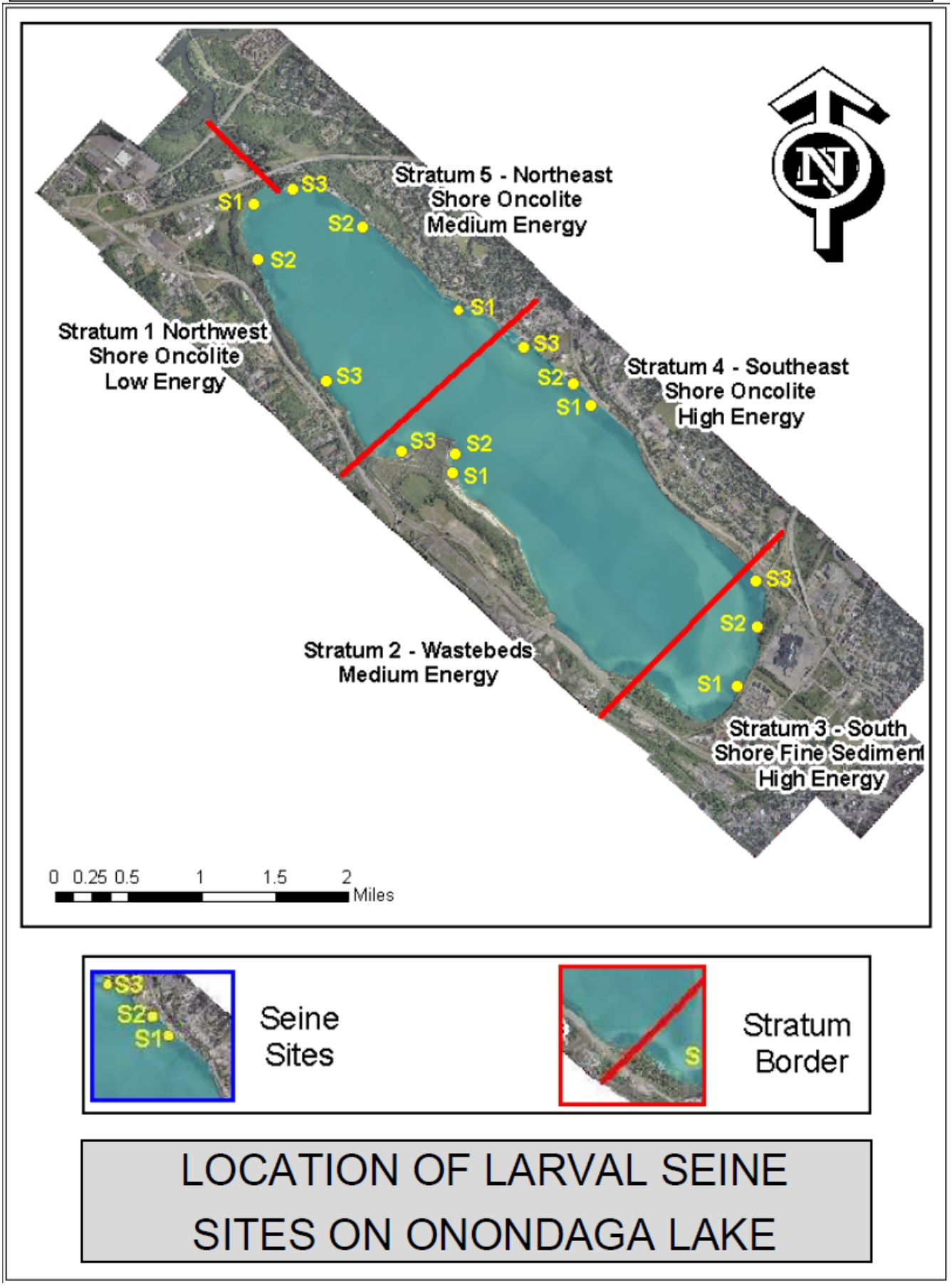
QAPP Signoffs (Initital and Date):

Field: _____ Office: _____ Data _____

_____ _____ Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Figure 1. Location of Larval Seine Sites in Onondaga Lake.



May 2012

APPENDIX A2:

Field Data Packet For Littoral YOY/Juvenile Fish Sampling

Table 4. Facility Code and Station Description

Facility Code	Site Abbreviation	Site Description
2581	ST1JS1R1	Stratum 1 Juvenile Seine Site 1
2584	ST1JS2R1	Stratum 1 Juvenile Seine Site 2
2587	ST1JS3R1	Stratum 1 Juvenile Seine Site 3
2590	ST2JS1R1	Stratum 2 Juvenile Seine Site 1
2593	ST2JS2R1	Stratum 2 Juvenile Seine Site 2
2596	ST2JS3R1	Stratum 2 Juvenile Seine Site 3
2599	ST3JS1R1	Stratum 3 Juvenile Seine Site 1
2602	ST3JS2R1	Stratum 3 Juvenile Seine Site 2
2605	ST3JS3R1	Stratum 3 Juvenile Seine Site 3
2608	ST4JS1R1	Stratum 4 Juvenile Seine Site 1
2611	ST4JS2R1	Stratum 4 Juvenile Seine Site 2
2614	ST4JS3R1	Stratum 4 Juvenile Seine Site 3
2617	ST5JS1R1	Stratum 5 Juvenile Seine Site 1
2620	ST5JS2R1	Stratum 5 Juvenile Seine Site 2
2623	ST5JS3R1	Stratum 5 Juvenile Seine Site 3

Table 5. Station Data Sheet for Juvenile Fish Sampling

Onondaga County Department of Water Envrironment Protection
Onondaga Lake Fish Monitoring Program

LITTORAL JUVENILES -- BAG SEINE

Date: _____ **Stratum:** _____

Crew: _____ **Site:** _____

Time Start: _____ (Start Seining) **Time End:** _____ (Processing Fish) **Facility Code:** _____

GPS North: 43° _____ West: 76° _____ *(decimal minutes)*

Field Observations - Only Enter One (1) Option

Weather: _____
OVercast PartlyCloudy HaZy CLear RAining SNowing

Waves: *Calm / Swells / Whitecaps*

Water Clarity: *Poor / Moderate / Good*

Wind: _____ **from:** _____
0-5mph 5-10 10-15 >15 *N,SE,SSE, etc.*

Significant Rainfall in the Last 48 Hours?
Yes / No

Habitat and Substrate Observations - Include Only The Actual Physical Area Seined.

Habitat: Vegetation _____ Pct cover _____ Structure _____ Pct _____
Emergent Submerged Algae Debris None *overhead Veg. Rocks Logs Dropoff Manmade*
Pct Cover Codes: N=none 0=1-5% 1=6-25% 2=26-50% 3=51-90% 4=>90%

Substrate: *VeGetated Plant Debris MuD SIlt SAnd* Type _____ Pct _____
GRavel CObble BOulder BedRock CLay Type _____ Pct _____
ONcolites WasteBed ConcreTe MarL UNknown Type _____ Pct _____
Pct Cover Codes: N=none 0=1-5% 1=6-25% 2=26-50% 3=51-90% 4=>90%

Water Quality:	*Depth(m)*	*Temp('C)*	*DO(mg/l)*	*DO(%Sat)*	*Cond*	*pH*	*Redox*

Average Depth (m): _____ **Shoreline Length (m)** _____

Comments: *(Gear Condition, Unusual Weather or Conditions, Equipment or Sampling Problems, etc.)*

_____

_____

_____

_____

_____

Data Validity Classification: *Good / Conditional / Invalid*

# of Attached Data Sheets: Bulk Fish _____ Indiv. Fish _____

QAPP Signoffs (Initital and Date):

Field: _____ Office: _____ Data _____

_____ _____ Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Table 6. Individual Fish Data Sheet For Juvenile Fish Sampling.

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page _____ **of** _____

INDIVIDUAL FISH DATA SHEET

Date: _____ **Program/GearType:** _____
Facility Code: _____ **Location/Site:** _____
(Include Facility Codes for all samples on data sheet)

Facility Code	Species Code	Common Name	Stage *(A,J,Y)*	Length *(mm)*	Weight *(grams)*	Scale #	Tag #	*Is fish Dead?*	DELTFM *Codes*	Comments

QAPP Signoffs (Initital and Date):
Field: _____ Office: _____ Data Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Table 7. Bulk Fish Data Sheet For Juvenile Fish Sampling.

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page ______ **of** ______

BULK CATCH DATA SHEET

(Record Individual Fish > Initial 30 Count, and Non-Boarded Estimates and/or Counts)

Date: ____________ **Program/GearType:** ____________

Facility Code: ____________ **Location/Site:** ____________

(Include Facility Codes for all samples on data sheet)

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

QAPP Signoffs (Initital and Date):

Field: ____________ Office: ____________ Data Entry: ____________

*** All fish with obvious DELTFM parameters must be listed on the individual fish data form.**

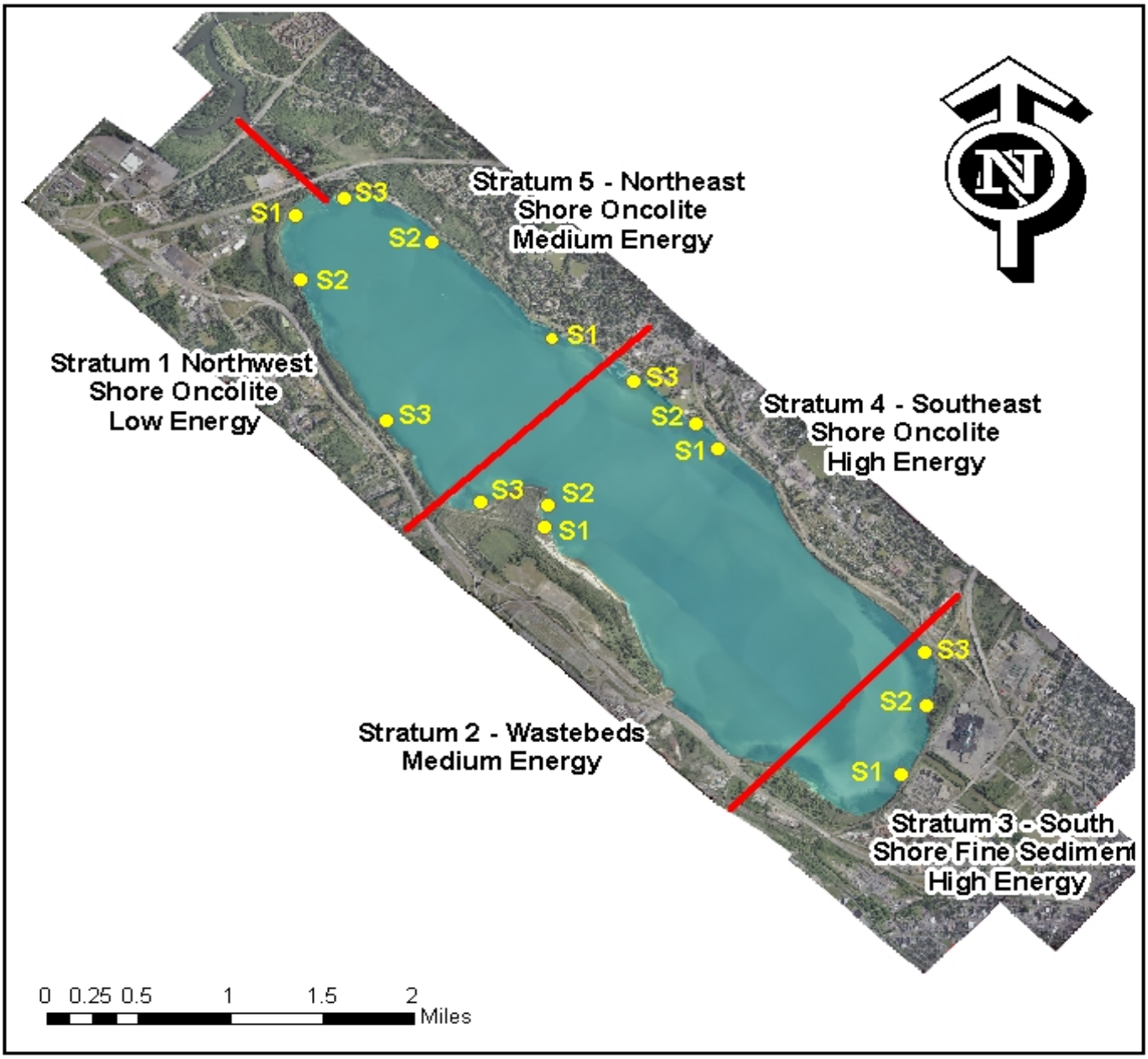
Revised by OCDWEP 2/2006

Species Codes and Common Names

Table 8. List of fish species codes/names.

Species Code	Common Name	Species Code	Common Name	Species Code	Common Name
0	No Catch	390	Spottail shiner	576	White bass
207	Sea lamprey	394	Spotfin Shiner	576.1	Temperate Basses
268	Longnose gar	396	Redfin shiner	591	Rock bass
271	Bowfin	397.1	Notropis sp.	595	Green sunfish
276	American eel	400	Bluntnose minnow	596	Pumpkinseed
285	Blueback Herring	401	Fathead minnow	598	Bluegill
289	Alewife	401.1	Pimephalus sp.	599.1	Lepomis sp.
290.1	Blueback and/or Alewife	403	Longnose dace	600	Smallmouth bass
294	Gizzard shad	406	Creek chub	601	Largemouth bass
297.1	Herring Family (Cluepeidae)	407	Fallfish	601.1	Black Bass (SM or LM)
326	Rainbow trout	408.1	Semotilus sp.	602	White crappie
327	Atlantic salmon	409.1	Minnow Family (Cyprinadae)	603	Black crappie
328	Brown trout	419	White sucker	603.1	Crappie (White or Black)
329	Brook trout	423	Northern hog sucker	603.2	Sunfish Family (Centrarchidae)
329.1	Tiger Trout (hybrid)	432	Shorthead redhorse	613	Johnny darter
332	Splake	433.1	Suckers (Catostomidae)	614	Tesselated darter
332.1	Trout Family (Salmonidae)	443	Yellow bullhead	616.1	Ethostoma sp.
335	Rainbow smelt	444	Brown bullhead	617	Yellow perch
340	Central mudminnow	444.1	Bullhead (species unknown)	618	Logperch
347	Northern pike	445	Channel catfish	624.1	Darter (not YPerch)
349	Chain pickerel	450.1	Freshwater Catfish	626	Walleye
350	Tiger muskellunge	461	Trout perch	628.1	Perch Family (Percidae)
350.1	Pike Family (Esocidae)	493	Burbot	700	Freshwater drum
365	Carp	531	Banded killifish	792	Round Goby
377	Golden shiner	545	Brook Silverside	970	NS (Bullhead sunfish, etc)
381	Emerald shiner	561	Brook stickleback	999	SPECIES UNKNOWN
385	Common shiner	575	White perch		

Figure 2. Location of Juvenile Seine Sites in Onondaga Lake.



Seine Sites

Stratum Border

LOCATION OF YOY-JUVENILE SEINE SITES ON ONONDAGA LAKE

APPENDIX A3:

Field Data Packet for Juvenile Fish Sampling (Electrofishing)

Table 9. Facility Code and Station Description

Facility Code	Site Abbreviation	Site Description
2676	EF1	Electrofishing Transect 1
2677	EF2	Electrofishing Transect 2
2678	EF3	Electrofishing Transect 3
2679	EF4	Electrofishing Transect 4
2680	EF5	Electrofishing Transect 5
2681	EF6	Electrofishing Transect 6
2682	EF7	Electrofishing Transect 7
2683	EF8	Electrofishing Transect 8
2684	EF9	Electrofishing Transect 9
2685	EF10	Electrofishing Transect 10
2686	EF11	Electrofishing Transect 11
2687	EF12	Electrofishing Transect 12
2688	EF13	Electrofishing Transect 13
2689	EF14	Electrofishing Transect 14
2690	EF15	Electrofishing Transect 15
2691	EF16	Electrofishing Transect 16
2692	EF17	Electrofishing Transect 17
2693	EF18	Electrofishing Transect 18
2694	EF19	Electrofishing Transect 19
2695	EF20	Electrofishing Transect 20
2696	EF21	Electrofishing Transect 21
2697	EF22	Electrofishing Transect 22
2698	EF23	Electrofishing Transect 23
2699	EF24	Electrofishing Transect 24

Table 10. Station Data Sheet For Juvenile Fish Boat Electrofisher Sampling

Onondaga County Department of Water Environment Protection
Onondaga Lake Fish Monitoring Program

LITTORAL JUVENILE -- BOAT ELECTROFISHER

Date: _____ **Transect:** _____
Crew: _____ **Facility Code:** _____
Start Time : _____ **End Time:** _____
GPS: North: 43° _____ West: 76° _____ **GPS:** North: 43° _____ West: 76° _____

Field Observations - Only Enter One (1) Option

Weather: _____
OVercast PartlyCloudy HaZy CLear RAining SNowing

Waves: *Calm / Swells / Whitecaps*

Water Clarity: *Poor / Moderate / Good*

Wind: _____ **from:** _____
0-5mph 5-10 10-15 >15 *N,S,E,W,SE,SW,NE,NW.*

Significant Rainfall in the Last 48 Hours? *Yes / No*

Water Quality:	*Depth(m)*	*Temp('C)*	*DO(mg/l)*	*DO(%Sat)*	*Cond*	*pH*	*Redox*

Comments: *(Gear Condition, Unusual Weather or Conditions, Equipment or Sampling Problems, etc.)*

_____
_____

BULK CATCH DATA -- Include Individual fish > initial 30 count, & non-boarded estimates and/or counts)

Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
		Total Catch:				

EF Settings:
Sec. Start: _____ **Sec End:** _____ **Total # Seconds:** _____ **(UnitEffort)**
Pct Range: _____ **Amps:** _____ **Avg. Speed:** _____
Frequency: _____ **Volts:** _____ **Avg. Depth:** _____

Data Validity Classification: *Good / Conditional / Invalid*

# of Attached Data Sheets: Bulk Fish _____ Indiv. Fish _____

QAPP Signoffs (Initital and Date):
Field: _____ Office: _____ Data _____
_____ _____ Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Table 11. Individual Fish Data Sheet For Juvenile Fish Boat Electrofisher Sampling.

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page _____ **of** _____

INDIVIDUAL FISH DATA SHEET

Date: _____ **Program/GearType:** _____
Facility Code: _____ **Location/Site:** _____
(Include Facility Codes for all samples on data sheet)

Facility Code	Species Code	Common Name	Stage *(A,J,Y)*	Length *(mm)*	Weight *(grams)*	Scale #	Tag #	*Is fish Dead?*	DELTFM *Codes*	Comments

QAPP Signoffs (Initital and Date):
Field: _____ Office: _____ Data Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Table 12. Individual Fish Data Sheet For Juvenile Fish Boat Electrofisher Sampling.

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page ________ **of** ________

BULK CATCH DATA SHEET

(Record Individual Fish > Initial 30 Count, and Non-Boarded Estimates and/or Counts)

Date: ______________ **Program/GearType:** ______________

Facility Code: ______________ **Location/Site:** ______________

(Include Facility Codes for all samples on data sheet)

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

QAPP Signoffs (Initital and Date):

Field: ______________ Office: ______________ Data Entry: ______________

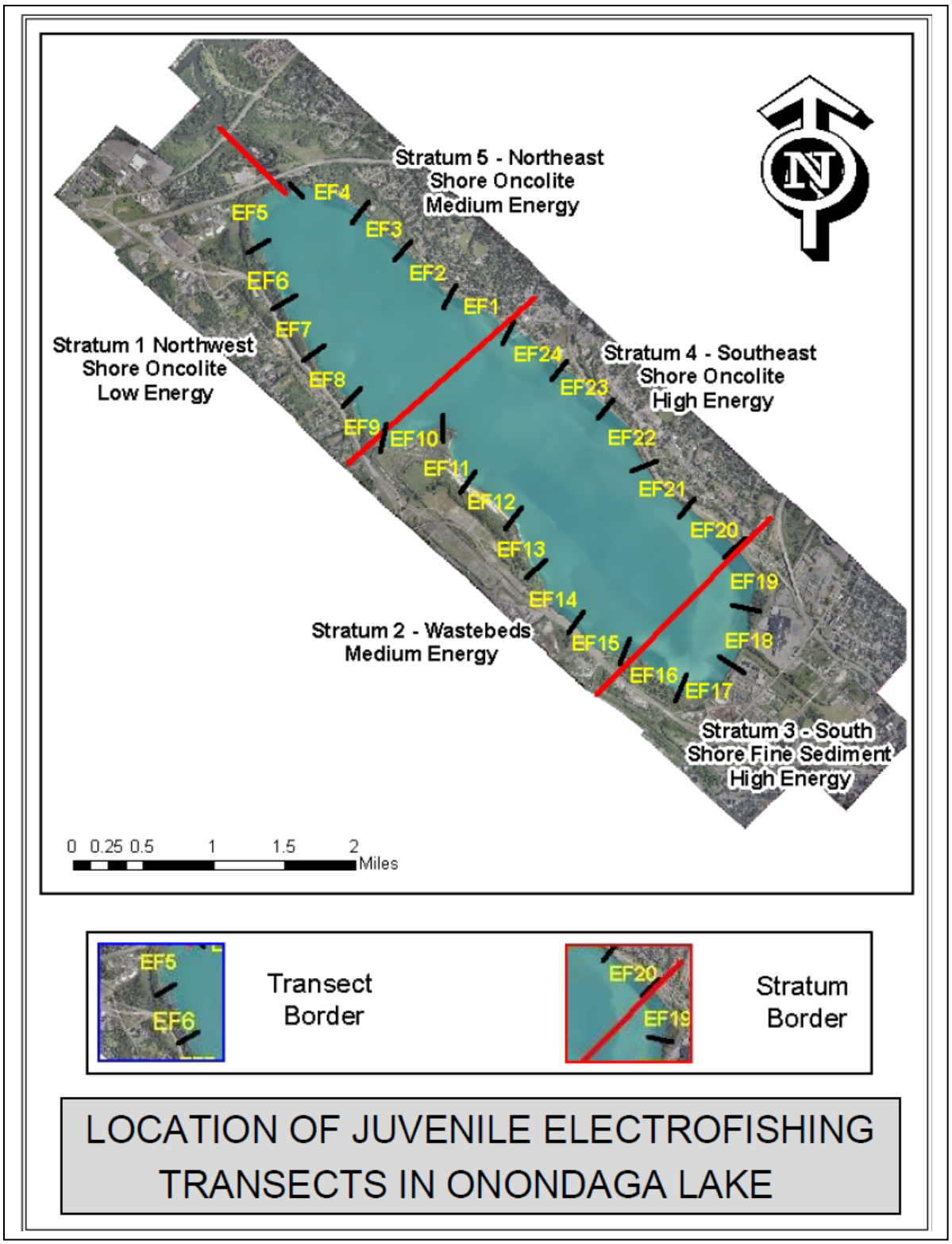
*** All fish with obvious DELTFM parameters must be listed on the individual fish data form.**

Revised by OCDWEP 2/200

Table 13. Species Codes and Common Names

Species Code	Common Name	Species Code	Common Name	Species Code	Common Name
0	No Catch	390	Spottail shiner	576	White bass
207	Sea lamprey	394	Spotfin Shiner	576.1	Temperate Basses
268	Longnose gar	396	Redfin shiner	591	Rock bass
271	Bowfin	397.1	Notropis sp.	595	Green sunfish
276	American eel	400	Bluntnose minnow	596	Pumpkinseed
285	Blueback Herring	401	Fathead minnow	598	Bluegill
289	Alewife	401.1	Pimephalus sp.	599.1	Lepomis sp.
290.1	Blueback and/or Alewife	403	Longnose dace	600	Smallmouth bass
294	Gizzard shad	406	Creek chub	601	Largemouth bass
297.1	Herring Family (Cluepeidae)	407	Fallfish	601.1	Black Bass (SM or LM)
326	Rainbow trout	408.1	Semotilus sp.	602	White crappie
327	Atlantic salmon	409.1	Minnow Family (Cyprinadae)	603	Black crappie
328	Brown trout	419	White sucker	603.1	Crappie (White or Black)
329	Brook trout	423	Northern hog sucker	603.2	Sunfish Family (Centrarchidae)
329.1	Tiger Trout (hybrid)	432	Shorthead redhorse	613	Johnny darter
332	Splake	433.1	Suckers (Catostomidae)	614	Tesselated darter
332.1	Trout Family (Salmonidae)	443	Yellow bullhead	616.1	Ethostoma sp.
335	Rainbow smelt	444	Brown bullhead	617	Yellow perch
340	Central mudminnow	444.1	Bullhead (species unknown)	618	Logperch
347	Northern pike	445	Channel catfish	624.1	Darter (not YPerch)
349	Chain pickerel	450.1	Freshwater Catfish	626	Walleye
350	Tiger muskellunge	461	Trout perch	628.1	Perch Family (Percidae)
350.1	Pike Family (Esocidae)	493	Burbot	700	Freshwater drum
365	Carp	531	Banded killifish	792	Round Goby
377	Golden shiner	545	Brook Silverside	970	NS (Bullhead sunfish, etc)
381	Emerald shiner	561	Brook stickleback	999	SPECIES UNKNOWN
385	Common shiner	575	White perch		

Figure 3. Location of Juvenile Electrofishing Transects in Onondaga Lake.



APPENDIX A4:

Field Data Packet For Nesting Surveys

Table 14. Facility Code and Station Description

Facility Code	Site Abbreviation	Site Description
2626	NS1	Nesting Survey Transect 1
2627	NS2	Nesting Survey Transect 2
2628	NS3	Nesting Survey Transect 3
2629	NS4	Nesting Survey Transect 4
2630	NS5	Nesting Survey Transect 5
2631	NS6	Nesting Survey Transect 6
2632	NS7	Nesting Survey Transect 7
2633	NS8	Nesting Survey Transect 8
2634	NS9	Nesting Survey Transect 9
2635	NS10	Nesting Survey Transect 10
2636	NS11	Nesting Survey Transect 11
2637	NS12	Nesting Survey Transect 12
2638	NS13	Nesting Survey Transect 13
2639	NS14	Nesting Survey Transect 14
2640	NS15	Nesting Survey Transect 15
2641	NS16	Nesting Survey Transect 16
2642	NS17	Nesting Survey Transect 17
2643	NS18	Nesting Survey Transect 18
2644	NS19	Nesting Survey Transect 19
2645	NS20	Nesting Survey Transect 20
2646	NS21	Nesting Survey Transect 21
2647	NS22	Nesting Survey Transect 22
2648	NS23	Nesting Survey Transect 23
2649	NS24	Nesting Survey Transect 24

Table 15. Station Data Sheet with Species Codes for Nesting Survey

Onondaga County Department of Water Environment Protection
Onondaga Lake Fish Monitoring Program

Page 1 of _____

NEST SURVEY COVER SHEET

Date: _____ **Transect:** _____
Crew: _____ **Facility Code:** _____
Time Start: _____ **End:** _____ **Observer:** _____

Field Observations - Only Enter One (1) Option

GPS: *Starting Coordinates* North: 43° _____ West: 76° _____ *(decimal minutes)*
Ending Coordinates North: 43° _____ West: 76° _____ *(decimal minutes)*

Weather: _____ **Waves:** *Calm / Swells / Whitecaps*
OVercast PartlyCloudy HaZy CLear RAining
Water Clarity: *Poor / Moderate / Good*

Wind: _____ **from:** _____ **Significant Rainfall in the Last 48 Hours?**
0-5mph 5-10 10-15 >15 *N,SE,SSE, etc.* *Yes / No*

Habitat: Vegetation _____ Pct cover _____ Structure _____ Pct _____
Emergent Submerged Algae Debris *overhead Veg. Rocks Logs Dropoff Manmade*
Pct Cover Codes: N=none 0=1-5% 1=6-25% 2=26-50% 3=51-90% 4=>90%

Substrate: *VeGetated Plant Debris MuD SIlt SAnd* Type _____ Pct _____
GRavel CObble BOulder BedRock CLay Type _____ Pct _____
ONcolites WasteBed ConcreTe MarL UNknown Type _____ Pct _____
Pct Cover Codes: N=none 0=1-5% 1=6-25% 2=26-50% 3=51-90% 4=>90%

Water Quality:	*Depth(m)*	*Temp('C)*	*DO(mg/l)*	*DO(%Sat)*	*Cond*	*pH*	*Redox*

Comments: *(Gear Condition, Unusual Weather or Conditions, Equipment or Sampling Problems, etc.)*

NUMBER OF NESTS OBSERVED

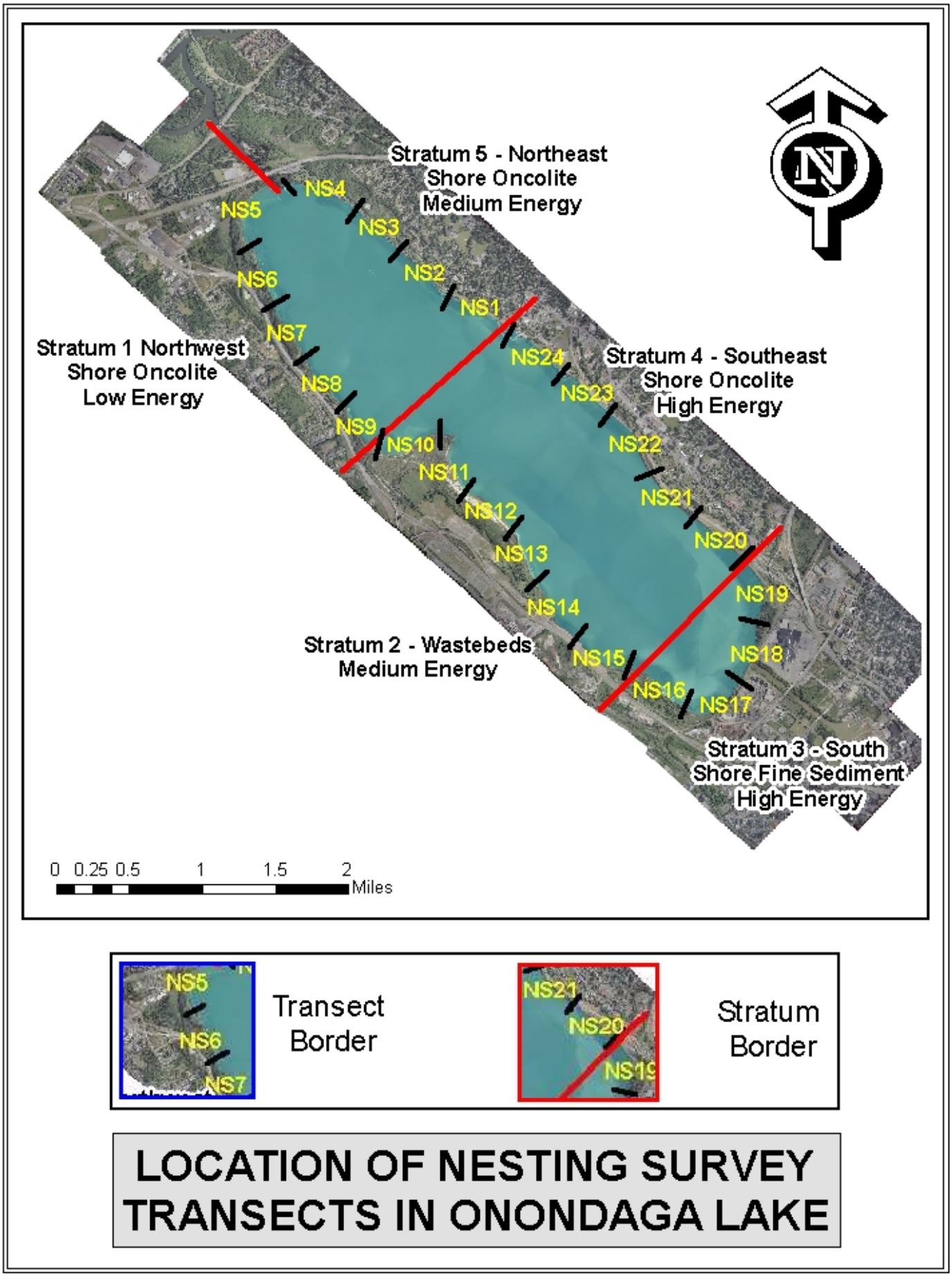
SppCode	Common Name	Field Marks	#Nests
999	UNKNOWN		
596	Pumpkinseed		
598	Bluegill		
599.1	Lepomis. sp.		
600	Smallmouth Bass		
601	Largemouth Bass		
601.1	Black Bass		
444.1	Bullhead		
		Total No. of Nests Observed:	

Average Water Depth (Meters) _____ **Data Validity Class:** *Good / Conditional / Invalid*

QAPP Signoffs (Initital and Date):
Field: _____ Office: _____ Data Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2008*

Figure 4. Location of Nesting Survey Transects in Onondaga Lake.



APPENDIX A5:

Field Data Packet For Littoral Adult Fish Sampling (Electrofishing)

Table 16. Facility Code and Station Description

Facility Code	Site Abbreviation	Site Description
2676	EF1	Electrofishing Transect 1
2677	EF2	Electrofishing Transect 2
2678	EF3	Electrofishing Transect 3
2679	EF4	Electrofishing Transect 4
2680	EF5	Electrofishing Transect 5
2681	EF6	Electrofishing Transect 6
2682	EF7	Electrofishing Transect 7
2683	EF8	Electrofishing Transect 8
2684	EF9	Electrofishing Transect 9
2685	EF10	Electrofishing Transect 10
2686	EF11	Electrofishing Transect 11
2687	EF12	Electrofishing Transect 12
2688	EF13	Electrofishing Transect 13
2689	EF14	Electrofishing Transect 14
2690	EF15	Electrofishing Transect 15
2691	EF16	Electrofishing Transect 16
2692	EF17	Electrofishing Transect 17
2693	EF18	Electrofishing Transect 18
2694	EF19	Electrofishing Transect 19
2695	EF20	Electrofishing Transect 20
2696	EF21	Electrofishing Transect 21
2697	EF22	Electrofishing Transect 22
2698	EF23	Electrofishing Transect 23
2699	EF24	Electrofishing Transect 24

Table 17. Station Data Sheet Littoral Adults – Boat Electrofishing.

Onondaga County Department of Water Environment Protection
Onondaga Lake Fish Monitoring Program

Page 1 of _____

LITTORAL ADULTS -- BOAT ELECTROFISHER

Date: _____ **Transect:** _____
Crew: _____ **Facility Code:** _____
Start Time : _____ **End Time:** _____
GPS: North: 43° _____ West: 76° _____ **GPS:** North: 43° _____ West: 76° _____

Field Observations - Only Enter One (1) Option

Weather: _____ **Waves:** *Calm / Swells / Whitecaps*
OVercast PartlyCloudy HaZy CLear RAining SNowing
Water Clarity: *Poor / Moderate / Good*

Wind: _____ **from:** _____ **Significant Rainfall in the Last 48 Hours?**
0-5mph 5-10 10-15 >15 *N,S,E,W,SE,SW,NE,NW.* *Yes / No*

Water Quality:	*Depth(m)*	*Temp('C)*	*DO(mg/l)*	*DO(%Sat)*	*Cond*	*pH*	*Redox*

Comments: *(Gear Condition, Unusual Weather or Conditions, Equipment or Sampling Problems, etc.)*

_____
_____

BULK CATCH DATA -- Include Individual fish > initial 30 count, & non-boarded estimates and/or counts)

Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
	Total Catch:					

EF Settings: **Sec. Start:** _____ **Sec End:** _____ **Total # Seconds:** _____ **(UnitEffort)**
Pct Range: _____ **Amps:** _____ **Avg. Speed:** _____
Frequency: _____ **Volts:** _____ **Avg. Depth:** _____

Data Validity Classification: *Good / Conditional / Invalid*

# of Attached Data Sheets: Bulk Fish _____ Indiv. Fish _____

QAPP Signoffs (Initital and Date):
Field: _____ Office: _____ Data Entry: _____
_____ _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Table 18. Individual Fish Data Sheet for Littoral Adult Fish Boat Electrofisher Sampling.

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page _____ **of** _____

INDIVIDUAL FISH DATA SHEET

Date: _____ **Program/GearType:** _____
Facility Code: _____ **Location/Site:** _____
(Include Facility Codes for all samples on data sheet)

Facility Code	Species Code	Common Name	Stage *(A,J,Y)*	Length *(mm)*	Weight *(grams)*	Scale #	Tag #	*Is fish Dead?*	DELTFM *Codes*	Comments

QAPP Signoffs (Initital and Date):
Field: _____ Office: _____ Data Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Table 19. Bulk Fish Data Sheet For Littoral Adult Fish Boat Electrofisher Sampling.

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page _______ **of** _______

BULK CATCH DATA SHEET

(Record Individual Fish > Initial 30 Count, and Non-Boarded Estimates and/or Counts)

Date: ______________ **Program/GearType:** ____________________

Facility Code: ______________________________ **Location/Site:** ____________________

(Include Facility Codes for all samples on data sheet)

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

QAPP Signoffs (Initital and Date):

Field: ______________ Office: ____________________ Data Entry: ____________________

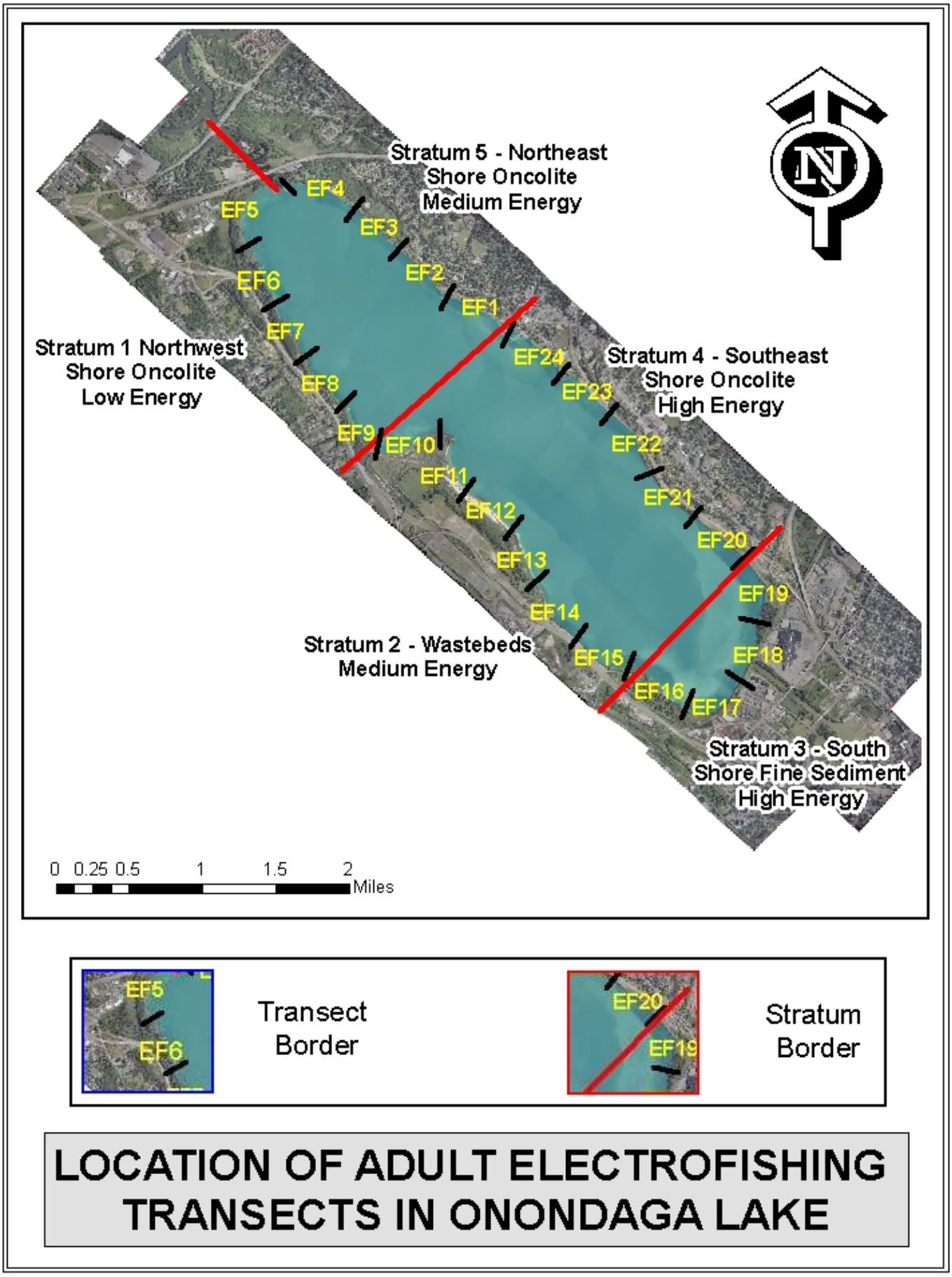
*** All fish with obvious DELTFM parameters must be listed on the individual fish data form.**

Revised by OCDWEP 2/2006

Table 20. Species Codes and Common Names

Species Code	Common Name	Species Code	Common Name	Species Code	Common Name
0	No Catch	390	Spottail shiner	576	White bass
207	Sea lamprey	394	Spotfin Shiner	576.1	Temperate Basses
268	Longnose gar	396	Redfin shiner	591	Rock bass
271	Bowfin	397.1	Notropis sp.	595	Green sunfish
276	American eel	400	Bluntnose minnow	596	Pumpkinseed
285	Blueback Herring	401	Fathead minnow	598	Bluegill
289	Alewife	401.1	Pimephalus sp.	599.1	Lepomis sp.
290.1	Blueback and/or Alewife	403	Longnose dace	600	Smallmouth bass
294	Gizzard shad	406	Creek chub	601	Largemouth bass
297.1	Herring Family (Cluepeidae)	407	Fallfish	601.1	Black Bass (SM or LM)
326	Rainbow trout	408.1	Semotilus sp.	602	White crappie
327	Atlantic salmon	409.1	Minnow Family (Cyprinadae)	603	Black crappie
328	Brown trout	419	White sucker	603.1	Crappie (White or Black)
329	Brook trout	423	Northern hog sucker	603.2	Sunfish Family (Centrarchidae)
329.1	Tiger Trout (hybrid)	432	Shorthead redhorse	613	Johnny darter
332	Splake	433.1	Suckers (Catostomidae)	614	Tesselated darter
332.1	Trout Family (Salmonidae)	443	Yellow bullhead	616.1	Ethostoma sp.
335	Rainbow smelt	444	Brown bullhead	617	Yellow perch
340	Central mudminnow	444.1	Bullhead (species unknown)	618	Logperch
347	Northern pike	445	Channel catfish	624.1	Darter (not YPerch)
349	Chain pickerel	450.1	Freshwater Catfish	626	Walleye
350	Tiger muskellunge	461	Trout perch	628.1	Perch Family (Percidae)
350.1	Pike Family (Esocidae)	493	Burbot	700	Freshwater drum
365	Carp	531	Banded killifish	792	Round Goby
377	Golden shiner	545	Brook Silverside	970	NS (Bullhead sunfish, etc)
381	Emerald shiner	561	Brook stickleback	999	SPECIES UNKNOWN
385	Common shiner	575	White perch		

Figure 5. Location of Adult Electrofishing Transects in Onondaga Lake.



APPENDIX A6:

Field Data Packet For Littoral Profundal Adult Fish Sampling (Gill Nets)

Table 21. Facility Code and Station Description

Facility Code	Site Description
2750	Stratum 1 – Northwest Shore
2756	Stratum 2 – Wastebeds
2762	Stratum 3 – South Shore
2768	Stratum 4 – Southeast Shore
2774	Stratum 5 – Northeast Shore

Table 22. Station Data Sheet For Littoral Profundal Adult Fish Sampling (Gill Nets)

Onondaga County Department of Water Environment Protection
Onondaga Lake Fish Monitoring Program

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Littoral Profundal Adult Gill Nets

Haul Date: _____ **Basin:** ____ **Facility Code:** _____

Net Set	**Net Hauled**
Date: _____	**Date:** _____
Crew: _____	**Crew:** _____
Time: _____	**Time:** _____
GPS North: 43° _____ *(decimal minutes)*	**GPS** North: 43° _____ *(decimal minutes)*
Position: West: 76° _____	**Position:** West: 76° _____
Water Depth _____ *(meters)*	
Weather: _____	**Weather:** _____
OVercast PartlyCloudy HaZy CLear RAining SNowing	*OVercast PartlyCloudy HaZy CLear RAining SNowing*
Wind: _____ **from:** _____	**Wind:** _____ **from:** _____
0-5mph 5-10 10-15 >15 *N,SE,SSE, etc.*	*0-5mph 5-10 10-15 >15* *N,SE,SSE, etc.*
For the Following Data, Circle the Appropriate Response	*For the Following Data, Circle the Appropriate Response*
Waves: *Calm / Swells / Whitecaps*	**Waves:** *Calm / Swells / Whitecaps*
Water Clarity: *Poor / Moderate / Good*	**Water Clarity:** *Poor / Moderate / Good*
Significant Rainfall in the Last 48 Hours? *Yes / No*	**Significant Rainfall in the Last 48 Hours?** *Yes / No*
Water Quality Profile Taken? *Yes / No*	**Water Quality Profile Taken?** *Yes / No*

Comments: *(Gear Condition, Unusual Weather, Predator Damage, Equipment or Sampling Problems, etc.)*

_____

_____

_____

_____

_____

Is Net Intact Upon Recovery? *Yes / No*

Total # of Hours Fished (Unit Effort): _____

Data Validity Classification: *Good / Conditional / Invalid*

# of Attached Data Sheets: BulkFish _____ Indiv. Fish _____

QAPP Signoffs (Initital and Date):

Field: _____ Office: _____ Data Entry: _____

_____ _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/200*

Table 23. Individual Fish Data Sheet For Littoral Profundal Adult Fish Sampling (Gill Nets).

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page _____ **of** _____

INDIVIDUAL FISH DATA SHEET

Date: _____ **Program/GearType:** _____
Facility Code: _____ **Location/Site:** _____
(Include Facility Codes for all samples on data sheet)

Facility Code	Species Code	Common Name	Stage *(A,J,Y)*	Length *(mm)*	Weight *(grams)*	Scale #	Tag #	*Is fish Dead?*	DELTFM *Codes*	Comments

QAPP Signoffs (Initital and Date):
Field: _____ Office: _____ Data Entry: _____

Original Prepared for OCDWEP by Ichthyological Associates, Inc. *Revised by OCDWEP 2/2006*

Table 24. Bulk Fish Data Sheet For Littoral Profundal Adult Fish Sampling (Gill Nets).

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

Page ________ **of** ________

BULK CATCH DATA SHEET

(Record Individual Fish > Initial 30 Count, and Non-Boarded Estimates and/or Counts)

Date: ________________ **Program/GearType:** ________________________

Facility Code: __________________________________ **Location/Site:** ________________________
(Include Facility Codes for all samples on data sheet) ________________________

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

Facility Code	Species Code	Common Name	Stage *(A/J/Y)*	Total #Fish	Total Wt (g)	#Fish Dead	Count or Est?
Total Fish:							

QAPP Signoffs (Initital and Date):

Field: ________________ Office: ________________________ Data Entry: ________________________

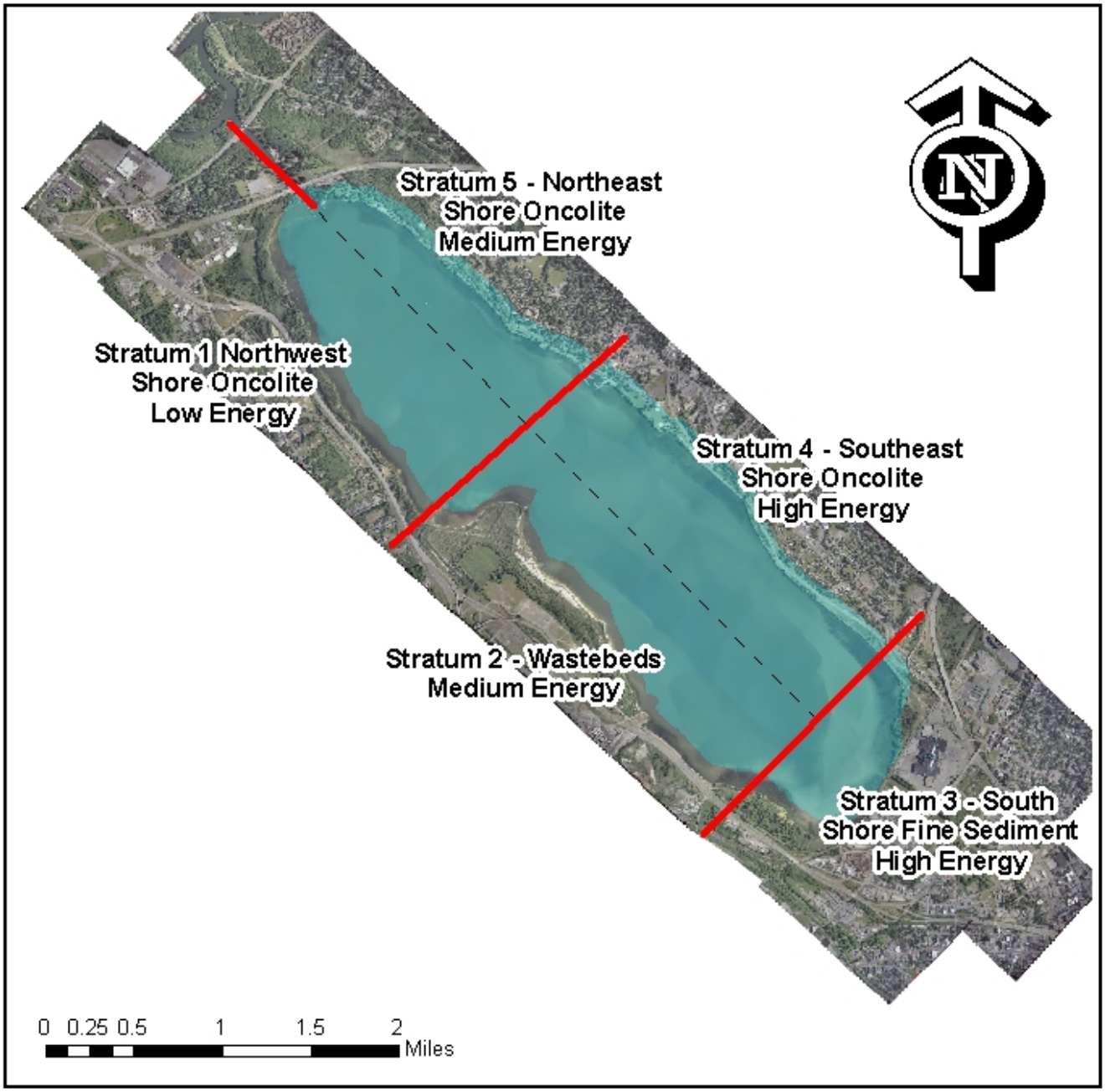
*** All fish with obvious DELTFM parameters must be listed on the individual fish data form.**

Revised by OCDWEP 2/2006

Table 25. Species Codes and Common Names

Species Code	Common Name	Species Code	Common Name	Species Code	Common Name
0	No Catch	390	Spottail shiner	576	White bass
207	Sea lamprey	394	Spotfin Shiner	576.1	Temperate Basses
268	Longnose gar	396	Redfin shiner	591	Rock bass
271	Bowfin	397.1	Notropis sp.	595	Green sunfish
276	American eel	400	Bluntnose minnow	596	Pumpkinseed
285	Blueback Herring	401	Fathead minnow	598	Bluegill
289	Alewife	401.1	Pimephalus sp.	599.1	Lepomis sp.
290.1	Blueback and/or Alewife	403	Longnose dace	600	Smallmouth bass
294	Gizzard shad	406	Creek chub	601	Largemouth bass
297.1	Herring Family (Cluepeidae)	407	Fallfish	601.1	Black Bass (SM or LM)
326	Rainbow trout	408.1	Semotilus sp.	602	White crappie
327	Atlantic salmon	409.1	Minnow Family (Cyprinadae)	603	Black crappie
328	Brown trout	419	White sucker	603.1	Crappie (White or Black)
329	Brook trout	423	Northern hog sucker	603.2	Sunfish Family (Centrarchidae)
329.1	Tiger Trout (hybrid)	432	Shorthead redhorse	613	Johnny darter
332	Splake	433.1	Suckers (Catostomidae)	614	Tesselated darter
332.1	Trout Family (Salmonidae)	443	Yellow bullhead	616.1	Ethostoma sp.
335	Rainbow smelt	444	Brown bullhead	617	Yellow perch
340	Central mudminnow	444.1	Bullhead (species unknown)	618	Logperch
347	Northern pike	445	Channel catfish	624.1	Darter (not YPerch)
349	Chain pickerel	450.1	Freshwater Catfish	626	Walleye
350	Tiger muskellunge	461	Trout perch	628.1	Perch Family (Percidae)
350.1	Pike Family (Esocidae)	493	Burbot	700	Freshwater drum
365	Carp	531	Banded killifish	792	Round Goby
377	Golden shiner	545	Brook Silverside	970	NS (Bullhead sunfish, etc)
381	Emerald shiner	561	Brook stickleback	999	SPECIES UNKNOWN
385	Common shiner	575	White perch		

Figure 6. Sample Locations Littoral Profundal Adult Fish Sampling (Gill Nets).



Note: **During night-time hours, two (2) nets will be randomly set in each of the five (5) strata. The nets will be set for two (2) hours perpendicular to shore in 3 to 10 meters of water**.

LOCATION OF LITTORAL-PROFUNDAL GILL NET SETS IN ONONDAGA LAKE

APPENDIX A7:

Game Fish List

Onondaga Lake Fisheries Assessment
Game Fish List

Largemouth bass
Walleye
White Crappie
Yellow Bullhead
Bluegill
Pumpkinseed
Yellow Perch
Smallmouth bass
Black Crappie
Brown Bullhead
Channel catfish
All esocids (pike family)
All salmonids (trout)
Rock bass

ATTACHMENT 3

QUALITY ASSURANCE PROGRAM PLAN

ONONDAGA LAKE MACROPHYTE ASSESSMENT PROGRAM (2012)

AMBIENT MONITORING PROGRAM

Prepared for the NYSDEC

Prepared by:

Onondaga County
Department Of Water Environment Protection

June 2012

TABLE OF CONTENTS

1.0 INTRODUCTION/PURPOSE

As part of the Onondaga Lake Ambient Monitoring Program the Onondaga County Department of Water Environment Protection has prepared a Quality Assurance Program Plan (QAPP) for the Onondaga Lake Macrophyte Assessment Program, 2012.

The County's long-term monitoring program includes assessment of physical, chemical, and biological attributes of the aquatic resources. The baseline Onondaga Lake Macrophyte Assessment Program, and subsequent annual and periodic efforts, are expected to address the goal of the *Ambient Monitoring Program*.

Background

The Macrophyte Assessment Program was developed in consultation with expert technical advisors in limnology. The 2012 lake macrophyte program is summarized in Table 1.

Development of the QAPP

The purpose of the QAPP is to mesh field collection procedures and data requirements into a comprehensive document that provides a template for field, laboratory, and data management methods. The QAPP is meant to supplement in-house training of OCDWEP technicians and provide a framework from which trained staff can conduct consistent field surveys. The QAPP is considered to be a living document. That is, as changes are made in the Onondaga Lake Macrophyte Assessment Program, revisions will be made to the QAPP to reflect those changes. These may include changes to the:

- intensity of the sampling program;
- incorporation of new elements to the program, or deletion of specific elements based upon changing condition in the lake and recommendations from members of the Onondaga Lake Technical Advisory Committee;
- revisions, clarifications, and improvements to methodologies; and
- incorporation of new methodologies into the program.

Thus the QAPP will serve multiple purposes. It provides documentation of standardized operations and procedures (SOPs), although more formal SOPs have been developed for in-house training and documentation purposes. It also provides a framework of data forms designed to ensure consistent collection and entry of data, and provide a framework for training of OCDWEP's staff via consistent mentoring by more senior, experienced staff through the structure of the QAPP.

The QAPP for the Onondaga Lake macrophyte assessment program has been divided into chapters. Each chapter represents a major field component of the AMP. Each chapter provides a purpose and description of the component, the procedures for sampling that component,

appropriate data sheets, maps, and descriptions of stations and station codes. The February 2012 version of the QAPP, incorporates program modifications to the 2012 macrophyte assessment program.

Table 1. Summary of year 2012 Onondaga Lake Macrophyte Assessment Program.

Component	Methodology/Gear	Sampling Objectives	Location and Number of Samples	Timing	Change
Onondaga Lake Aerial Photography	Program utilizes plane with belly mounted 9x9 camera. 60% forward overlap, 30% side overlap.	Determine annual percent of littoral zone with macrophytes.	-Three (3) flight lines full lake coverage.	-Late July to when water clarity is approximately 3-meters on the secchi disk. -Early morning with low sun angle.	- Start time changed from August to late July.
Field Species Verification of Aerial Photography	Visual identification.	Determine species.	-Two (2) sites in each of the five (5) strata for a total of ten (10) sites.	-Within 1 week of the aerial photos.	- No Change from previous year.

2.0 STAFF TRAINING

The OCDWEP has approached the AMP under the self-monitoring element that is central to the federal Clean Water Act. OCDWEP has acquired a staff with a wide range of academic education supplemented by experience gained by working for state agencies, universities, and environmental consulting and research firms. This staff of scientists and technicians are supported by maintenance and operation personnel that provide the skills to build, construct, maintain, and modify gear needed to conduct the surveys. This expertise allows the OCDWEP to successfully train and mentor qualified individuals to provide a high level of quality to the data of the macrophyte assessment program. As with any long-term monitoring program, individuals will advance in their careers, retire, or move to new locations. This matriculation will require periodic in-house training of new individuals. The QAPP is integral to this training. Its use and understanding will provide each individual with an easy to understand document to ensure day-to-day and year-to-year consistency of the Onondaga Lake Macrophyte Assessment Program.

In addition to the QAPP and SOPs, the County's Consultant, Ecologic LLC, conducts annual audits for macrophyte field verification component. The audit is intended to ensure that the field technicians conducted their work in a professional manner and comply with the

procedures outlined in the QAPP and SOPs. In addition, the audits determine if any observation would jeopardize the quality of the data (technique, field logs, training, etc.).

Thus the use of the QAPP in conjunction with the formal Standard Operating Procedures (SOPs) and external audits for the biological monitoring program activities, the *Onondaga County Ambient Monitoring Program: Onondaga Lake Macrophyte Assessment Program (2012)* and subsequent programs will provide OCDWEP with a successful monitoring program.

3.0 AERIAL PHOTOGRAPHY

3.1 Procedures

Aerial photographs will be taken of Onondaga Lake on an annual basis utilizing a qualified contracted aerial photography firm. The aerial photographs must meet the following specifications:

- 1"=445' +/- scale.
- 3 flight lines (Must duplicate previous flight lines).
- 63 total exposures.
- 60% forward lap.
- 30% side lap.
- Formal titling of 63 exposure (*Onondaga Lake Macrophyte Survey – Date, Time, Scale, Flight Line and Exposure).*
- 2 sets of color contact prints.
- 1 set of black and white prints.

3.1.1 Lake Macrophyte Growth Conditions

Step 1. Visually survey the macrophyte growth in the littoral zone from a boat during other lake sampling events (optimal time is usually Early July). Timing is critical; the aerial flight needs to be scheduled when macrophytes are approaching their peak, but before the lake macroalgae peaks (Usually late June to mid July).

Note: Prior to the aerial flight, large buoys (nearly 3ft diameter) will be positioned at the field verification locations for visual identification in the photos (Figure 1: Macrophyte Field Verification Sampling Locations).

Step 2. Contact flight contractor to determine flight feasibility.

Note: These indicators are not always achieved due to turbidity, wind and other environmental factors. These are guidelines to determine the best possible conditions for aerial photographs.

3.1.2 Pre-flight Planning and Coordination

Step 1. Review weekly secchi disc readings.

Step 2. Review weather report for the past week. No significant rainfall should be recorded for at least 48 hours prior to the flight.

Step 3. Review detailed weather report for the next few days. A clear day with low humidity and no haze needs to be targeted for the flight.

Step 4. Contact flight contractor as early as possible in the morning to confirm the flight. Usually this is done at 700 hours to allow the contractor travel time to shoot the photos during the period of low sun angle which is the period of 600 –1030 hours.

3.2 Macrophyte Digitizing from Aerial Photos

Step 1. Geo referenced color Tiff images of the littoral zone are imported into an ArcView job file.

Step 2. The Tiff images are overlaid at a scale of 1:1,856 on a bathymetric map of Onondaga Lake. Digitizing should be carried out on the computer screen and areas perceived as macrophyte growth, based on color and texture, should be delineated.

Step 3. The perimeter of each macrophyte bed in the lake is outlined using the polygon feature of ArcView.

Step 4. In addition to macrophyte beds, nearshore areas that appear to have been dredged, piers, and other structures should be delineated and categorized separately from the macrophyte beds.

Step 5. ArcView will calculate the area of polygons in the file; this will be comparable to the area of the lake where macrophytes are present.

4.0 FIELD SPECIES VERIFICATION OF AERIAL PHOTOGRAPHY

4.1 Procedures

Field verification of macrophyte species present in Onondaga Lake will be conducted within one (1) week of the aerial flight. Two (2) samples will be collected from each of the five (5) strata for a total of ten (10) samples (Figure 1).

4.1.1 Pre-field:

Step 1. Review QAPP to determine overall needs of programs.

Step 2. Assemble: map and field sheets, equipment, and species key.

Step 3. Review weather reports for sampling feasibility.

4.1.2 Field:

Step 1. Proceed to the first monitoring site. The following (table 2) summarizes the site description and coordinates for each sampling location.

Table 2. Site description and coordinates for each macrophyte sampling Location.

Site Description	Coordinates/Position
Onondaga Lake Site 1	43° 06.653' N, 76° 13.746' W
Onondaga Lake Site 2	43° 05.966' N, 76° 12.525' W
Onondaga Lake Site 3	43° 05.468' N, 76° 11.773' W
Onondaga Lake Site 4	43° 04.489' N, 76° 10.667' W
Onondaga Lake Site 5	43° 03.853' N, 76° 11.057' W
Onondaga Lake Site 6	43° 04.324' N, 76° 12.202' W
Onondaga Lake Site 7	43° 05.388' N, 76° 12.565' W
Onondaga Lake Site 8	43° 06.813' N, 76° 14.702' W
Onondaga Lake Site 9	43° 05.589' N, 76° 13.937' W
Onondaga Lake Site 10	43° 06.909' N, 76° 14.390' W

Step 2. Upon arrival at site position the boat in approximately 1 to 1.5 meters of water, then anchor the boat to secure the position.

Step 3. Confirm and record GPS location (the actual final position) and site number, then begin filling out the macrophyte field verification sheet (Table 3, Appendix A1).

Step 4. With rope or pole attached, position the meter-squared frame in the water and lower to bottom If dense beds of macrophytes are present use the rake to firmly ground the frame.

Step 5. Using the metal rake remove all macrophytes from the square meter area. If there are emergent or floating leafed macrophytes in the sample area, it may be necessary to pull them by hand in order to get them loose from the bottom. If large amounts of macroalgae are present the algae should be carefully pushed aside prior to collecting the sample, note presence of macroalgae and relative abundance on the datasheet in the comment section.

Step 6. As macrophytes are removed from the sample area place them in a tub filled with water.

Step 7. After removing all the macrophytes in the sample area, visually separate them into similar groups, placing each group into a separate 5-gallon bucket.

Step 8. Once all macrophytes are separated into groups, remove individual specimens from the 5-gallon buckets for identification. Spread the specimen out on a flat surface (top of a cooler) and identify it using a key. Record the identified species on the macrophyte field verification sheet. Continue to identify all remaining species of plants in this manner.

Step 9. Estimate percent cover of macrophytes from the area around the sample site in approximately a 5-meter radius around the boat. In addition, estimate the relative abundance for each species within the 5-meter radius.

Note: Determine and record if the species in the 5-meter radius represent the species around the boat (growth may be patchy). For example, the 1-square meter area may be primarily curly pondweed, but may have an elodea nearby within the 5-meter radius. These types of comments should be noted on the field data sheet.

Note: If a successful identification cannot be completed in the field, place the specimen in a plastic quart jar and fill with 10% buffered formalin for preservation. Use a separate generic name on the data sheet (such as Species a, b and so on) for each unidentified species, and estimate relative abundance for that species as you would for species identified in the field. The jar should be clearly marked with the following information:

- Date and time.
- Generic species name.
- Location.
- Field crew.

- Comments.

Step 10. Once all of the plants have been identified or preserved for further identification, and the field data sheet entries are complete, remove group of buoys. Then proceed to next station, and repeat Step 1 through 9.

4.1.3 End of Sample Day

Step 1. Review field notes for completeness.

Step 2. Submit original data sheets and field notes for duplication.

Step 3. Write down needed equipment repairs.

Step 4. Log any samples into the biological laboratory

4.1.4 End of Sample Event

Step 1. Log original data sheets/notes into OCDWEP Hardcopy File System.

Step 2. Submit duplicate copy of data sheets/notes for data entry.

4.1.5 Field Data Sheet Packet

Appendix A1 contains examples of the field verification data sheet (Table 3) and map of sampling stations (Figure 1).

5.0 CHRONOLOGY OF QAPP

The QAPP for the Onondaga Macrophyte Assessment Program is a living document in that it will be periodically updated to reflect changes in the monitoring program that are instituted to improve the efficiency of data collection, focus on a particular aspect of the aquatic macrophytes. The periodic updating of the QAPP will provide a written record of sampling procedures over the entire life of the Onondaga Macrophyte Assessment Program. Annual revisions to the QAPP have incorporated various changes made to the macrophyte assessment program.

The original QAPP, and subsequent revisions, have been reviewed by the NYSDEC, revised by OCDWEP as requested and approved by the NYSDEC prior to implementation.

6.0 LITERATURE CITED

OCDWEP *SOP For Macrophyte Field Verification of Aerial Photography (DOC No. BIO-012)*

APPENDIX A1

Field Data Packet for Macrophyte Species Verification of Aerial Photography

May 2012

Table 3. Macrophyte Field Verification Sheet.

Onondaga County Department of WATER ENVIRONMENT PROTECTION

MACROPHYTE FIELD VERIFICATION SHEET

Date: _____

Crew: _____

Site Number: _____

Weather: _____
OVercast PartlyCloudy HaZy CLear RAining SNowing

Wind: _____ **from:** _____
0-5mph 5-10 10-15 >15 *N,S,E,W,SE,SW,NE,NW.*

Date of Aerial Photography: _____

Depth of Water (Meters): _____

Substrate Type: _____
Rock, logs, sand, silt, oncolites, solvay waste, etc.

Do the Species in the 1-meter^2 Represent the Species Found in the 5-meter Radius (Y/N)? ___

M.phyte: Dense Growth ☐ **Sparse Growth** ☐
Algae: Dense Growth ☐ **Sparse Growth** ☐
COMMENTS:

GPS Coordinates: **N: 43°** _____
W: 76° _____

MACROPHYTE SPECIES IDENTIFICATION		
Common Name	**Scientific Name**	**Est. Percent Coverage (5-meter Radius)**

Samples Collected For Laboratory Identification*
* Preserve samples in 10% Buffered Formalin.

Date: _____

Crew: _____

Site Number: _____

Weather: _____
OVercast PartlyCloudy HaZy CLear RAining SNowing

Wind: _____ **from:** _____
0-5mph 5-10 10-15 >15 *N,S,E,W,SE,SW,NE,NW.*

Date of Aerial Photography: _____

Depth of Water (Meters): _____

Substrate Type: _____
Rock, logs, sand, silt, oncolites, solvay waste, etc.

Do the Species in the 1-meter^2 Represent the Species Found in the 5-meter Radius (Y/N)? ___

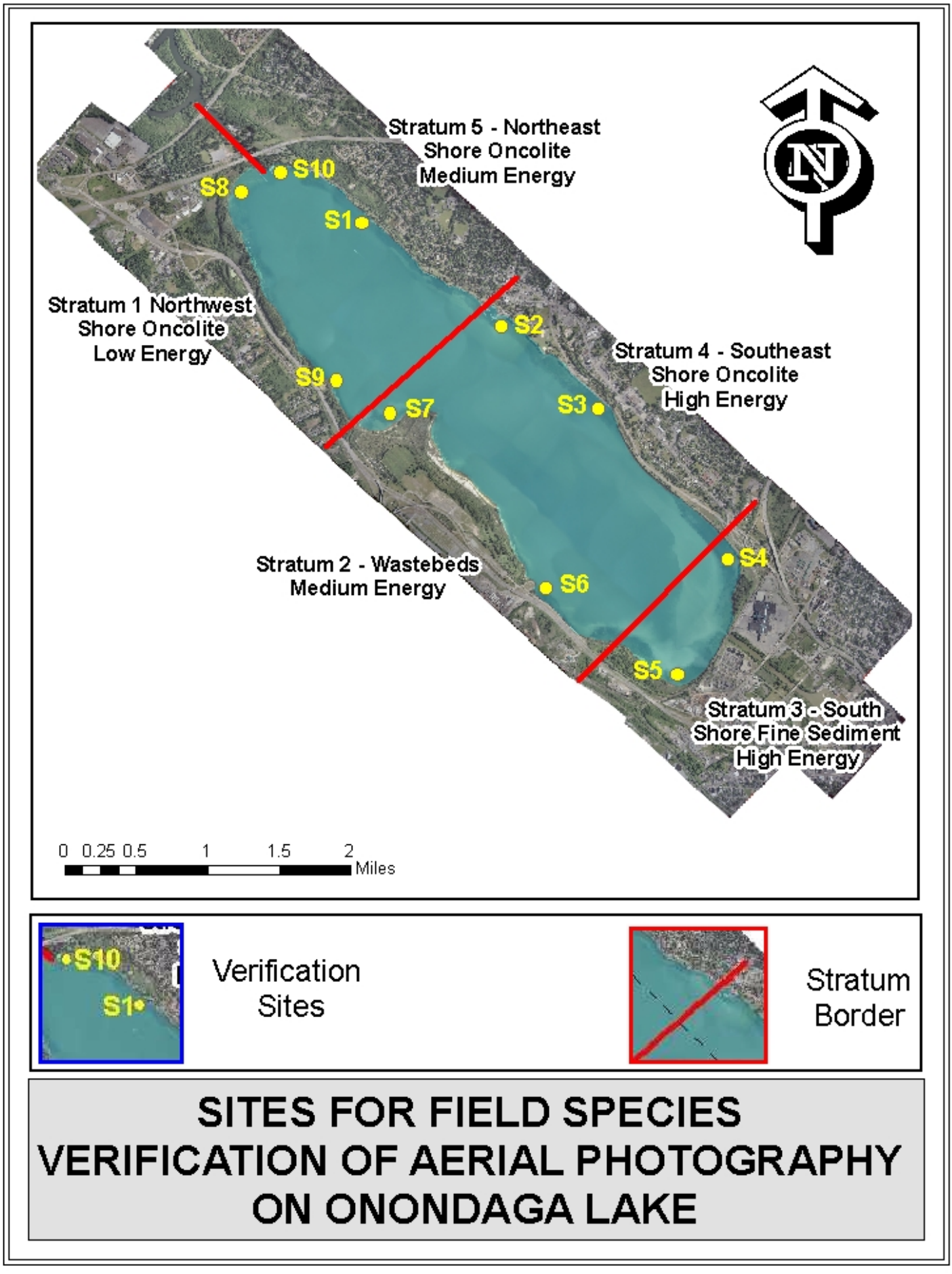
M.phyte: Dense Growth ☐ **Sparse Growth** ☐
Algae: Dense Growth ☐ **Sparse Growth** ☐
COMMENTS:

GPS Coordinates: **N: 43°** _____
W: 76° _____

MACROPHYTE SPECIES IDENTIFICATION		
Common Name	**Scientific Name**	**Est. Percent Coverage (5-meter Radius)**

Samples Collected For Laboratory Identification*
* Preserve samples in 10% Buffered Formalin.

Figure 1. Macrophyte Field Verification Sampling Locations.



ATTACHMENT 4

Data Analysis and Interpretation Plan
Onondaga Lake and Watershed
Ambient Monitoring Program

June 2012

Onondaga County Department of Water Environment Protection
650 Hiawatha Boulevard West
Syracuse, New York 13204-1194

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Tables

Figures

1. OBJECTIVES OF THE DAIP

Each year Onondaga County Department of Water Environment Protection (OCDWEP) collects and analyzes more than 20,000 water quality samples and hundreds of biological samples from sites within Onondaga Lake and its watershed. Results are used to evaluate water quality conditions and assess whether the surface waters are in compliance with applicable standards, criteria, and guidance values. The biological samples are used to evaluate the nature of the biological community and assess change.

This Data Analysis and Interpretation Plan (DAIP) was prepared to guide program managers and advisors regarding how these thousands of measurements will be analyzed and interpreted. It is a roadmap of how data become information (**Figure 1: Flow Chart of Decisions and Responsibilities: Onondaga Lake Rehabilitation).** This document is updated annually, as new information becomes available, new issues emerge, or new tools provide additional insight into data analysis and interpretation.

2. REGULATORY BACKGROUND – AMENDED CONSENT JUDGMENT

In January 1998, Onondaga County signed an Amended Consent Judgment (ACJ) committing to a phased program of upgrades and improvements to the County's wastewater collection and treatment system. The ACJ includes three major elements:

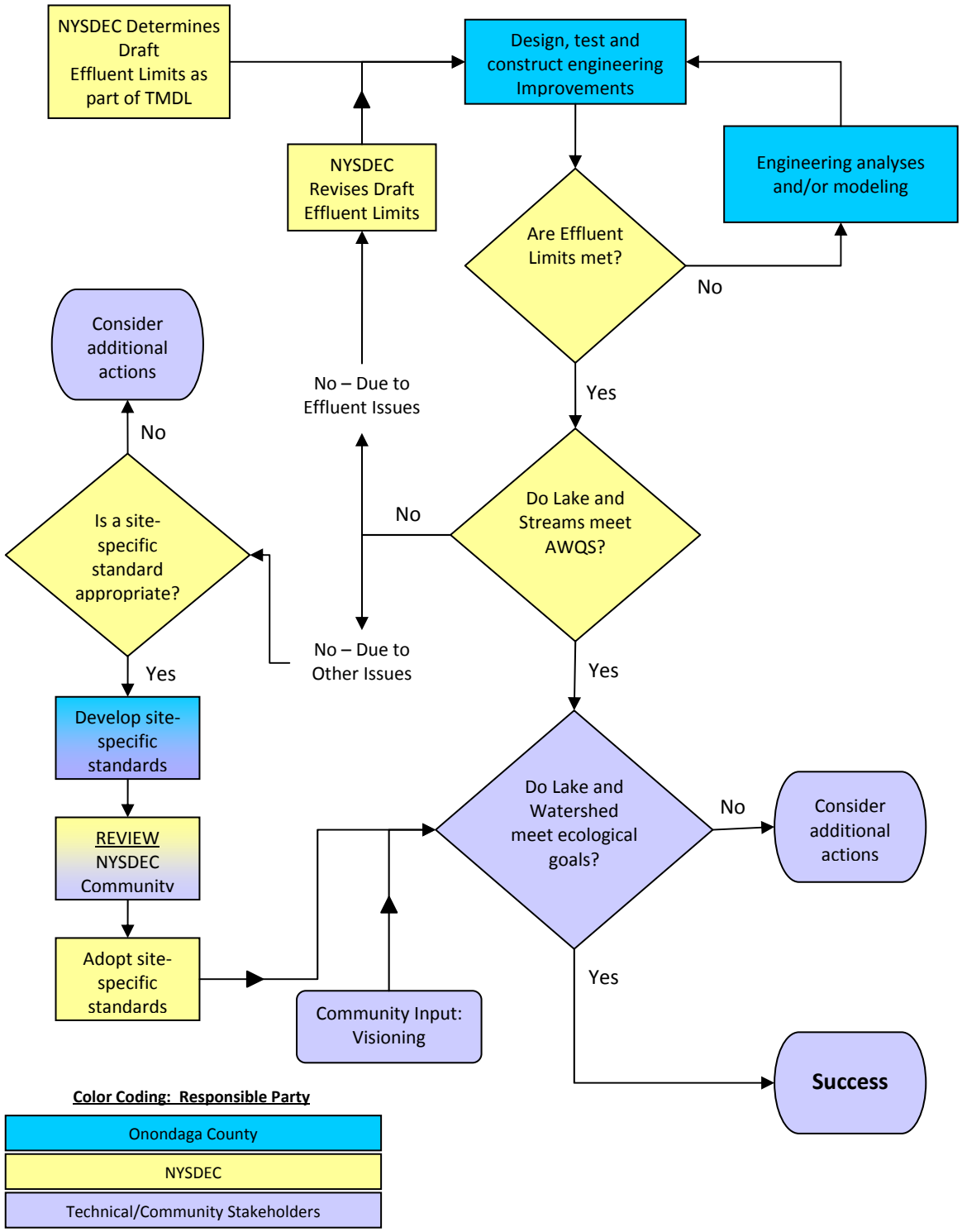
- Improvements to the wastewater and stormwater collection systems to abate Combined Sewer Overflows (CSOs);
- Improvements to the Metropolitan Syracuse Wastewater Treatment Plant (Metro) to reduce the concentration of ammonia N, phosphorus, BOD, solids, and bacteria in treated effluent prior to discharge; and
- Monitoring Onondaga Lake, the lake tributaries, and the Seneca River to track their response to the pollution abatement actions.

Improvements to Metro and the CSOs are being implemented over an 18 year period. One of the factors considered in developing this extended phasing plan was recognition of the need for "adaptive management". There was significant uncertainty associated with predicting how Onondaga Lake and the lake tributaries would respond to reductions in the loading of wastewater-related contaminants. The AMP supplies the data needed to evaluate the surface waters' response.

Onondaga County is required to design, fund and implement the AMP so that data and information are available to support key decisions regarding adequacy of the pollution abatement measures and the need for additional actions. These key decisions relate to the level of treatment and the location of the Metro discharge. The AMP data set also provides information for NYSDEC to use as they develop the Metro SPDES permit, which will include the CSOs.

The November 2009 fourth stipulation to the Amended Consent Judgment calls for modifications to the AMP designed to "enhance monitoring of the tributary water quality in the tributaries impacted by CSOs, to determine the effectiveness of the gray and green infrastructure projects…" The enhanced tributary monitoring program design was approved by NYSDEC in December, 2011; the elements of this work program have been incorporated into the February 2012 update of the DAIP.

Figure 1. Flow Chart of Decisions and Responsibilities: Onondaga Lake



2.1 Water Quality Classification and Designated Use

Lakes and streams are classified according to their designated use (for example, water supply, swimming, fish propagation, aesthetic enjoyment, and fish survival). Onondaga Lake is classified as B and C (**Figure 2: Regulatory Classifications and Bathymetry of Onondaga Lake** and **Table 1**) The Class B segment encompasses the northern basin; the Class C segments include much of the southern basin and a small area around the mouth of Ninemile Creek. Both B and C waters must exhibit water quality conditions suitable for fish survival and propagation. Class B waters are to be suitable for primary water contact recreation (e.g. swimming) and secondary water contact recreation (e.g. boating). Class C waters shall be suitable for primary and secondary water contact recreation, although other factors may limit the use for these purposes.

The main stems of the lake tributaries are primarily classified as C waters (suitable for fish propagation and secondary water contact recreation) but several small segments are Class B. The Seneca River segment in the vicinity of the Onondaga Lake outflow and downstream is Class B. As summarized in **Table 1**, several Class C stream segments within the subwatersheds are required to comply with Class C(T) water quality standards, meaning that dissolved oxygen and ammonia levels shall be suitable for salmonids.

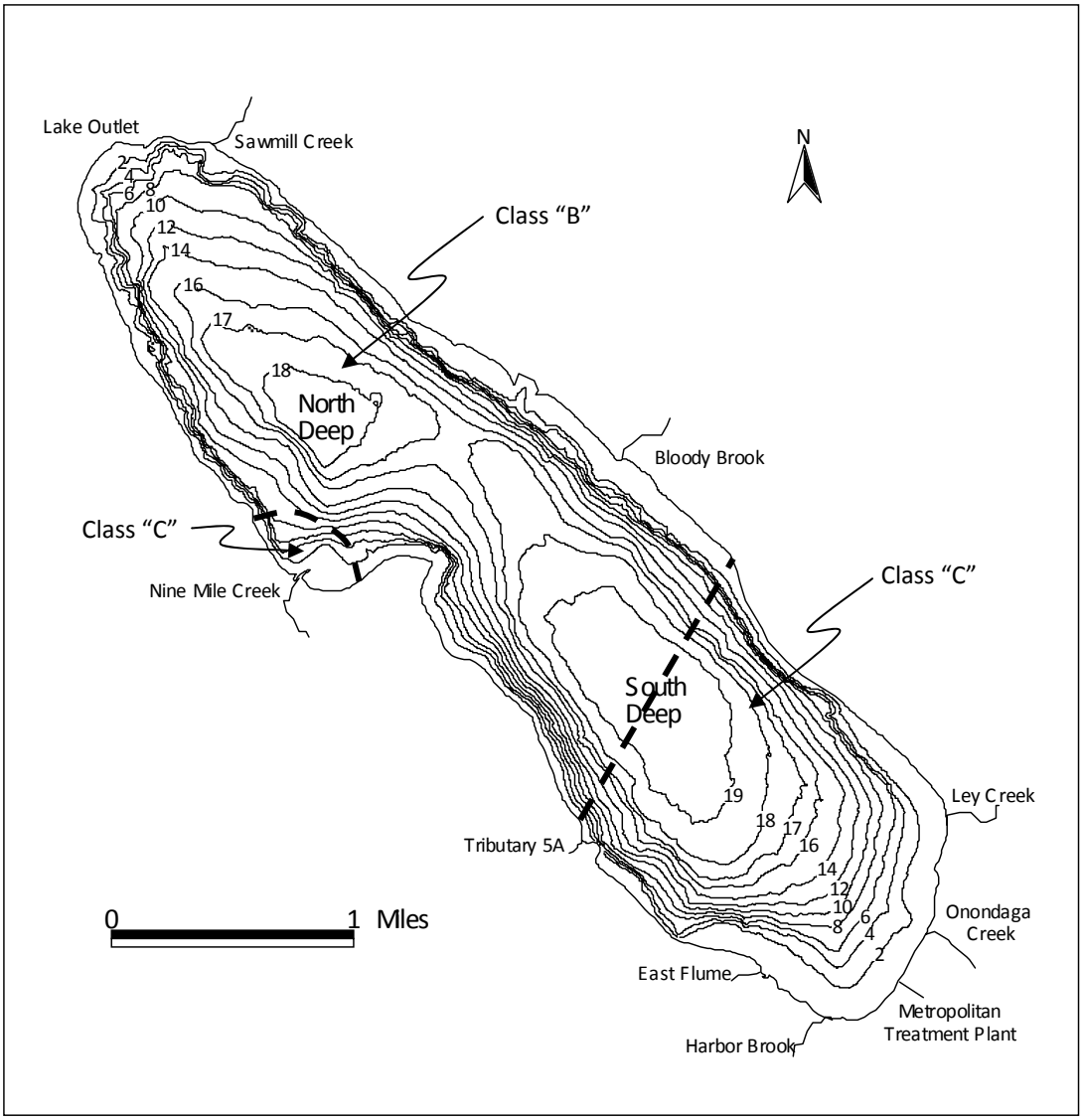


Figure 2. Regulatory Classifications and Bathymetry of Onondaga Lake (Note: Contour lines are in meters)

Table 1. Summary of Regulatory Classification of Onondaga Lake and Tributary Streams.

Water body	Description of Segment	Regulatory Classification	Standards
Onondaga Creek	Enters Onondaga Lake at southeastern end. Mouth to upper end of Barge Canal terminal (0.85 miles)	C	C
	Upper end of Barge Canal terminal to Temple Street (1.7 miles)	C	C
	From Temple Street, Syracuse to Tributary 5B (4.4 miles)	B	B
	From Tributary 5B to Commissary Creek (1.9 miles)	C	C
	From Commissary Creek to source	C	C(T)
Ninemile Creek	Enters Onondaga Lake from south. From mouth to Allied Chemical Corp. water intake located on creek to point mid-way between Airport Rd and Rt. 173 bridge at Amboy (3.4 miles).	C	C
	From point mid-way between Airport Rd and Rt. 173 to outlet of Otisco Lake	C	C(T)
Harbor Brook	Enters Onondaga Lake at the southern most point of the lake and within the City of Syracuse. From mouth to upper end of underground section, at Gifford Street (approx. 1.9 miles)	C	C
	From upper end of underground section to City of Syracuse line (1.3 miles)	B	B
	From City of Syracuse City line to source	C	C(T)
Ley Creek	Enters Onondaga Lake 0.2 mile southeast of point where City of Syracuse line intersects east shore of lake. From mouth to Ley Creek sewage treatment plant outfall sewer.	C	C
	From Ley Creek sewage treatment plant outfall sewer to South Branch. Tributaries 3-1A and 3-lB enter from north approximately 3.0 and 3.1 miles above mouth respectively.	B	B
Bloody Brook	Enters Onondaga Lake 2.25 miles southeast of outlet. From mouth to trib. 1 of Bloody Brook (approximately 0.37 miles from mouth)	B	B
	From trib. 1 of Bloody Brook to source.	C	C
Onondaga Lake (1)	Northwest of a line extending from a point located on the west shore 0.25 miles northwest of the mouth of trib. 5A to a point on the east shore located at a point 0.6 miles southeast of the mouth of Bloody Brook, except portions of the lake designated as items no. 2 and 3.	B	B
Onondaga Lake (2)	Southeast of a line extending from a point located on the west shore 0.25 miles northwest of the mouth of trib. 5A to a point on the east shore located at a point 0.6 miles southeast of the mouth of Bloody Brook, except portions of the lake designated as items numbered 1 and 3.	C	C
Onondaga Lake (3)	Area within 0.25 mile radius of the mouth of Ninemile Creek, except portions designated as items numbered 1 and 2.	C	C

Source: NYSDEC (classifications as of February 2012); on-line linkage http://www.dec.ny.gov/regs/4539.html#17588

2.2 Compliance Assessment

The regulatory goal of the ACJ is to bring Onondaga Lake and the segments of the lake tributaries affected by Onondaga County's municipal discharges into compliance with best usage designated for Class B and C waters pursuant to 6 NYCRR Parts 701 and 703. As outlined in the ACJ, specific NY State Water Quality Standards and Guidance that will be used to assess the extent to which these actions are successful include the following:

- Dissolved Oxygen: 6NYCRR Sec. 703.3
- Ammonia: 6 NYCRR Sec. 703.5
- Turbidity: 6 NYCRR Sec. 703.2
- Floatable Solids in CSO Discharges: 6 NYCRR Sec. 703.2
- Phosphorus: 6 NYCRR Sec. 703.2
- Water Quality Standards & Guidelines (NYSDEC TOGS 1.1.1)
- Nitrogen: 6 NYCRR Sec. 703.2
- Bacteria: 6 NYCRR Sec. 703.4

3. SUMMARY OF THE ONONDAGA COUNTY AMBIENT MONITORING PROGRAM (AMP)

Onondaga County is required by the ACJ to design and implement an annual monitoring program of the lake, the lake tributaries, and portions of the Seneca River adjacent to the Onondaga Lake Outlet. The objective of the Ambient Monitoring Program (AMP) is to provide the data and information needed to assess the effectiveness of the controls at Metro and the CSOs and determine if additional remedial measures are required to bring the waters into compliance with applicable state standards and guidelines and federal criteria.

Onondaga County and its partners rely on an integrated program of monitoring and modeling to determine whether the planned improvements to the Onondaga County wastewater collection and treatment infrastructure are effective in bringing the surface water system into compliance with state and federal requirements. Monitoring is used to measure conditions over the 18-year period of phased improvements to the wastewater collection and treatment system. Modeling is used to describe the interrelationships between physical, chemical, and biological characteristics of the lake and watershed. Models are also valuable tools for interpreting data and understanding underlying mechanisms. Once verified, models can be used to predict future conditions under a range of management scenarios and environmental conditions. The interrelationship between the management questions, monitoring and modeling, and the spatial and temporal designation of compliance is summarized in **Table 2**.

Table 2. Summary of management questions and decision analysis.

Management Question:	Decision Analysis Components and Regulatory References	Spatial and Temporal Scale of Assessment	Tools for Assessment
Can ambient water quality standards be achieved with continued Metro discharge to Onondaga Lake?	Dissolved Oxygen: 6NYCRR Sec. 703.3 Ammonia: 6 NYCRR Sec. 703.5 Turbidity: 6 NYCRR Sec. 703.2 Floatables: 6 NYCRR Sec. 703.2 Phosphorus: 6 NYCRR Sec. 703.2 TOG 1.1.1 Nitrogen: 6 NYCRR Sec. 703.2 Bacteria: 6 NYCRR Sec. 703.4	Dissolved Oxygen: Upper waters, fall mixing, South Deep Ammonia and nitrite: Upper waters; South Deep, year-round Bacteria: Class B portions of lake	Monitoring: AMP data Modeling CSOs: Use SWMM to confirm: system-wide annual average capture of 85% of combined sewage volume. Modeling Lake: Onondaga Lake model (development began in 2005)
Must Metro effluent meet the Stage III phosphorus and ammonia limits for discharge to Onondaga Lake or the Seneca River in order for the receiving water to achieve compliance with ambient water quality standards?	Phosphorus: 6 NYCRR Sec. 703.2 (*possibly modified by site-specific guidance value)* Trophic state indicators: frequency, intensity and duration of algal blooms Ammonia: TOG 1.1.1 NYSDEC revised TMDL for phosphorus: **(pending- 2012)**	Phosphorus and other trophic state parameters: Summer average, upper waters, South Deep Dissolved Oxygen: Upper waters, fall mixing, South Deep Ammonia: Upper waters; South Deep, year-round	For lake discharge: • AMP data: Ammonia: effects of Stage 3 limits, met in 2004 TP: effects of Stage 2 limits, met in 2006 For Seneca River discharge: TRWQM

Are additional measures needed to ensure compliance with dissolved oxygen standards during fall mixing?	Feasibility analysis of hypolimnetic oxygenation (ENSR 2004). *Status: removed from ACJ by stipulation*	Focus of compliance for dissolved oxygen: fall mixing, upper waters	• AMP data: profiles and buoy • Mass-balance model • Onondaga Lake model

3.1 History of Onondaga County Monitoring Efforts

The AMP is not Onondaga County's first monitoring effort. Following completion of a baseline State of the Lake Report in 1970, Onondaga County conducted an annual program from 1970–1997 to monitor tributaries, quantify external loading, and track lake water quality conditions and trends in response to pollution abatement efforts. When the ACJ was signed in 1998, Onondaga County modified its historical monitoring program to ensure that the data collected would be adequate to evaluate the response of the lake, streams, and river to the planned improvements to the CSOs and Metro. This process of evaluation and modification was a collaborative effort of Onondaga County, Onondaga Lake Technical Advisory Committee (OLTAC), U.S. Geological Survey (USGS), New York State Department of Environmental Conservation (NYSDEC), Environmental Protection Agency (EPA) and Atlantic States Legal Foundation (ASLF). The AMP began in August 1998 and is scheduled to continue through 2018.

The AMP differs from the historical program in several important ways:

- Storm Event Monitoring: The AMP incorporated a storm event program on the CSO-affected tributaries (Onondaga Creek, Harbor Brook, Ley Creek), plus Ninemile Creek. Storm event data are used to evaluate the effectiveness of the CSO remedial measures. Beginning in 2012, storm event sampling will occur during overflows from the combined sewer system. Monitoring will include priority pollutant scans in addition to conventional wastewater and stormwater related parameters.

- Stream Mapping: A stream mapping component was added to the AMP to document habitat quality along the CSO-affected tributaries; this program will support evaluation of the effectiveness of CSO controls and has provided additional information regarding nonpoint sources of pollution (particularly sediment).

- Recreational Indices: The AMP was expanded to include monitoring for indices of recreational quality (bacteria and water transparency) at a network of eight nearshore stations (a ninth station was added in 2006).

- In-Situ Buoy: A monitoring buoy has been placed at the Onondaga Lake South Deep station to provide high-frequency measurements of water temperature, dissolved oxygen and related parameters.

- Precipitation Stations: Onondaga County has expanded its network of precipitation gauging stations.

- Biological Monitoring: With the AMP, Onondaga County undertook an extensive biological monitoring program.

3.2 Design of the AMP: Required Elements

The AMP was designed to provide data and information needed to guide management decisions regarding the level of treatment of municipal wastewater (including CSOs) and the location of the Metro discharge.

The AMP includes Onondaga Lake, the lake's tributaries, and the Seneca River in the region of the Onondaga Lake outlet. The program includes measures to evaluate physical and habitat conditions, chemical water quality, and the nature of the biota as summarized in the language from the ACJ listing the required elements of the AMP.

These required elements from Appendix D of the ACJ include measures to:

- Assess compliance with ambient water quality standards and guidance values in the lake and tributary streams
- Estimate loading of materials to the lake, including the volume and loading of materials from the combined sewer overflows
- Evaluate physical habitat conditions in the lake and tributaries
- Evaluate the lake's trophic state (level of productivity)
- Model the assimilative capacity of the Seneca River in the region of the Onondaga Lake outlet to support a decision regarding diversion of Metro effluent
- Characterize the lake's biological community.

In addition to these specific measures, Appendix D of the ACJ (abstracted below) includes requirements to document data integrity (for example, preparation of a detailed Quality Assurance Project Plan). Onondaga County is required to consult with technical experts to ensure that the AMP is designed and implemented in a defensible manner. Data interpretation and reporting is to be open and subject to rigorous technical review. Finally, Appendix D includes specific requirements to ensure that Onondaga County's monitoring program collects data related to habitat quality. The addition of attributes to measure habitat quality highlights the expansion of the program from a traditional water quality monitoring program to one that aims at a more holistic assessment of ecological integrity.

OCDWEP also has an expanded monitoring program on the Seneca River that is not part of the AMP; this program extends into the Oneida River and is used to evaluate performance of other Onondaga County wastewater treatment plants.

An overview of how the AMP is designed to meet ACJ requirements is provided in **Table 3**. While the AMP is designed to assure compliance with the specific requirements in the ACJ, Onondaga County collects and analyzes additional data to meet related program objectives. In many cases, additional data are collected that enable a more integrated analysis of water quality conditions

and the response of the biota. Details of how data collected through the AMP are used and interpreted is included in **Table 4.** Onondaga Lake Chemical/Water Quality Monitoring Program.

The ACJ has been amended periodically, most recently by stipulation in November, 2009 (referred to as the fourth stipulation). The ACJ amendments have added other requirements to the AMP. The current AMP requirements are summarized below.

AMBIENT MONITORING PROGRAM REQUIREMENTS
(Appendix D of the ACJ)
Abstracted from the Amended Consent Judgment, January 1998

I. Tributaries and Lake Water Quality Monitoring Program

1. Assess compliance with ambient water quality standards and progress toward use attainment.
2. Assess physical habitat for stream and lake biota, and indicators of the biotic response.
3. Incorporate flexibility to assess additional chemicals or potential sources as needed
4. Concentrate data collection during critical ecological periods (e.g. spring spawning of dominant lake fishes, onset of thermal stratification, fall mixing).
5. Define monitoring as a priority at the Department and commit adequate resources
6. Increase participation of outside technical experts, e.g., Onondaga Lake Technical Advisory Committee in design and implementation of AMP and interpretation of results.
7. Incorporate appropriate QA/QC.
8. Maintain data in an electronic format that facilitates summarizing data, reporting results, and depicting results (including graphical depiction)

II. Tributary Monitoring Program

1. Quantify external loadings of phosphorus, nitrogen, suspended solids, indicator bacteria, heavy metals, and salts. Utilize FLUX, or the most recent version of comparable software, to estimate loading and the standard effort of the estimate.
2. Conduct monitoring during high flow events to partition point and nonpoint sources of phosphorus (minimum of 5 events annually).
3. Sample upstream and downstream of CSO discharges to Onondaga Creek, Harbor Brook and Ley Creek, during storms of sufficient size to trigger overflows (per fourth stipulation: sample receiving water during overflow events for priority pollutants in addition to parameters associated with wastewater and stormwater).
4. Assess compliance with water quality standards in Onondaga Creek, Harbor Brook and Ley Creek.
5. Measure attributes of the physical environment in tributaries: (a) velocity; (b) cross-sectional area to map erosional and depositional sections; (c) survey for presence and character of sludge deposits in depositional areas and map; (d) map physical characteristics of the stream bed that could affect spawning habitat from mouth to first barrier; (e) sample macroinvertebrate communities and calculate NYSDEC rapid field biotic index throughout tributaries' length.
6. Continue cooperative arrangements with USGS to gauge discharge of the major tributaries.

7. Continue data collection, analysis and reporting consistent with historical database (1970 to 1997) to enable statistical trend analysis.
8. Install flow metering devices and indicators of overflows on CSOs to estimate annual discharge. Use this information to estimate percent capture of total runoff on an annual basis.

III. Onondaga Lake Monitoring Program

1. Assess compliance with ambient water quality standards including bacteria in nearshore areas.
2. Assess trophic status of the Lake.
3. Continue data collection, analysis, and reporting consistent with the long-term lake database (1970 – 1997) to enable statistical trend analysis.
4. Complement chemical program with a biological monitoring effort to assess the densities and species composition of phytoplankton, zooplankton, macrophytes, macroinvertebrate, and fish.
5. Evaluate success of walleye, bass, and sunfish propagation (quantitative lake-wide nest surveys, recruitment estimates, and juvenile community structure). Coordinate with NYSDEC fisheries management activities on the lake.
6. Establish data sharing protocols with NYSDEC for County to track contaminants in fish flesh.
7. Acquire and track data by others regarding nature of littoral sediments in Onondaga Lake.

IV. Seneca River Program

1. Evaluate current water quality of the Seneca River and compliance with water quality standards upstream and downstream of the Onondaga Lake outlet.
2. Evaluate and quantify the assimilative capacity of the Seneca River and quantify effects of zebra mussels.
3. Monitor critical conditions of warm weather and low flows.
4. Test temporal and spatial variability (e.g., diurnal variations in river water quality, and the extent of chemical stratification).

Table 3. Elements of the AMP in relation to ACJ-Required Monitoring Objectives

ACJ Statement of Required Program Objective	Ambient Monitoring Program Elements	Data Used To
Quantify external loading of phosphorus, nitrogen, suspended solids, indicator bacteria, and salts. Assess the reduction in loading achieved by the CSO improvements. Design program to evaluate the relative contribution of point and nonpoint sources of pollution to the lake.	Tributary monitoring (Annual Program): biweekly and high flow events – includes locations upstream and downstream of CSOs, urban and rural segments of subwatersheds. Storm event program (Periodic): higher frequency sampling on CSO-affected streams during storms.	Estimate annual external loading to the lake Calculate loading from CSO-affected tributaries and compare pre-and post-remedial load of phosphorus, suspended sediment and bacteria
Assess the tributaries' physical habitat and macroinvertebrate community	Periodic stream mapping using NRCS Visual Stream Assessment Protocol in CSO-subwatersheds- Macroinvertebrate surveys CSO-affected subwatersheds every 2 years.	Quantify baseline conditions and provide basis to measure change. Calculate standard indices to indicate status of water quality and habitat conditions. Evaluate changes over time.
Gather data on an adequate temporal and spatial scale to assess compliance with ambient water quality standards	Lake monitoring program (Annual): South Deep Station and nine nearshore stations Tributary monitoring program (Annual) Seneca River monitoring program (Annual)	Assess compliance with numerical and narrative standards for substances per TOGS 1.1.1 Calibrate and verify models
Evaluate changes in the water quality and trophic state of Onondaga Lake in response to reductions in external loading achieved by the improvements to Metro and the CSOs.	Lake monitoring program (Annual): phosphorus, chlorophyll-a, water clarity, DO status of lower waters Tributary and Metro effluent monitoring (Annual): loads (esp. nutrients) Seneca River monitoring (Annual)	Assess inputs and trends Calibrate USGS watershed model using AMP data Construct conceptual and mass-balance models Calculate "fish space metrics" to track changes in fish habitat Develop and calibrate Onondaga Lake model
Coordinate data collection and analysis to provide data at an adequate spatial and temporal scale to use in existing or revised lake models	Annual program and supplemental investigations, NYSDEC review and approvals Meetings with OLTAC and work groups	Support conceptual and empirical (mass-balance) model; AMP data will be used to calibrate and verify new lake model (completed)
Assess Seneca River water quality between Cross Lake and the Three Rivers junction.	Annual surveys during low flow conditions at Seneca River Buoy 316.	Assess current conditions and compliance provide data for model verification (completed)
Evaluate the assimilative capacity of the Seneca River and quantify effects of dreissenid mussels.	River modeling work group and peer review Surveys during low flow conditions	Assess current conditions, data set for model verification (completed)

Table 4. Detailed Reporting of AMP Program, Data Analysis and Interpretation Strategy. ***Lake Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Alkalinity, Total	Concentration	• Charge Balance • Trends • Compute Hardness	South Deep North Deep	UML composite LWL composite	South Deep: Biweekly (April- Dec) North Deep: Quarterly (+ winter)	Wildco Beta horizontal sampler/ Churn
Bacteria Fecal Coliform, E. Coli	• Abundance of indicator organisms • Comparison with standards	• Potential presence of pathogens • Comparison with standards • Use attainment. • Trend analysis • Effectiveness of CSO control measures.	South Deep North Deep Nearshore sites	0m	South Deep: 5 samples/month (April - October) North Deep: As above, plus winter (as possible) Nearshore: 5 samples/month (April -October)	Grab sample into sterile bottle
Carbon: TOC, TIC	Concentration	• Trends • Trophic Status. • Indicator of oxygen demanding material. • Support models	South Deep North Deep	Discrete depths (0m, 6m, 12m, 18m)	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly (+ winter)	Submersible Pump
Low level Mercury: Total and Methyl Mercury	Concentration	• Compliance with standards • Trends	South Deep North Deep	3m & 18m	April, August, October	Teflon Dunker Modified USEPA 1669

Table 4 Detailed Reporting of AMP Program. (continued) ***Lake Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Collection Method
Metals: Cd, Cr, Cu, Ni, Pb, Zn, As, K, Se	Concentration	• Compliance • Charge balance computations (K)	South Deep North Deep	UML composite LWL composite	Quarterly	Wildco Beta horizontal sampler/ Churn
Metals/Salts: Ca, Na, Mg, Mn, Fe, Cl, SO_4	Concentration	• Charge Balance (data quality) • Trends • Geochemical analysis • Electrochemical (redox) • Density stratification	South Deep North Deep	UML composite LWL composite	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly (+ winter)	Wildco Beta horizontal sampler/ Churn
Nitrogen: NO_3, NO_2	• Concentration • Compliance	• Compliance. • Nitrogen cycling • Use attainment	South Deep North Deep	UML composite LWL composite	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly (+ winter)	Wildco Beta horizontal sampler/ Churn
Nitrogen: TKN, NH3-N, Org-N, TKN-Filtered Total N (calculated)	Concentration	• Compliance • Nitrogen cycling • N:P ratios • Habitat for biota • Trend analysis • Model support	South Deep North Deep	Discrete Depths (0m, 3m, 6m, 9m, 12m, 15m, 18m)	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly (+ winter)	Submersible Pump
Phosphorus: TP, SRP, TDP	Concentration	• Trophic status • Trends • Compliance • TMDL analysis • Model support • Bioavailability	South Deep North Deep	Discrete Depths (0m, 3m, 6m, 9m, 12m, 15m, 18m) plus 1m, biweekly, June 1 – Sept 30	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly (+ winter)	Submersible Pump

Table 4 Detailed Reporting of AMP Program. (continued) ***Lake Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Collection Method
Silica-dissolved	Concentration	Trophic levels interaction	South Deep North Deep	Discrete depths (0m, 6m, 12m, 18m)	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly (+ winter)	Submersible Pump
Solids: TS, TSS, TDS	Concentration	• Compliance • Trend analysis • Chemical stratification • Correlation with turbidity	South Deep North Deep	Discrete depths (0m, 6m, 12m, 18m)	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly (+ winter)	Submersible Pump
Sulfides	Concentration	• Anoxia • Model support (diagenesis)	South Deep North Deep	Discrete depths (12m, 15m, 18m)	When anoxia present South Deep: Biweekly North Deep: Quarterly	Wildo Beta horizontal sampler
Turbidity	Light scattering (NTU)	• Trend analysis • Correlation with indices affecting water clarity	South Deep	Discrete depths (2m, 6m)	Daily at 15 minute intervals (Apr-Dec)	YSI Buoy
			South Deep North Deep	UML composites, plus 0m at S Deep	South Deep UML: Biweekly(Apr-Dec) North Deep: Quarterly (+winter)	Wildco Beta horizontal sampler/ Churn

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Collection Method
Field data: pH, Temperature, Salinity, Conductivity, Dissolved Oxygen, ORP	• Volume-days of Anoxia • Rate of hypolimnetic oxygen depletion • DO during fall mixing • Volume-days of anoxia • Fish-space metrics	• Compliance • Stratification (thermal and chemical) • Model support • Trend analysis • Ammonia toxicity. • Use attainment.(habitat) • Concentration of reduced substances and oxidation status of lake (ORP data) • pH indicator of CO2 production and decomposition.	South Deep North Deep	0.5 m intervals through water column	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly Winter as possible	YSI (In-situ)
		• Compliance with DO and pH standards. • Evidence of mixing processes (seiche)	South Deep	Discrete depths (2m, 6m, 12m, 15m)	Daily at 15 minute intervals (Apr-Dec)	YSI Buoy
Secchi Disk Transparency	• Average Secchi, percent of measurements meeting 1.2 m (nearshore), 1.5 m (South Deep)	• Secchi disk transparency: Compliance swimming safety guidance • Trends • Trophic Status • Indicator of water clarity • Aesthetics • Use attainment	South Deep North Deep Nearshore sites	Depth at which the disk is no longer visible from the surface	South Deep: Weekly (May-Sep) Biweekly (Apr, Oct-Dec) North Deep: Quarterly Winter as possible Nearshore: Weekly (May–Sep)	

Lake Program Summary

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
LiCor Underwater Illumination Profile	• Extinction coefficient	• Trends • Trophic Status • Indicator of water clarity • Aesthetics • Use attainment	South Deep North Deep	From lake surface to depth at which light is 1% of surface illumination	Biweekly (Apr-Dec)	LiCor Datalogger
Chlorophyll-*a* & Phaeophytin-*a*	• Concentration • Magnitude and frequency of bloom conditions	• Use attainment. • Aesthetic quality • Assess trophic Trends • Food web • Lake model calibration and validation	South Deep North Deep	UML composite and Photic Zone[1]	South Deep: In duplicate weekly (May-Sept) and biweekly (April; Oct –Dec) North Deep: Quarterly	¾" Tygon tube sampler (Depth-integrated tube samples)
Phytoplankton	• Biovolume • Abundance • Species composition • Annual succession • Percent blue green	• Assess community structure, importance of cyanobacteria • Trends in abundance and biomass • Aesthetic quality • Correlation with chlorophyll • Relationship to light penetration	South Deep North Deep	UML composite	South Deep: Biweekly (Apr–Nov) and monthly in winter, as conditions allow North Deep: Quarterly	¾" Tygon tube sampler (Depth-integrated tube samples)

1 The Photic Zone is defined as two times the Secchi disk transparency depth measured the day of sampling.

Table 4 Detailed Reporting of AMP Program. (continued) ***Lake Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Zooplankton	• Count • Dry weight biomass • Identification • Abundance • Species composition • Annual succession • Size	• Trends in abundance and biomass • Assess community structure • Size structure • Correlate data with other regional lakes (Oneida Lake) • Test relationship to fish community • Infer food web impacts	South Deep North Deep	UML composite and 15 m tow	South Deep: Biweekly (Apr– Nov) North Deep: Quarterly	Vertical Haul 0.5 m diameter net, 80 μm mesh
Macrophytes	Plant distribution	Used to track percent cover during years without field surveys	Entire Lake	To maximum depth of plant growth	Annual late July	Digitize beds from aerial photographs using GIS
	Lakewide and by strata: • Species richness • Biomass • Percent cover	• Percent cover compared with optimal levels for warmwater fish community (bass) nursery and cover • Biomass to support lake model • Richness compared with regional lakes Trends	Transects in littoral strata	From shoreline to depth where plant growth stops (6 m contour standard)	2000, 2005, 2010 (August surveys)	Field surveys

Table 4. Detailed Reporting of AMP Program. (continued***)*** . ***Lake Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Fish Nesting survey	Count Where possible, identify species	Change over time: lakewide and at five strata used for biological programs	Entire Lake divided into 24 sections	1 m	June	Visual Count around littoral zone
Littoral Larvae (seining)	• Species identification • Length frequency • Catch per unit effort	• Community Structure • Growth rate, compared to regional lakes and to historical data • Species Richness • Pollution tolerance	15 sites lakewide	~ 1m	Mid May Early July	Larval Fish Seine 10 m sweep
Fish Littoral Juvenile (seines)	• Number and species of juveniles • Catch per unit effort	• Community Structure • Size/length distribution • Species Richness • Evidence of recruitment • Pollution tolerance	15 sites lakewide	~ 1m	Every three weeks (Mid July-October)	¼" mesh bag seine sweep
Fish Littoral Juvenile (boat electrofishing)	• Number and species of juveniles • Catch per unit effort	• Community Structure • Size/length distribution • Species Richness • Evidence of recruitment • Pollution tolerance	24 sections	< 1m	Late July	Night Electrofishing

Table 4. Detailed Reporting of AMP Program. (continued) ***Lake Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Fish Littoral Adults	• Number and species captured • Catch per unit effort	• Community Structure • Size/length distribution • Species Richness • Evidence of recruitment • Pollution tolerance • Index of Biological Integrity	24 sections	< 1m	May, September	Night Electrofishing
Fish Pelagic Adults	• Number and species captured • Catch per unit effort	• Community Structure • Size/length distribution • Species Richness • Evidence of recruitment • Pollution tolerance	10 sites (1 per station)	3-10 m water (2 hour set)- night	May, September (within one week of electrofishing event)	Littoral - Profundal Experimental Gill Nets and Hydroacoustics
Fish Deformities, Erosions, Lesions, Tumors, Fungal and Multiple Anomalies (DELT-FM)	Number and types of anomalies	Change over time	Lakewide	All (most are adults captured by electrofishing)	Screening on all captured fish	Visual analysis by trained field teams

Table 4. Detailed Reporting of AMP Program. (continued) ***Tributary Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
Alkalinity	Concentration	• Calculate bicarbonate (charge balance) • Trends	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF- Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Depth Integrated Sampling Techniques
Bacteria: Fecal Coliform	Abundance Compliance	• Potential presence of pathogens • Trends • Compliance with standards • Effectiveness of CSO control measures	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Minimum 5 samples per month (Jan-Dec)	Grabs
BOD-5	Concentration	• Load • Indicator of oxygen-demanding material	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Wildco Beta horizontal sampler/churn

Table 4. Detailed Reporting of AMP Program. (continued) ***Tributary Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
Carbon: TOC, TOC-F, TIC	Concentration	• Trends • Trophic status • Oxygen demand • Load	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Depth Integrated Sampling Techniques
Cyanide	Concentration	Compliance	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook and Sawmill Creek: only sampled June – Sept	Quarterly	Depth Integrated Sampling Techniques
Metals: Cd, Cr, Cu, Ni, Pb, Hg, Zn, As, K	Concentration	• Compliance (if AWQS) • Load • Data quality (K used in charge balance)	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: only sampled, June – Sept	Quarterly	Depth Integrated Sampling Techniques

Table 4. Detailed Reporting of AMP Program. (continued) ***Tributary Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
Metals/Salts: Ca, Na, Mg, Mn, Fe, Cl, SO4, SiO2-diss	Concentration	• Compliance (if AWQS) • Load • Data quality (major ions used in charge balance) • Geochemical analysis	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Nitrogen: TKN, NH_3-N, Org-N, TKN-Filtered Total N (calculated)	Concentration	• Trends • Support TMDL • Load • Nutrient criteria for flowing waters	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Depth Integrated Sampling Techniques
Nitrogen: NO_3, NO_2	Concentration	• Compliance with standards • Load • Trends	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Depth Integrated Sampling Techniques
Phosphorus: TP, SRP, TDP	Concentration	• Trends • Support TMDL • Load • Bioavailability • Nutrient criteria for flowing waters	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Depth Integrated Sampling Techniques

Table 4. Detailed Reporting of AMP Program. (continued) ***Tributary Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
Solids: TSS, TDS	Concentration	Loading	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Depth Integrated Sampling Techniques
Turbidity	Concentration	Transport dynamics	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January-December)	Depth Integrated Sampling Techniques
Field data: pH, Temperature, Salinity, Specific conductance, Redox potential, dissolved oxygen	Average, maximum and minimum values	• Compliance • Trend analysis. • Use attainment.(habitat) • pH indicator of production and decomposition.	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; ; Ley; Trib5A; Metro; EF-Manhole#015; Outlet; Bloody Brook and Sawmill Creek: biweekly, June – Sept	Biweekly (January- December)	In-situ
Sampling in CSO affected tributaries during storm & overflow events: • Bacteria • Floatables • Priority pollutants • Ammonia N • Total N & Total P • In-situ	Concentration	Compliance with ambient water quality standards	Sampling will rotate among sites downstream of representative CSOs in Onondaga Creek and Harbor Brook.	As conditions allow: target four overflow events per site, over a two-year period (rotating between sewersheds). High frequency, short duration sampling at transects across the stream. For 2012-2013, sampling is planned for EBSS.	Combination of depth-integrated samples (VOC collected using special apparatus) grabs and composite samples. *Details: OCDWEP 2011*

Table 4. Detailed Reporting of AMP Program. (continued) ***Seneca River Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
BOD-5	Concentration	• Indicator of oxygen-demanding material	Buoy 412, 316, 269, 240, 222, 212	1 meter below water surface 1 meter above the river sediments	Once, low flow conditions (July – September)	Wildco Beta horizontal sampler
Carbon: TOC, TDC	Concentration	• Trends • Trophic status • Indicator of oxygen-demanding material	Buoy 412, 316, 269, 240, 222, 212	1 meter below water surface 1 meter above the river sediments	Once, low flow conditions (July – September)	Wildco Beta horizontal sampler Tube sampler "Depth Integrated Tube samples"
Chlorophyll-*a*	Concentration	• Trophic status • Trends	Buoy 412, 316, 269, 240, 222, 212	Through the water column. Tube composite through the photic zone and a grab at 1-meter above the river sediments.	Once, low flow conditions (July – September)	

Table 4. Detailed Reporting of AMP Program. (continued) ***Seneca River Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Metals/Salts: Cl	Concentration	• Trends • Geochemical analysis	Buoy 412, 316, 269, 240, 222, 212	1 meter below water surface 1 meter above the river sediments	Once, low flow conditions (July – September)	Wildco Beta horizontal sampler
Nitrogen: TKN, NH3-N, TKN-Filtered, NO3, NO2 Total N (calculated)	Concentration	• Compliance • N dynamics • N:P ratios • Trends • Nutrient criteria for flowing waters	Buoy 412, 316, 269, 240, 222, 212	1 meter below water surface 1 meter above the river sediments	Once, low flow conditions (July – September)	Wildco Beta horizontal sampler
Phosphorus: TP, SRP, TDP	Concentration	• Trophic status and algal productivity • Trends • Nutrient criteria for flowing waters	Buoy 412, 316, 269, 240, 222, 212	1 meter below water surface 1 meter above the river sediments	Once, low flow conditions (July – September)	Wildco Beta horizontal sampler
Solids: TSS, VSS	Concentration	• Trends • Indicator of water clarity	Buoy 412, 316, 269, 240, 222, 212	1 meter below water surface 1 meter above the river sediments	Once, low flow conditions (July – September)	Wildco Beta horizontal sampler

Table 4. Detailed Reporting of AMP Program (continued) ***Seneca River Program Summary***

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Turbidity	Light scattering (NTU)	• Trends • Indicator of water clarity	Buoy 412, 316, 269, 240, 222, 212	1 meter below water surface 1 meter above the river sediments	Once, low flow conditions (July – September)	Wildco Beta horizontal sampler
			Buoy 316	Upper waters: 0.86m Lower waters: 3.80 m	Daily at 15 minute intervals (April- Nov)	YSI Buoy
Field data: pH, Temperature, Salinity, Conductivity, Dissolved Oxygen, ORP	Concentration	• Compliance • Stratification regime. • Trends • Ammonia toxicity. • Redox status • pH indicator of CO2 production/decomposition • DO indicator of suitability of aquatic biota/zebra mussel activity. • Support river model and evaluate assimilative capacity	Buoy 316	0.5 m increments	Once, low flow conditions (July – September)	YSI (in-situ)
			Buoy 316 (Seneca River)	Upper waters: 0.86m Lower waters: 3.80 m	Daily at 15 minute intervals (April- Nov)	YSI Buoy
Secchi Disk Transparency		• Indicator of water clarity • Use attainment	Buoy 412, 316, 269, 240, 222, 212	from the surface		Secchi Disk

LiCor Underwater Illumination Profile		• Trends • Indicator of water clarity	Buoy 412, 316, 269, 240, 222, 212	Licor data – 20 cm intervals from river surface to depth at which light is 1% of surface illumination	Once, low flow conditions (July – September)	LiCor Datalogger

3.3 Design of the AMP: Underlying Assumptions

Design of the AMP builds on decades of monitoring within the lake and its watershed. Several important assumptions underlie the monitoring program; these assumptions are based on analysis of the historical data and mass-balance calculations. Among the assumptions are:

- South Deep is representative of lake-wide conditions.

  This assumption has been evaluated by comparing data collected at North Deep on a quarterly frequency with the South Deep data. A t-test of paired samples was used to compare data from 1999-2007, and resulted in no systematic difference in trophic status indicator parameters (chlorophyll-a, phytoplankton biomass, and Secchi disk transparency) measured at North and South Deep. Of the other parameters, the N species and Fe are higher at South Deep, which is likely due to the Metro discharge. Fecal coliform bacteria are higher at South Deep; this is attributed to the proximity of major sources (storm water and CSO discharges). Specific conductance and pH were higher at North Deep, likely reflecting the influence of Ninemile Creek.

- External loading to the lake is assessed by monitoring discharge and concentration of six tributaries plus Metro effluent. In total, approximately 95% of the water flow into the lake is gauged and sampled. It is assumed that this monitoring is sufficient to provide a robust estimate of external loading.

  This assumption was tested in 2003, when storm event samples were obtained from two small streams draining the nearshore (ungauged) portion of the watershed. The concentrations of monitored parameters in the two streams, Bloody Brook and Sawmill Creek, were less than or comparable to concentrations measured in the gauged streams. With the very low flow contribution, it was determined that the loading from the nearshore (ungauged) portion of the lake watershed was minimal. That is, the ungauged areas do not contribute a disproportionate load given their drainage area.

- Deposition onto the lake surface (including precipitation and dry fall) accounts for a small fraction of the total external nutrient load and can be adequately characterized from regional data.

  The mass balance framework developed by Dr. William Walker provides a basis for evaluating the magnitude and importance of precipitation within the lake's phosphorus budget. The lake surface area comprises a very small fraction of the overall drainage basin, and precipitation onto the lake surface represents about 2% of the total water inflow. The concentration of phosphorus in rainwater is variable, but

typically well below the concentrations measured in the tributary streams, and an order of magnitude less than the concentration in the Metro effluent. Again looking to Dr. Walker's mass balance framework, precipitation represents < 1% of the total P loading to the lake assuming the regional average TP concentration in precipitation of 30 µg/l. Doubling this estimated concentration still represents less than 1% of the current total annual TOP load; for this reason site-specific sampling has not been recommended. The magnitude and importance of atmospheric loading of mercury has not been quantified as part of the AMP.

- Groundwater does not represent a significant component of the lake's hydrologic budget.

  This assumption can be examined by evaluating the extent to which water and chloride models show reasonable agreement between inputs, outputs, and retention in the lake. Onondaga Creek is influenced by groundwater seepage into the downstream reaches just above the Inner Harbor. Likewise, groundwater flux into Ninemile Creek has been documented. A chloride model of the lake, assuming no groundwater contribution, was constructed (Doerr et al. 1994) and predicted measured concentrations within about 5%. This implies that groundwater input to the lake is likely a minor component (<5%) of the hydrologic budget.

- Water quality of the lake may be adequately characterized by examining the lake as a two-layer system during the period of thermal stratification, which typically extends from late May through late October. Furthermore, the photic zone does not extend into the lower water layer.

  This assumption is tested as part of the Onondaga Lake water quality model development and peer review process, which began in 2005.

3.3 Design of the AMP: Hypothesis Testing and Statistical Power

The elements of the monitoring program were distilled into a series of testable hypotheses. This work product was used as a basis for evaluating the AMP design, allowing the project team and the advisors to determine whether the correct parameters were being measured. A summary of the hypotheses for elements of the monitoring program is presented in **Table 5**. There are three types of hypotheses to be tested using data generated by the AMP:

- Is Onondaga County in compliance with the effluent limits required by the State Pollution Discharge Elimination System (SPDES) permit?

- Have ambient water quality standards or guidance values in the receiving water been met?

- Is there a trend or shift in the monitoring data, in both water quality and biological programs?

It is evident from the list of hypotheses that a major focus of the AMP is to differentiate actual trends from natural variability. OLTAC member Dr. William W. Walker Jr. examined the historical monitoring data to characterize the variability of the parameters used to assess progress (for example, concentrations of ammonia-N, bacteria, chlorophyll-a at the lake's South Deep station). The AMP design was then evaluated to determine what magnitude of "true" change in concentration could be detected at a given level of statistical certainty. The AMP was modified to increase the monitoring frequency for certain parameters that are highly variable (e.g. chlorophyll-a). For the majority of lake water quality parameters the biweekly sampling program was found to be adequate. Dr. Walker summarized his analysis of the power of the water quality monitoring program in the Phase 1 Statistical Framework (January 1999) and an updated Phase 1 Statistical Framework (January 2002). His report evaluating the design of the biological programs and their power to detect change was issued as the Phase 2 Statistical Framework (February 2000) and an update to the Phase 2 Statistical Framework (August 2002).

Dr. Walker has updated the statistical framework for both the water quality and biological programs using recent data. The update was structured to reference these specific hypotheses.

Table 5. Summary of Hypotheses Underlying the AMP.

Monitoring Parameter	Hypothesis	Type of Hypothesis			Data Used for Assessment
		Compliance with SPDES permit	Compliance with AWQS or guidance value	Significant Trend or Shift in Data	
Ammonia-N	Improvements at Metro enable the County to meet Stage III effluent limits for ammonia N	*			Outfall 001 effluent concentrations, calculated for summer and winter (seasonal limits apply)
	Reduced ammonia load results in compliance with ambient water quality standards and federal criteria for ammonia in Onondaga Lake		*	*	South Deep station, biweekly monitoring, discrete samples collected at 3-m intervals, with temperature and pH
Nitrite-N	Achievement of Stage III effluent limits for ammonia results in compliance with the NYS ambient water quality standard for nitrite (warm water fish community)		*	*	UML, LWL composite samples, biweekly at South Deep
Phosphorus	Improvements at Metro enable the County to meet final SPDES effluent limits (as set forth in a revised TMDL on or before Jan 1 2009)	*			Outfall 001 effluent concentrations
	Reduced phosphorus load from Metro reduces concentration of phosphorus in Onondaga Lake		*	*	South Deep station Biweekly monitoring TP, SRP and TDP, discrete samples collected at 3-m intervals
	Reduced phosphorus load from Metro brings the lake into compliance with guidance value (or site-specific guidance Value)		*	*	TP at South Deep, 1-m depth (biweekly measurements, June –Sept)

Table 5. Summary of Hypotheses Underlying the AMP (continued)

Monitoring Parameter	Hypothesis	Type of Hypothesis			Data Used for Assessment
		Compliance with SPDES permit	Compliance with AWQS or guidance value	Significant Trend or Shift in Data	
Dissolved Oxygen	Improvements at Metro enable the County to meet interim effluent limits for BOD	*			Outfall 001 effluent concentrations
	Improvements at Metro and related nonpoint source phosphorus load reductions bring the lake into compliance with NYS AWQS for DO during fall mixing.		*	*	Weekly or biweekly profiles and high-frequency measurements at buoy at South Deep station
	Improvements at Metro and related nonpoint source phosphorus load reductions reduce the volume-days of anoxia and hypoxia.			*	Weekly or biweekly profiles and high-frequency measurements at buoy at South Deep station
	Improvements at Metro and related nonpoint source phosphorus load reductions reduce the areal hypolimnetic oxygen depletion rate.			*	Weekly or biweekly profiles and high-frequency measurements at buoy at South Deep station
Indicator bacteria	CSO remedial measures and improved stormwater management reduce the loading of fecal coliform bacteria entering the lake from tributaries during high flow conditions.		*	*	Storm event data: baseline and post-improvement rating curves for fecal coliform bacteria (tributary stations)
	Implementation of improvements (including CSO projects) and progress with stormwater management will reduce concentration of indicator organisms		*	*	Indicator bacteria abundance at nearshore stations during summer and following storms (lake stations, Class B and C segments).

Table 5. Summary of Hypotheses Underlying the AMP (continued)

Monitoring Parameter	Hypothesis	Type of Hypothesis			Data Used for Assessment
		Compliance with SPDES permit	Compliance with AWQS or guidance value	Significant Trend or Shift in Data	
Chlorophyll-*a*	Metro improvements and watershed phosphorus load reductions result in lower chlorophyll-a concentrations in the lake.			*	Weekly or biweekly measurements at South Deep, photic zone and UML
Secchi disk transparency	Metro improvements and related nutrient load reductions result in improved water clarity (as measured by Secchi disk transparency) in Onondaga Lake			*	Weekly or Biweekly measurements at South Deep and nearshore stations.
Phytoplankton community	Metro improvements and watershed phosphorus load reductions result in lower biomass of phytoplankton in the lake			*	Biweekly samples of UML phytoplankton community, numbers, size and identifications (PhycoTech)
	Metro improvements and watershed load reductions result in reduced relative abundance of cyanobacteria to the lake's phytoplankton community (measured by percent of total biomass)			*	Biweekly composite samples of UML phytoplankton abundance, biomass, and ID (PhycoTech)
Zooplankton community	Metro improvements and watershed phosphorus load reductions reduce the biomass of zooplankton in Onondaga Lake by reducing the algal food supply			*	Biweekly composite samples of UML and tow (0-15 m), zooplankton abundance, size, biomass, ID (Cornell)

Table 5. Summary of Hypotheses Underlying the AMP (continued)

Monitoring Parameter	Hypothesis	Type of Hypothesis			Data Used for Assessment
		Compliance with SPDES permit	Compliance with AWSQ or guidance value	Significant Trend or Shift in Data	
Macrophytes	Metro improvements and watershed phosphorus load reductions indirectly result in increased areal coverage of macrophytes in lake's littoral zone			*	Percent cover, biomass, and maximum depth of growth. Surveys: 2000, 2005, 2010 plus annual aerial photo evaluation
	Metro improvements and watershed phosphorus load reductions result in increased number of macrophyte species			*	Macrophyte species richness Detailed surveys: 2000, 2005, 2010

Table 5. Summary of Hypotheses Underlying the AMP (continued)

Monitoring Parameter	Hypothesis	Type of Hypothesis			Data Used for Assessment
		Compliance with SPDES permit	Compliance with AWQS or guidance value	Significant Trend or Shift in Monitoring Data	
Fish community	Implementation of nutrient load reductions at Metro and nonpoint sources, including CSO remediation, will indirectly increase the number of fish species present in Onondaga Lake			*	Annual monitoring program: Species richness, electrofishing, gill nets, seines
	Implementation of point and nonpoint nutrient load reductions will indirectly increase the number of fish species that are sensitive to pollution in Onondaga Lake			*	Annual monitoring program: Electrofishing, pollution tolerance index (Whittier and Hughes 1998)
	Implementation of point and nonpoint nutrient load reductions will increase the reproductive success of fish in Onondaga Lake			*	Annual monitoring program: Nesting survey, larval tows, larval light traps, littoral seines
	Implementation of point and nonpoint nutrient load reductions will improve the lake's IBI. Note that effects may be more evident in Strata 2, 3, and 4.			*	Annual monitoring program: Electrofishing
	Implementation of point and nonpoint nutrient load reductions will increase the habitat available for the coolwater fish community			*	Fish space metrics: dissolved oxygen and temperature profiles at South Deep station

3.4 Design of the AMP: Data Management

The AMP produces an extensive dataset; more than 20,000 water quality measurements are obtained each year in Onondaga Lake, its tributary streams, and the Seneca River. Dr. Walker has developed an integrated database to manage the data. This effort has resulted in a powerful tool for the County and other stakeholders to evaluate specific results by parameter, depth, and date. The database is also used to screen for outliers and test for trends; it generates plots for data exploration and reporting.

3.5 Design of the AMP: Metrics to Measure and Report Progress

Analytical and field data are submitted on a quarterly basis to the NYSDEC. Screened and validated data are provided annually and are included in the OCDWEP Annual AMP Report. The process of turning data into information occurs continually through the year and is formalized in the Annual AMP report. Results and findings of the complete monitoring effort are documented in this report is reviewed by OLTAC members and NYSDEC. The County is required to submit an approvable annual AMP report to NYSDEC by December 1 each year.

A series of metrics have been developed to organize and report the extensive AMP dataset. As defined by EPA, metrics are attributes of the physical, chemical and/or biological ecosystem that respond to human disturbance. For the Onondaga Lake watershed, metrics are designed to indicate progress toward compliance with applicable standards and guidelines, and progress toward attaining a desired use.

Selected metrics may relate directly to an impairment of the lake or watershed; relate to a resource of interest; or correspond to a published standard that, in turn, reflects the requirements of public health or the aquatic biota. Candidate metrics can be measured and interpreted with relative ease to answer basic questions, such as, “is the lake getting better?” and “is it safe for my family to swim here?”

Metrics selected to interpret and report on the AMP data are listed in **Table 6**. Note that the metrics are grouped into categories addressing human uses and ecosystem function: (1) water contact recreation; (2) aesthetics; (3) aquatic life protection; and (4) sustainable recreational fishery Metrics for water contact recreation are straightforward: New York State Department of Health and EPA have standards and guidance values for indicator bacteria and water clarity that are designed to be protective of human health and safety. Selecting metrics for aesthetics is slightly more judgmental, as they relate to perceived attributes such as water color and clarity, odors, and the visible extent of weed and algal growth. Water quality conditions needed to support aquatic life are fairly well defined in federal criteria and state standards. Onondaga County AMP metrics are designed to track water quality and habitat conditions during critical periods for reproduction and survival of young animals.

Table 6 Summary of Metrics

Desired Use	Metrics	Measured By
Water contact recreation	Indicator Bacteria	Fecal coliform bacteria abundance measured at stations within the Class B segment of Onondaga Lake (includes nearshore and North Deep station)
	Water Clarity	Secchi disk transparency at nearshore stations.
Aesthetics	Water Clarity	Secchi disk transparency at South Deep.
	Bloom frequency and magnitude	Percent of chlorophyll-*a* measurements greater than 15 µg/l (USEPA threshold for public perception as impaired for recreational use)
		Percent of chlorophyll-*a* measurements greater than 30 µg/l (threshold for public perception of nuisance bloom).
	Algal community structure	Percent of algal community represented by cyanobacteria (blue-green taxa)
Aquatic Life Protection	Ammonia N	Percent of measurements in compliance
	Nitrite N	Percent of measurements in compliance
	Dissolved Oxygen	DO at fall mixing.
		Duration of DO concentrations < 4 mg/l (buoy data)
	Integrated metrics	"Fish space" metrics, volume-days with suitable conditions of DO and temperature for cold water and cool water fish communities *(Note: this metric does not account for other requirements such as habitat and forage base)*
	Species assemblage	Percent intolerant or moderately intolerant of pollution
Fish Reproduction	Number of species with documented reproduction and recruitment[2]	Nesting surveys, larval sampling (Larval seines), young-of-year sampling (littoral and pelagic) adult survey (electrofishing, gill netting), hydroacoustical survey.
	Habitat quality	Percent cover of macrophytes: scaled to optimal level for largemouth bass (40 - 60% cover is target).

[2] Sampling captures young-of-the-year (YOY) fish in the lake. It is assumed that the majority of these small fish originated in the lake, given their size and limited mobility of the early life stages. However, the presence of YOY fish that originated in the Seneca River or tributaries to Onondaga Lake cannot be ruled out.

4. DATA INTERPRETATION FOR THE BIOLOGICAL PROGRAMS

Analysis and interpretation of the biological components of the AMP is challenging. There are no equivalent promulgated standards as cited for the water quality parameters. The plan for analysis and interpretation of the biological data is primarily focused on changes over time. There are also limited comparisons with reference systems such as Oneida Lake, and comparisons to benchmark conditions considered desirable for various functions and values of the aquatic ecosystem.

One way to interpret the fish data is to compare the current community to the fish community present in Onondaga Lake at two critical periods: (1) during the early years of European settlement, and (2) during the early 1960s. The nature of the early fish community can provide insight into the natural condition, while the community during the 1960s likely represents the worst conditions of water quality and habitat degradation.

However, the biological data, including fish, must be evaluated with respect to the rest of the ecosystem. For example, the reproductive success of some fish species is influenced by macrophyte coverage, planktivorous fish can alter zooplankton community assemblages, and zebra mussels can alter trophic interactions. Bacteria are very important to a lake's food-chain. Bacteria are monitored in the Lake and Tributaries as indicators of the potential presence of pathogens in the Lake and Tributaries. In order to fully understand and interpret changes to one aspect of the biological community it is necessary to describe the biological components that interact and influence the community in question. This important effort will continue as the AMP progresses through 2018.

4.1 Sampling design

Biological sampling in Onondaga Lake occurs both nearshore (fish, macroinvertebrates, macrophytes) and offshore (larval fish, zooplankton, phytoplankton). Because of the variability of the lake's nearshore habitat conditions, the littoral habitat was divided into five strata based on a combination of substrate type and wave energy, both of which influence aquatic macrophytes and macroinvertebrates and, in turn, fish distribution. These five strata are displayed in **Figure 3 (Shoreline and Littoral Zone Strata used in the AMP Biological Programs)**:

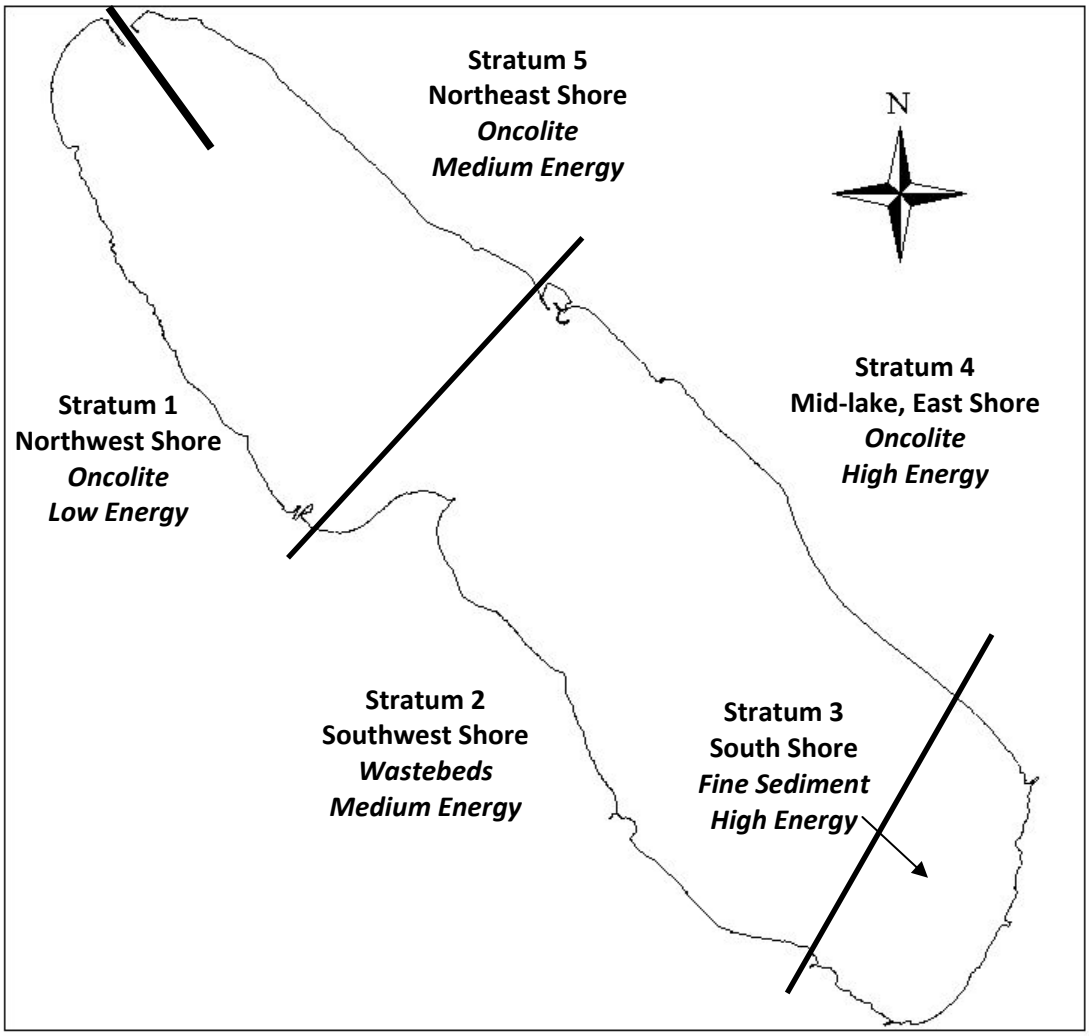
Stratum 1. Oncolite substrate with low wave energy (NW portion of the lake).

Stratum 2. Wastebed substrate with moderate wave energy (SW shore)

Stratum 3. Soft substrate with high wave energy (South end)

Stratum 4. Oncolite substrate with high wave energy (SE shore)

Stratum 5. Oncolite substrate with medium wave energy (NE shore)



Strata Boundaries	**Figure 3.** Shoreline and Littoral Zone Strata used in the AMP Biological Programs

4.2 Species Data

Species data collected during the biological monitoring programs are used to evaluate pollution tolerance of the biological community, the presence of exotic or invasive species, nuisance species that affect best usage of the lake, and evaluate the status of those species highlighted in the ACJ.

- Pollution tolerance. Organisms have varying degrees of sensitivity to disturbances in their environment. Those most sensitive to disturbance are the first to be extirpated and the last to re-colonize. Dominance and distribution of pollution-tolerant or pollution-sensitive organisms can indicate relative degree of impact between locations. Changes in the distribution of these communities can be tracked over time. The AMP utilizes several ways of examining pollution tolerance, including metrics specifically derived to quantify this property of the community (**Table 7**).

- Exotic/invasive species. Onondaga Lake is directly connected to the Barge Canal system, therefore it is highly susceptible to invasion by exotic species. Invasive species often take advantage of disturbance to establish populations. Once established they can dramatically alter habitat, water quality, and trophic structure. The AMP has detected the early stages of invasion of several important species. For example, the exotic zooplankton *Cercopagis pengoi* was first detected in Onondaga Lake during routine sampling in 2000. Once exotic species are detected, the program can be tailored to track their progress and effects on the ecosystem. Zebra mussels within Onondaga Lake have been collected since annually 2002, in 2007 a closely related species of the zebra mussel, the quagga mussel *Dreissena bugensis* was detected in Onondaga Lake. The quagga mussel is able to colonize soft substrate enabling it to thrive in deeper water than the zebra mussel. In 2011 the zebra mussel sampling program was expanded to include the collection of additional deep water samples aimed at tracking the quagga mussel.

- Associated with nuisance conditions. Some species can be considered to be a nuisance to humans. Some of these obvious, such as blue-green algal blooms; others become apparent to lake users through indirect effects in the food web. For example, the 2002 increase in alewife (*Alosa pseudoharengus*) numbers reduced the population of larger zooplankton (their preferred food source) in the lake; this reduction in larger zooplankton decreased the effective grazing pressure on algae. As a result, water clarity declined. Larger zooplankton species are returning to the lake, and water clarity has improved, as alewife abundance has declined.

- Included in management/rehabilitation plan. Some species have special meaning within the context of the ACJ and/or future management plans. This is most common with the fish program. For example, the ACJ states the County should "evaluate the success of

walleye, bass and sunfish propagation (quantitative lakewide nest surveys, survival and recruitment estimates, and juvenile community structure) in the lake" (ACJ Appendix D, IV.5). These species are given special consideration within the biological monitoring program.

Table 7. Summary of Pollution Tolerance Metrics Used for the Biological Monitoring Program

Program	Component	Pollution Tolerance Metric	Comments
Fish	Adult	Pollution Tolerance Index	Based on the Index published by Whittier and Hughes (1998). Tolerance categories include: intolerant, moderately intolerant, moderate, moderately tolerant, and tolerant.
		Indicator Species	Indicator species are used to assess environmental condition, using organisms with documented tolerance or sensitivity to environmental degradation
	Young-of-the-Year	Indicator Species	Young-of-the-year organisms are good indicators of environmental change, as they are highly susceptible to disturbance and pollution.
Macrophytes	Field Survey	Non specific	Some species have known tolerances to water quality variables. For example *Potamogeton pectinatus* (common in Onondaga Lake since at least the early 1990s) is more tolerant of salinity than many other macrophytes. Knowledge of these types of tolerances can help in understanding the current lake community as well as the changes that occur.

4.3 Population Data

Population data collected during the biological monitoring programs are used to evaluate individual size, abundance and reproductive success in Onondaga Lake and the tributaries.

- Average size of individuals. Size of individuals is monitored for fish and zooplankton in the AMP. The size that animals attain is a function of both the genetics of the organism as well as the environmental conditions the organism has been subjected to throughout its life. Changes in the ecosystem are often reflected by changes in growth, thus making analysis of size of certain organisms a potential valuable monitoring tool. For example, growth may be density dependant, so populations with poor recruitment may be characterized by fast-growing individuals. In addition, the size structure of some organisms can have dramatic cascading effects throughout the trophic structure of the lake. Average size of some organisms can also be compared to other regional lakes.

- Abundance. Abundance measures are difficult to quantify in biological populations due to their inherent spatial and temporal variability. However, changes in abundance can provide useful information in the AMP because change in population size is the mechanism underlying changes in many community metrics. Expected changes in abundance due to improving water quality or habitat may not always be positive. Some species exploit disturbed conditions and their abundance can be expected to decrease with improving conditions. As the dynamics of the lake community change, the lake will become more hospitable to some species and less to others, gradually abundance of species will change to reflect the new lake condition.

- Reproductive success. Monitoring reproduction and recruitment of the fish community is particularly useful because the early life history stages are often very sensitive to disturbance. Reproductive success is affected by both biotic and abiotic factors. For example, reduction in ammonia concentration in the water column during the spring is likely to increase survival of sensitive early life stages (abiotic factor). Any effects of improved water quality on the fish community will likely first be reflected in the early life history stages. However, the food web effects must also be considered. Predation by fish such as alewife will reduce survival of larval fishes (biotic factor). The AMP monitors nesting of fish, larval fish, and juveniles.

4.4 Community Data

Community data collected during the biological monitoring programs are used to evaluate richness, diversity, and relative abundance of indicator species in Onondaga Lake and the tributaries.

- Richness. Richness, the number of different taxa (usually species) found in a community, is calculated for all components of the biological monitoring program. Richness may not be correlated with water or habitat quality. In fact, richness can increase with disturbance; for example, invasive species may become established without eliminating native species. Richness measurements can be used to detect substantial changes in community structure, if the sampling effort is held relatively constant. If changes in richness are detected, the underlying mechanism will be investigated to analyze the potential significance.

- Diversity. The distribution and abundance of different organisms, and how these attributes vary both spatially and temporally, play a major role in determining how an ecosystem functions to process energy and materials (Hooper et al. 2005). The numbers and types of organisms present (sometimes referred to as biodiversity) act together with the effects of climate, resource availability, and disturbance regimes to influence ecosystem properties (Hooper et al. 2005). Species composition, richness, evenness, and interactions respond to and influence ecosystem properties (Hooper et al. 2005). A high biodiversity can be interpreted as indicating functional stability (Karr 1968, Margalef 1968, Odum 1969). Biodiversity can be expressed in terms of numbers of entities (how many genotypes, species, or ecosystems), the evenness of their distribution, the differences in their functional traits, and their interactions (Hooper et al. 2005).

  The Onondaga Lake biological monitoring program utilizes the Shannon-Weiner diversity index as a measure of biodiversity. Shannon-Weiner diversity is a function of both the number of species present (richness) and the equitability of distribution of individuals within these species (evenness) (Washington 1984). Shannon-Weiner diversity is greatest when large numbers of taxa are represented in equal proportions. Shannon-Weiner diversity can help determine if disparity occurs between different sites within the same waterbody or over time. However, care should be taken to not compare Shannon-Weiner diversity values between waterbodies as this metric is expected to differ depending on size and connectedness of the waterbody. Shannon-Weiner diversity is usually utilized with other more descriptive indices that, taken together, can yield a more complete view of the community. This group of metrics is used to document change at the community level. If changes are observed, species-level

information is examined to determine the source of those changes and whether they might be attributed to changes in habitat or water quality.

- Presence and relative abundance of indicator organisms. One important characteristic of macroinvertebrates is their differential tolerance to various types of pollution; these different tolerances can influence the species composition and relative abundance of organisms in stream segments affected by various types of pollution. Several indices have been developed to examine the macroinvertebrate community and infer water quality and habitat conditions. Benthic macroinvertebrates are good indicators of localized conditions due to their limited migration patterns and sessile mode of life.

  The tolerance of benthic macroinvertebrates to various types of pollution has been investigated, including organic (oxygen-demanding) waste, nutrients, sediment, salts, metals, and temperature. Both point sources and nonpoint sources (runoff) can cause these types of pollution to reach streams and rivers.

  The AMP includes two macroinvertebrate sampling efforts to evaluate if the stream biota changes as CSO improvements are brought on line. The first is the biennial tributary macroinvertebrate program; macroinvertebrates are collected and identified to the lowest possible taxon (ideally, the species level) at three or four sites on the CSO-affected streams (Onondaga Creek, Ley Creek, and Harbor Brook). The second effort is associated with the stream mapping program; macroinvertebrates are collected and identified to family at one site per stream mile on the three CSO-affected streams. Results are used to calculate standard indices that assess whether a stream segment is impaired, and what type of pollution is most likely responsible. The next stream mapping program is scheduled to occur in 2015, coinciding with the biennial tributary macroinvertebrate program.

5. MODELING

An integrated program of monitoring and modeling will provide the information needed to determine whether the improvements to Metro and the CSOs are sufficient to bring the surface waters (Onondaga Lake, the tributary streams, and a segment of the Seneca River) into compliance with state and federal requirements. Data from the AMP are used to construct and verify models. There are conceptual models of the lake and its watershed that describe how energy and materials cycle. Mathematical models, which are quantitative formulations of mechanisms and interactions that affect water quality, have recently been completed. Three inter-related models have been developed. Anchor QEA developed the Three Rivers Water Quality Model (TRWQM) and the Onondaga Lake Water Quality Model (OLWQM). The model of the Onondaga Lake watershed was completed by USGS.

5.1. Conceptual Model

A conceptual model describes the interrelationships between physical, chemical, and biological characteristics of the lake and watershed; it provides a tool for interpreting data and understanding underlying mechanisms. The conceptual model also provides a valuable tool to evaluate the adequacy of the monitoring program itself and determine whether the appropriate questions are being asked of the ecosystem and the data set. Finally, the conceptual model provides the foundation for development of a predictive mathematical model.

5.2. Mass-balance Model

The development and structure of a mass-balance modeling framework for Onondaga Lake is described in the Onondaga County AMP Annual Reports. The framework facilitates computation and analysis of mass balances for nutrients and other water quality components using hydrologic and water quality data collected in the Lake and its tributaries since 1986. Lake water and mass balances are formulated on yearly and seasonal (May-September) time scales. Results provide a basis for:

- Estimating the magnitude and precision of loads from each source;
- Assessing long-term trends in load and inflow concentration from each source and source category (point, nonpoint, total);
- Evaluating the adequacy of the monitoring program, based on the precision of loads computed from concentration and flow data;
- Developing and updating an empirical nutrient loading model that predicts eutrophication-related water quality conditions (as measured by nutrient concentrations, chlorophyll-a, algal bloom frequency, transparency, and hypolimnetic oxygen depletion) as a function of yearly nutrient loads, inflows, and lake morphometry;
- Developing simple input/output models for other constituents; and
- Developing data summaries to support integration and interpretation of monitoring results in the County's annual AMP reports.

5.3. NYSDEC Total Maximum Daily Load (TMDL) Allocation

The ACJ requires that NYSDEC issue a revised Total Maximum Daily Load (TMDL) allocation for phosphorus inputs to Onondaga Lake. The TMDL will define the total loading of phosphorus that can be assimilated by the lake while maintaining compliance with water quality standards. The total required reductions in point and nonpoint source loading will be defined. To complete this

task, NYSDEC requires a reliable model of how the lake responds to loading, plus an accurate allocation of the sources of phosphorus. The draft TMDL for Onondaga Lake was released for public review in March 2012.

5.4. USGS Onondaga Lake Watershed Model

One of the projects funded by the Onondaga Lake Partnership is a watershed model of the lake. USGS is developing this model which will be used to estimate nonpoint source loads of materials to Onondaga Lake under various hydrologic conditions and land use practices. The tributary loading estimates developed through the AMP were the basis for model calibration. This model is now complete.

5.5. Three Rivers Water Quality Model (TRWQM)

A water quality model of the Three Rivers system was developed by Anchor QEA, LLC to assess the waste load assimilative capacity of the Seneca River. The model quantifies the River's assimilative capacity and accommodates respiration of zebra mussels, as set forth in the AMP Requirements (ACJ Appendix D, item IV.2). The model will serve as the basis for a TMDL allocation for oxygen-demanding materials and will be used to determine if diversion of Metro effluent to the Seneca River is a viable alternative.

Onondaga County funded development of the TRWQM. The model domain extends from Cross Lake to the Phoenix Dam. A peer review of the TRWQM has been completed.

The model simulates water quality conditions in the river in response to various environmental conditions, including upstream water quality conditions, point source discharges, water temperature, and zebra mussel growth.

5.6. Onondaga Lake Water Quality Model

In 2005, Onondaga County completed a Request for Proposals and selection process for development of a water quality/eutrophication model of Onondaga Lake. Anchor QEA, LLC has completed the lake model that will be used for the NYSDEC TMDL allocation and final effluent limits. This water quality model links the watershed model and the TRWQM. The model was developed using data from the AMP and serves as the primary means of determining the level of treatment and location of the Metro discharge. Model development was a collaborative effort including Onondaga Lake Partnership as well as expert peer reviewers. While the primary focus is on water quality, the model incorporates biological influences on the lake ecosystem. The overall goal was to develop a tool that can help assess water quality improvements from both the bottom-up effects (i.e. reduced loading of nutrients and organic material) and the top-down effects (i.e. food web interactions).

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