Library Reference 2.1

Onondaga County Department of
WATER ENVIRONMENT PROTECTION

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July 23, 2010

HAND DELIVERY

Joseph M. Zalewski, P.E.
Regional Water Engineer
New York State Department of Environmental Conservation
Division of Water, Region 7
615 Erie Boulevard West
Syracuse, NY 13204-2400

RE: Final Year 2010 Annual Ambient Monitoring Program

Dear Mr. Zalewski:

Please find the following summary in response to your review comments dated July 12, 2010, with reference to the draft Year 2010 Annual Ambient Monitoring Program (AMP), dated February 2010.

Comment 1: Appendix C, Page 9, Footnote 6: Please insert "with NYS Ambient Water Quality Standards" at end of the footnote.
Response 1: Appendix C, Footnote 6 has been edited as follows: "A minimum of five (5) samples will be collected per month for each of the tributary sampling sites to assess compliance with NYS Ambient Water Quality Standard for Fecal Coliform bacteria."

Comment 2: Appendix D, Footnote 8 and Appendix E, Footnote 6: It is our understanding that the zooplankton collection net will have a flow meter so the results can be quantified after pouring into a one liter container. Please incorporate language regarding the flow metering into the footnotes.
Response 2: Appendix D, Footnote 8 has been edited as follows:

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; 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 19 Quality Assurance Program Plan for the 2010 Water Quality Monitoring Program).

Please note that the change from the net tow through the UML in 2009 to the 6 meter vertical net haul during the thermally stratified period, is based on the recommendation dated 4/21/10 from Dr. Lars Rudstam, Onondaga Lake Technical Advisory Committee member, to always include one zooplankton tow from 15 m depth and an additional tow from the 6 m depth on dates with stratified water column. The whole water column sample is needed to include the metalimnion, where we are likely to start seeing accumulation of zooplankton as oxygen levels improve and the epilimnetic sample is needed for continuity of the dataset (and for identifying metalimnetic concentrations by difference).

Comment 3: Appendix D, Footnote No. 4: Please include a description of the "Special" TP samples to be collected between June 1 - September 30, 2010.
Response 3: The 1 meter TP sample collected between June 1 - September 30, 2010, is designated as a "special" sample as samples are typically collected at 3 meter depth increments. The sample is collected special between June 1 - September 30, to assess compliance with the NYS AWQS numerical Guidance Value of 20 µg/l summer average in the upper waters. Appendix D, Footnote No. 4 has been edited to explain why a separate 1 meter sample is collected.

Comment 4: Appendix G: Please include mercury sampling and analysis in this table. (See comment No. 6b below).
Response 4: Appendix D (2010 Onondaga Lake Sampling Program (references the frequency/schedule for the collection of the special ultra low-level mercury samples (total and methyl Hg by the contract laboratory) at the South and North Deep stations. Ultra low-level mercury samples will be collected during three key periods each year: April (pre-stratification), August (stratified, after several months of anoxic conditions at the sediment surface), and October (after fall mixing). These samples will be collected during the first biweekly sampling event conducted post-turnover and are therefore included in Appendix D. Appendix G (2010 Onondaga Lake Fall Turnover Sampling Program) refers to any additional sampling conducted during the critical period of fall turnover, during a week the tributary sampling event is scheduled.

Please note that there is no increase in the frequency of Onondaga Lake ultra low-level mercury samples. The County suggests that DWEP be provided with the results of Honeywell's extensive mercury sampling efforts, in order to evaluate and incorporate these data as necessary in the Annual AMP Reports.

Comment 5: Appendix H, Page 17:
(1) Please include brief narrative description of the location of Buoy No. 316.
(2) Appendix H heading, Page 18 lists sample depths as 1-meter below the water surface and 1-meter above the river sediments, however, the paragraph on Page 17 states "one in the upper and one in the lower waters". Please make the wording consistent, if appropriate.
(3) It is our understanding that Underwater Illumination Profile and Secchi Disk Transparency are not parameters measured real-time by Buoy 16. Please clarify in the table. How often will light penetration be measured with the instruments at this site?
Response 5: Appendix H, page 17:
(1) Added brief narrative description of the location of Buoy 316 as follows:
As part of the AMP dated August 1998, annual monitoring at Buoy 316 is conducted during low flow conditions to assess background water quality for dissolved oxygen and the zebra mussel "signature" parameters. Buoy 316 is located in Baldwinsville (upstream of the Onondaga Lake Outlet).

(2) Page 17 Appendix H, lists the field data logged at 15-minute intervals over a 24-hour period at Buoy 316 by installing two (2) YSI data-loggers (one in the upper water and one in the lower water). The depths at which the 2 data-loggers are deployed in the water column are approximate (1-meter below the water surface and 1-meter above the channel bottom). Page 18 Appendix H lists samples collected per event at 1-meter below the water surface and 1-meter above the river sediments during each of the monthly sampling events.

(3) The Secchi Disk Transparency and Underwater Illumination Profile are parameters not measured by the data-loggers. Appendix H (Page 18) has now been modified to add in-situ parameters collected during the monthly sampling events and parameters collected at typically 15-minute intervals at Buoy 316 using the two (2) YSI dataloggers. As noted in the revised Appendix H, Licor data used for light penetration is measured at Buoy 316 during each sampling event at 20 cm increments through the water column.

Comment 6: Appendix I:

a. **Appendix C:**

Comment i) Bullet No. 2: The Spencer Street sampling location on Onondaga Creek should not be deleted. Sampling at this location may be reduced to include, at a minimum, those dates and parameters associated with the Onondaga Creek Salt Spring sampling (also known as the Spence-Patrick Spring). This will continue to allow assessment of the impacts of the Salt Spring since data will be available upstream (background at Spencer St.), the contribution of the Salt Spring, and the total downstream at Kirkpatrick Street. The sampling in this segment of Onondaga Creek may be revised as follows: <u>Sample Spencer Street, the Salt Spring, and Kirkpatrick Street locations at the time when then Salt Spring is typically sampled each year and include the complete list of parameters typically analyzed at the Salt Spring.</u>

Response i) In 2010, Spencer Street sampling will be reduced from biweekly to semi-annually (same frequency as the Spence-Patrick Spring wellpoint sampling) during a tributary sampling event. Spencer Street will be sampled 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 (Spencer Street) and downstream (at Kirkpatrick Street). Added Footnote No. 8, which references the reduced Onondaga Creek at Spencer Street sampling.

Comment ii) Bullet No.3: Please revise the name of Site No.9 on Page 7 and Footnote No. 3 on Page 9 of Appendix C (2010 Tributary Sampling Program) to reflect the changes (i.e., Bloody Brook at Onondaga Lake Park instead of Old Liverpool Road).

Response ii) Corrected and changed sampling site number 9 to Bloody Brook at Onondaga Lake Park in Appendix C (2010 Tributary Sampling Program).

b. **Comment: Appendix G: The fall turnover period is important for mercury dynamics in Onondaga Lake and therefore mercury should be included in the parameters analyzed during this period. Please include mercury in the Appendix G table.**

Response: See Response to Comment 4 above.

For your approval, attached is a copy of the final Annual 2010 AMP, dated July 2010, which reflects these modifications. I want to take this opportunity to thank you for the review and hope that these responses sufficiently address NYSDEC comments. Should you have any questions, please contact Jeanne C. Powers.

Sincerely,

PATRICIA M. PASTELLA, P.E., BCEE
Commissioner

JS/ncs
Encs.

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YEAR 2010 ANNUAL

AMBIENT MONITORING PROGRAM

Onondaga County
Department of Water Environment Protection
Syracuse, New York

July 2010

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APPENDIX A

2010 Non-Event Water Quality & Biological Sampling Schedule (April 2010 - March 2011)

DATE /DAY	PROGRAM	EVENT	APPENDIX
April 2010			
April 1/Thursday	Onondaga Lake	Lake Special Weekly	F
April 6/Tuesday	Onondaga Lake	Double Lake (South & North Deep) (w/Lake Special Weekly)	D & F
April 12/Monday	Onondaga Lake	Lake Special Weekly	F
April 13/Tuesday	Tributary	Biweekly	C
April 20/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
April 26/Monday	Onondaga Lake	Lake Special Weekly	F
April 27/Tuesday	Tributary	Biweekly	C
May 2010			
May 4/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
May 10/Monday	Onondaga Lake	Lake Special Weekly	F
May 11/Tuesday	Tributary	Biweekly	C
May 18/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D &F
May 25/Tuesday	Onondaga Lake	Lake Special Weekly	F
May 26/Wednesday	Tributary	Biweekly	C
June 2010			
June 1/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
June 7/Monday	Onondaga Lake	Lake Special Weekly	F
June 8/Tuesday	Tributary	Quarterly Extended	C
June 15/Tuesday	Onondaga Lake	Double Lake (South & North Deep) (w/Lake Special Weekly)	D & F
June 21/Monday	Onondaga Lake	Lake Special Weekly	F
June 22/Tuesday	Tributary	Biweekly	C
June 29/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
July 2010			
July 6/Tuesday	Onondaga Lake	Lake Special Weekly	F
July 7/Wednesday	Tributary	Biweekly	C
July 13/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
July 19/Monday	Onondaga Lake	Lake Special Weekly	F
July 20/Tuesday	Tributary	Biweekly	C
July 22/Thursday	River*	Monthly	H
July 27/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
August 2010			
August 2/Monday	Onondaga Lake	Lake Special Weekly	F
August 3/Tuesday	Tributary	Biweekly	C
August 10/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
August 12/Thursday	River*	Monthly	H
August 16/Monday	Onondaga Lake	Lake Special Weekly	F
August 17/Tuesday	Tributary	Biweekly	C

APPENDIX A (Continued)
2010 Non-Event Water Quality & Biological Sampling Schedule (April 2010 - March 2011)

DATE /DAY	PROGRAM	EVENT	APPENDIX
August 24/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
August 30/Monday	Onondaga Lake	Lake Special Weekly	F
August 31/Tuesday	Tributary	Biweekly	C
September 2010			
September 7/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
September 9/Thursday	River*	Monthly	H
September 13/Monday	Onondaga Lake	Lake Special Weekly	F
September 14/Tuesday	Tributary	Quarterly Extended	C
September 21/Tuesday	Onondaga Lake	Double Lake (South & North Deep) (w/Lake Special Weekly)	D & F
September 27/Monday	Onondaga Lake	Lake Special Weekly	F
September 28/Tuesday	Tributary	Biweekly	C
October 2010			
October 5/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
October 11/Monday	Onondaga Lake	Lake Special Weekly	F
October 12/Tuesday	Tributary	Biweekly	C
October 19/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
October 26/Tuesday	Tributary	Biweekly	C
November 2010			
November 2/Tuesday	Onondaga Lake	Lake South Deep	D & F
November 8/Monday	Tributary	Quarterly Extended	C
November 16/Tuesday	Onondaga Lake	Double Lake (South & North Deep)	D & F
November 23/Tuesday	Tributary	Biweekly	C
November 30/Tuesday	Onondaga Lake	Lake South Deep	D
December 2010			
December 7/Tuesday	Tributary	Biweekly	C
December 14/Tuesday	Onondaga lake	Lake South Deep	D
December 21/Tuesday	Tributary	Biweekly	C
January 2011			
January 4/Tuesday	Tributary	Biweekly	C
January 11/Tuesday	Onondaga Lake	Winter**	E
January 19/Wednesday	Tributary	Biweekly	C
February 2011			
February 1/Tuesday	Tributary	Biweekly	C
February 8/Tuesday	Onondaga Lake	Winter**	E
February 14/Monday	Tributary	Biweekly	C
March 2011			
March 1/Tuesday	Tributary	Biweekly	C
March 8/Tuesday	Onondaga Lake	Winter**	E
March 15/Tuesday	Tributary	Biweekly	C
March 29/Tuesday	Tributary	Quarterly Extended	C

*** River sampling events to target low flows (at or less than 500 cfs at Baldwinsville). Sampling event dates 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 Water Quality & Biological Sampling Schedule (April 2010 - March 2011)

DATE /DAY	PROGRAM	EVENT	APPENDIX
April 2010			
Week of April 26th [1]	Fish Community	Pelagic Larval	J
May 2010			
Week of May 10th	Fish Community	Pelagic Larval	J
Week of May 24th	Fish Community	Pelagic Larval	J
Week of May 24th [2]	Fish Community	Electrofishing	J
Week of May 31st [3]	Fish Community	Adult Fish Profundal Zone (Gill Nets)	J
June 2010			
Month of June [4]	Macrophyte	Aerial Flight	K
Month of June [4]	Macrophyte	Field Species Verification	K
Week of June 7th [5]	Fish Community	Nesting Survey	J
Week of June 7th	Fish Community	Pelagic Larval	J
Week of June 14th	Lake Macroinv.	Macroinvertebrate	L
Week of June 21st	Fish Community	Pelagic Larval	J
Week of June 21st	Fish Community	Juvenile Seines	J
July 2010			
Month of July	Tributary Macroinv.	Macroinvertebrates	L
Month of July	Tributary Habitat	Macroinvertebrates	L
Week of July 5th	Fish Community	Pelagic Larval	J
Week of July 12th	Fish Community	Juvenile Seines	J
Week of July 19th	Fish Community	Pelagic Larval	J
August 2010			
Month of August	Macrophyte	Lake Littoral Zone Survey	K
Week of August 2nd	Fish Community	Pelagic Larval	J
Week of August 2nd	Fish Community	Juvenile Seines	J
Week of August 23rd	Fish Community	Juvenile Seines	J
September 2010			
Week of September 6th	Fish Community	Juvenile Seines	J
Week of September 13th [2]	Fish Community	Electrofishing	J
Week of September 20th [3]	Fish Community	Adult Fish-Profundal Zone (Gill Nets)	J
Week of September 27th	Fish Community	Juvenile Seines	J

[1] Pelagic Larval sampling events will begin in April when the water temperatures are 7-8°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 June 7th/September 20th)
[3] Gill Nets are done during the day within one week of littoral electrofishing; (Tentative back-up events: week of June 14th/September 27th).
[4] 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).
[5] Nesting Survey event occurs once in June dependant upon water temperatures of 15-20°C, clarity, and peak spawning of select gamefish.

APPENDIX B

2010 Event-Based Water Quality Sampling Schedule

Ambient Monitoring Program
Onondaga County, New York

PROGRAM/EVENT(S)	FREQUENCY	PARAMETERS	LOCATIONS
I. ONONDAGA LAKE TRIBUTARIES 1. High-Flow	Minimum 5 times/year.	APPENDIX C	All Tributary Monitoring Sites.
II. ONONDAGA LAKE 1. Winter	Once per month January, February, March (Weather Permitting).	APPENDIX E	North or South Deep (sampling station depends on extent of ice cover).
2. Fall Monitoring	Weekly sampling and field data more frequently.	APPENDIX G	Onondaga Lake
III. RIVER MONITORING 1. Annual River Monitoring Program	Three times per year. Once per month July-September. (Target Low-flows).	APPENDIX H	1 River Monitoring Station (Buoy 316).

APPENDIX C

2010 Tributary Sampling Program

Ambient Monitoring Program
Onondaga County, New York

Sampling site numbers correspond to the following sites:

1	Nine Mile Creek at Lakeland (Route 48)
2a	Harbor Brook at Hiawatha Blvd.
2b	Harbor Brook at Velasko Road
3a	Onondaga Creek at Kirkpatrick Street
3b	Onondaga Creek at Dorwin Avenue
4	Ley Creek at Park Street
5	Tributary 5A at State Fair Boulevard[1]
6	Metro Effluent[2]
7	Allied East Flume
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[3]
10	Sawmill Creek at Onondaga Lake Recreational Trail[4]

PARAMETER/ FREQUENCY	1	2a	2b	3a	3b	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
CN/ Quarterly	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
TP, SRP, TDP/ Biweekly	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
TKN, NH_3-N, NO_3, NO_2, Org-N/ Biweekly	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
Fecal Coliform[6]/ (Minimum 5 samples/month)	X	X	X	X	X	X	X	X	X	[7]		X	X

PARAMETER/ FREQUENCY	1	2a	2b	3a	3b	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
Equipment Blank 1 – Dunker-Churn (Churn A) BOD5, 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/ Biweekly													
Equipment Blank 1 – Dunker-Churn (Churn A) BOD5, 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/ Quarterly													
Equipment Blank 2 – Churn (Churn B) 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/ Biweekly													
Equipment Blank 2 – Churn (Churn B) 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/ Quarterly													

2010 Tributary Sampling Program

[1]Tributary 5A flow will also be monitored quarterly (during the Quarterly Extended Tributary sampling events, which includes the quarterly and biweekly parameters).
[2] Metro Effluent 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.
[3] Bloody Brook at Onondaga Lake Park will be sampled biweekly from June 1 – September 30 during the Tributary sampling events.
[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] A minimum of five (5) samples will be collected per month for each of the tributary sampling sites to assess compliance with NYS Ambient Water Quality Standard for Fecal Coliform bacteria.
[7] The Fecal Coliform sample will be collected at the surface (0m) for the Lake Outlet sampling site.
[8] Spencer Street sampling will be sampled semi-annually (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 (Spencer Street) and downstream (at Kirkpatrick Street).

Note: ***A minimum of 5 tributary sampling events will be conducted for predetermined high flow conditions [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

2010 Onondaga Lake Sampling Program

Ambient Monitoring Program

Onondaga County, New York

	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, August, October (post-turnover)
Ca, Na, Mg, Mn, Fe	Composite			Composite				Biweekly
Cl, SO_4	Composite			Composite				Biweekly
TS, TSS, TDS, SiO_2-diss, TOC, TOC-F, TIC	X		X		X		X	Biweekly
Turbidity	Composite							Biweekly
BOD_5	Composite			Composite				Biweekly
TP[4], 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	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, TOC-F, TIC, TP, SRP, TDP, TKN, NH_3-N, Org-N, F-TKN								Biweekly

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. 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 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.
  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 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] A "Special" TP 500 ml sample to be collected during the South Deep biweekly sampling events at the 1m depth between June 1 - September 30, 2010, to assess compliance with the NYS AWQS numerical Guidance Value of 20 µg/l summer average in the upper waters.

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

[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; 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 19 Quality Assurance Program Plan for the 2010 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 E

2010 Onondaga Lake Winter Sampling Program

Ambient Monitoring Program
Onondaga County, New York

	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, TOC-F, TIC	X		X		X		X	
Turbidity	Composite							
BOD_5	Composite			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	X							
Sulfide[3]					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[4], Secchi Disk Transparency	Recorded at site							
Phytoplankton [5]	Composite							
Zooplankton [6]	Composite			X				
Equipment Blank 1 – Pump TS, TSS, TDS, SiO2, TOC, TOC-F, TIC, TP, SRP, TDP, TKN, NH3-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								

2010 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 strongly 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] Sampling of sulfides only if anoxic conditions are determined through the YSI profile (to be completed prior to sampling).

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

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

[6] 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 UML and poured into a 1-liter container and preserved according to the Field Preservation Guide).

APPENDIX F

2010 Onondaga Lake Special Weekly Sampling Program

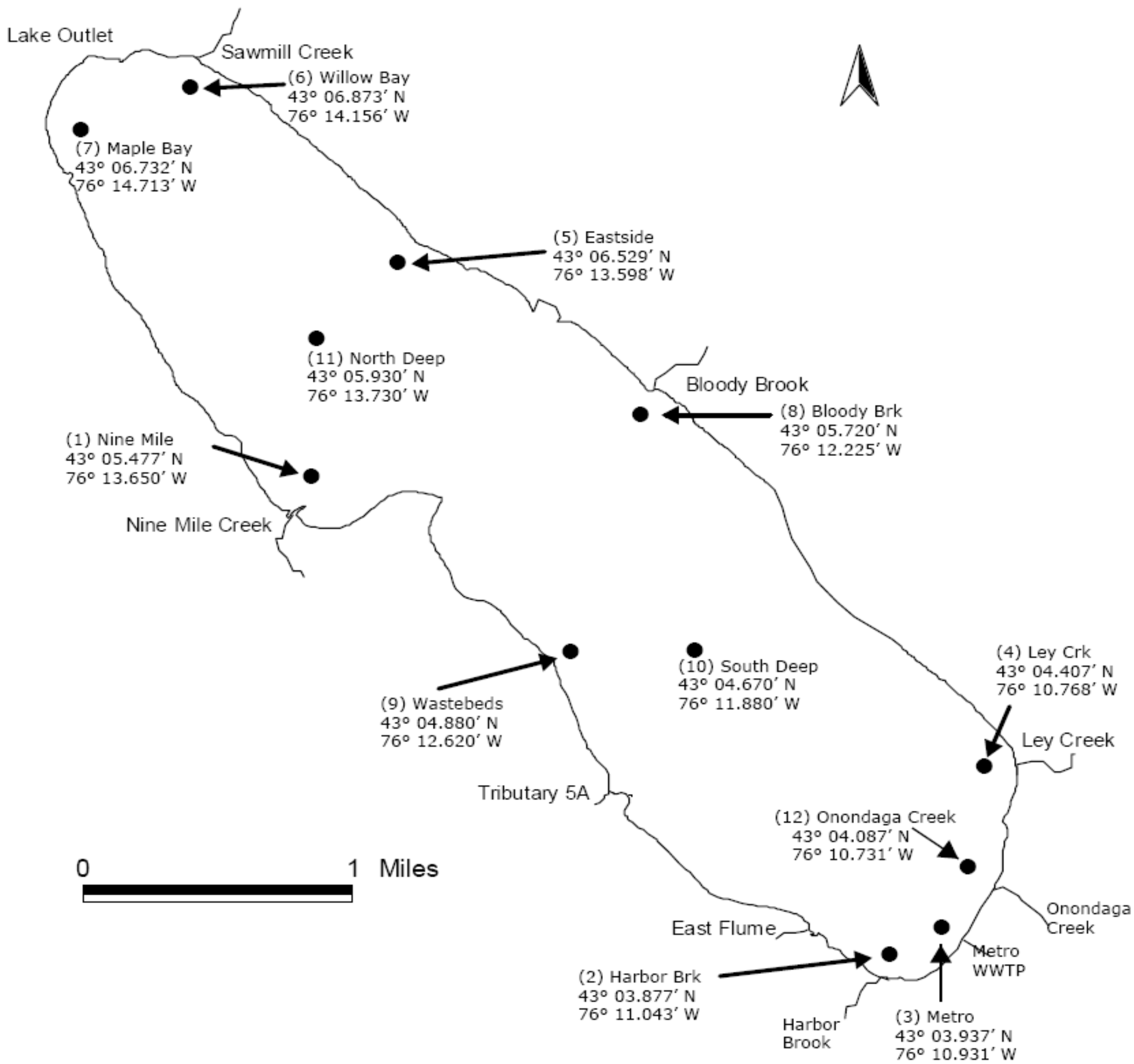
Ambient Monitoring Program
Onondaga County, New York

PARAMETERS	FREQUENCY	LOCATIONS
Fecal Coliform E. Coli Turbidity Secchi Disk Transparency Temperature	Weekly sampling (5 x month) April 1 – October 30	Onondaga Lake (Nearshore sites)[1] (See Figure 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*[2] 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 (5 x month) April 1 – October 30	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 (5 x month) April 1 – October 30	Onondaga Lake North Deep station – Site 11 43° 05.930' N 76° 13.730' W

[1] The nearshore sampling stations are standardized to water depths of 4-5 feet of water. Samples will be collected from the water surface (<1m).

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

Figure 1 Onondaga Lake Near Shore Sampling Locations



<u>**APPENDIX G**</u>

2010 Onondaga Lake Fall Turnover Sampling Program

Ambient Monitoring Program
Onondaga County, New York

PARAMETER	**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							
Temperature, pH, Dissolved Oxygen, Specific Conductance, Salinity, Redox Potential	Measured every half-meter from 0- to 18-meter depth (South & North Deep)							More frequently. Every effort made to collect daily profiles during the first three days of fall mixing.
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.

APPENDIX H

2010 River Sampling Program

Ambient Monitoring Program
Onondaga County, New York

Buoy Location: Seneca River: Buoy # 316 (in Baldwinsville, upstream of the Onondaga Lake Outlet)
(43° 07.249' N Latitude, 76° 14.938' W Longitude)

Frequency: Monthly sampling event from July – September 2010
(Target critical low stream flows)

The following table summarizes the in-situ field data to be collected during each monthly 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)	

The following table summarizes the field data to be collected typically at 15-minute intervals over a 24-hour period at Buoy 316 by installing two (2) YSI data-loggers (one in the upper and one in the lower waters) during the monthly sampling events from July through September 2010.

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)

2010 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 each of the monthly sampling events from July – September 2010.

Analytical parameters		
PARAMETER	**NO. OF SAMPLES PER EVENT (2 SAMPLES)[1]**	**FREQUENCY/TIMING**
TOC	2	Monthly (July – September) Target low stream flows.
TOC-F	2	
TKN	2	
NO_2	2	
NH_3	2	
F-TKN	2	
NO_3	2	
Chlorophyll-*a*[2]	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, F-TKN, NO_3, SRP, TDP, TP, TSS, Cl, BOD_5, Turbidity		Monthly

2010 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 each of the monthly sampling events 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 (1-meter below the water surface and 1-meter above the river sediments for one composite sample for analysis) during each of the sampling events.

APPENDIX I

2010 Water Quality Monitoring Programs

Summary of Modifications from 2009 Program

Appendix A: Year 2010 Non-Event Sampling Schedule (April 2010 - March 2011)

As required by Appendix D of the Amended Consent Judgment, included is an annual sampling schedule for the 2010 non-event related sampling, specifying dates, locations, and parameters. In the event of a need to alter the schedule due to unforeseeable circumstances, NYSDEC and ASLF shall be notified *via fax only* as soon as practicable prior to the event.

Appendix B: Year 2010 Event-Based Sampling Schedule

The monitoring program for event related sampling specifies the number of annual activities. Storm Event Monitoring program has not been included in this submittal.

Appendix C: Year 2010 Tributary Sampling Program

Modifications:

- Clarification of parameter name from Silica to Silica-Dissolved, as the analytical method used by the OCDWEP Environmental Laboratory has always been for determining the dissolved fraction because the samples are filtered.
- Added Footnote No.8. In 2010, Spencer Street sampling will be reduced from biweekly to semi-annually (same frequency as the Spence-Patrick Spring wellpoint sampling) during a tributary sampling event. Spencer Street will be sampled 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 (Spencer Street) and downstream (at Kirkpatrick Street).
- Deleted Bloody Brook at Old Liverpool Road (Site 9a) biweekly. This site was added in 2009, in order to evaluate the nature and sources of bacterial contamination in Bloody Brook. Based on the comparability of data with the downstream location (at Onondaga Lake Park), it is proposed that this location be dropped.
- Footnote 3:
  Changed Bloody Brook (at Onondaga Lake Park) biweekly sampling from April 1 through April 1, 2010, to biweekly from June 1, 2010, through September 1, 2010 (summer recreational season).
- Footnote 5:
  It is proposed that the Hg samples be collected and analyzed from each of the tributary sampling sites at the OCDWEP Environmental Laboratory using EPA method 1631 revision E using a Cold Vapor Atomic Adsorption Spectrometry (CVAAS) which has a lower MRL of 1.5 ng/l than the EPA Method 245.2 by Cold Vapor Atomic Adsorption Spectrometry (CVAAS), which is currently used with an MRL of 20ng/l, which will improve the level of tributary Hg compliance assessment.
- Footnote 6:
  Fecal coliform bacteria data were not assessed for compliance in the past, because the minimum number of samples was not collected. It is proposed that a minimum of five (5) samples will be collected each month year-round for every of the tributary site to assess compliance for Fecal Coliform bacteria. This modification is based on NYSDEC's recommendation (letter dated February 17, 2010), regarding the comments relating to the Onondaga Lake Ambient Monitoring Program 2008 Annual Report, draft dated September 2009.

2010 Water Quality Monitoring Programs
Summary of Modifications from 2009 Program

Appendix D: Year 2010 Onondaga Lake Sampling Program

Modification:

- Clarification of parameter name from Silica to Silica-Dissolved, as the analytical method used by the OCDWEP Environmental Laboratory has always been for determining the dissolved fraction because the samples are filtered.

- Change in 2010 from the net tow through the UML in 2009 to the 6 meter vertical net haul during the thermally stratified period, is based on the recommendation dated 4/21/10 from Dr. Lars Rudstam, Onondaga Lake Technical Advisory Committee member, to always include one zooplankton tow from 15 m depth and an additional tow from the 6 m depth on dates with stratified water column. The whole water column sample is needed to include the metalimnion, where we are likely to start seeing accumulation of zooplankton as oxygen levels improve and the epilimnetic sample is needed for continuity of the data set (and for identifying metalimnetic concentrations by difference).

Appendix E: Year 2010 Onondaga Lake Winter Sampling Program

Modification:

- Clarification of parameter name from Silica to Silica-Dissolved, as the analytical method used by the OCDWEP Environmental Laboratory has always been for determining the dissolved fraction because the samples are filtered.

Appendix F: Year 2010 Onondaga Lake Special Weekly Sampling Program

Modification:

- In 2009, the frequency (5 x month) of the weekly sampling of the nearshore, South and North Deep sites was extended to April 1 – November 30 in order to continue evaluating compliance with the NYS water quality Fecal Coliform monthly geometric mean from a minimum of five samples, standard of 200 colonies per 100 mL to be met during all periods when disinfection is practiced. Recommend dropping the sampling for the month of November 2010, to be consistent with the Metro Effluent disinfection period.
- Added GPS Coordinates for the Onondaga Creek nearshore Site #12.

Appendix G: Year 2010 Fall Turnover Sampling Program

Modification:

- Clarification of parameter name from Silica to Silica-Dissolved, as the analytical method used by the OCDWEP Environmental Laboratory has always been for determining the dissolved fraction because the samples are filtered.

Appendix H: Year 2010 River Sampling Program

Modification:

- Renamed the parameter for Total Dissolved Carbon (TDC) to TOC-F to be consistent with the existing nomenclature.

Appendix I: Year 2010 Storm-Event Monitoring Program

Modification:

- The Storm Event Monitoring Program has not been included with this Annual 2010 AMP submittal. In accordance with the Fourth Stipulation and Order Amending the Amended Consent Judgment, the County will develop a modified water quality program in tributaries impacted by CSOs, to determine the effectiveness of the gray and green infrastructure projects. Event based sampling program for the tributaries will be evaluated and developed in accordance with these requirements (draft will be submitted to DEC/ASLF by 5/16/10).

APPENDIX J

Onondaga Lake Fish Community Sampling Plan 2010

Ambient Monitoring Program
Onondaga County, New York

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.	-No Change from previous year.
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 = 15 -Total No. of events = 6 -Total No. of samples = 90	-Daytime -Every 3 weeks. -July - October.	-No Change from previous year.
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-Profundal Zone	Experimental gill nets of standard NYSDEC dimensions.	Determine community structure, and species richness.	-One net per strata. -Nets set on bottom, parallel to shore at a water depth of 4-5m for two hours. -Total No. of events = 2 -Total No. of samples = 10	-During the day. -Twice per year, within one week of littoral electrofishing.	-No Change from previous year.
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).	-No Change from previous year.

APPENDIX K

Onondaga Lake Macrophyte Assessment Program 2010

Ambient Monitoring Program
Onondaga County, New York

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.	-June or July when water clarity is approximately 3-meters on the secchi disk. -Early morning with low sun angle.	-No change from previous year.
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.
Onondaga Lake Littoral Zone Survey	Stratified Design. Line transects. Transects sampled from shore to 6m depth. 1 m^2 quadrats sampled for species composition and cover. 0.25 m^2 quadrats sampled for biomass.	Determine species composition, percent cover, frequency of occurrence, biomass, maximum depth, and distribution.	-20 line transects total (4 per stratum). -1 m^2 cover quadrats sampled every other meter along transect to 6m depth. -0.25 m^2 biomass quadrats sampled once per 30m of transect to a depth of 6m.	-August.	-No change from 2005.

APPENDIX L

Onondaga Lake and Tributary Macroinvertebrate Assessment Program 2010

Ambient Monitoring Program
Onondaga County, New York

Component	Methodology/Gear	Sampling Objectives	Location and Number of Samples	Timing	Change
Onondaga Lake Littoral Zone Macroinv. Sampling	Petite Ponar Dredge in the littoral zone.	NYSDEC Water Quality Assessment Protocol. HBI - Hilsenhoff Biotic Index. % Oligocheates.	- Five locations, one in each strata. - At each site 18 replicate petite ponar samples are collected.	June	No Change from 2005.
Tributary Macroinv. Sampling	Kick Screen Sampling Jab Net Sampling	NYSDEC Water Quality Assessment Protocol HBI – Hilsenhoff Biotic Index % Oligocheates	- Four (4) Sites on Onondaga Creek - Three (3) Sites on Ley Creek - Three (3) Sites on Harbor Brook	July during low flow conditions.	No Change from 2008.
Habitat Assessment	USEPA Rapid Bioassessment Protocol	Habitat Characterization	- Four (4) Sites on Onondaga Creek - Three (3) Sites on Ley Creek - Three (3) Sites on Harbor Brook	July during low flow conditions.	No Change from 2008.

ATTACHMENT 1

QUALITY ASSURANCE PROGRAM PLAN
FOR THE 2010 WATER QUALITY MONITORING PROGRAM

AMBIENT MONITORING PROGRAM

Prepared for the NYSDEC

by:

Onondaga County
Department of Water Environment Protection

July 2010

QUALITY ASSURANCE PROGRAM PLAN

YEAR 2010 WATER QUALITY MONITORING PROGRAM
(AMBIENT MONITORING PROGRAM)
Onondaga County
Syracuse, New York
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 2010 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.

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 2010 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 1 through December 14, 2010, according to the calendar included in Appendix A Year 2010 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 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 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 2010 Ambient Monitoring Program (non-event sampling schedule). The parameters to be sampled and their schedules are detailed in Appendix C Year 2010 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, Sawmill Creek, Onondaga Lake Outlet, Harbor Brook at Hiawatha Boulevard, 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 and 13 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 from Buoy 316 as part of the AMP. A separate Three Rivers Water Quality Monitoring Program at select sites between Cross Lake and the Three Rivers Junction will be conducted in 2010 to gain additional data to support further calibration and validation efforts of the Three Rivers Water Quality Model. The Supplemental Workplan is not included with the Year 2010 AMP submittal, as it is not part of the approvable program.

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 H of the Year 2010 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 AND QUALIFICATIONS

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.

Representative examples of Mr. Noce's work experience include:

- Environmental Laboratory supervisor responsible for nutrient, organic, and solid waste analysis for 22 years.
- Responsibility for the collection and analyses of surface water, wastewaters, and solid/hazardous wastes utilized in a variety of programs by the Department of Water Environment Protection.
- Laboratory Director for Water Environment Protection responsible for administration of analytical service and compliance mandated by the National Environmental Laboratory Accreditation Program. Responsibilities include operation of lab facility and general supervision of 19 analysts.

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. Antonio D. Deskins, Sanitary Engineer II

Mr. Deskins 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. James Hassett - Engineering Hydrology; Water Pollution Engineering; Water Quality Modeling
   SUNY College of Environmental Science and Forestry (ESF)
   122 Bray Hall
   Syracuse, NY 13210

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

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

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

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

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

B. SAMPLING SCHEDULE

2010 Non-Event Water Quality
Sampling Schedule (April 2010 - March 2011)

DATE /DAY	PROGRAM	EVENT	APPENDIX
April 2010			
April 1/Thursday	Onondaga Lake	Lake Special Weekly	F
April 6/Tuesday	Onondaga Lake	Double Lake (South & North Deep) (w/Lake Special Weekly)	D & F
April 12/Monday	Onondaga Lake	Lake Special Weekly	F
April 13/Tuesday	Tributary	Biweekly	C
April 20/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
April 26/Monday	Onondaga Lake	Lake Special Weekly	F
April 27/Tuesday	Tributary	Biweekly	C
May 2010			
May 4/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
May 10/Monday	Onondaga Lake	Lake Special Weekly	F
May 11/Tuesday	Tributary	Biweekly	C
May 18/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D &F
May 25/Tuesday	Onondaga Lake	Lake Special Weekly	F
May 26/Wednesday	Tributary	Biweekly	C
June 2010			
June 1/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
June 7/Monday	Onondaga Lake	Lake Special Weekly	F
June 8/Tuesday	Tributary	Quarterly Extended	C
June 15/Tuesday	Onondaga Lake	Double Lake (South & North Deep) (w/Lake Special Weekly)	D & F
June 21/Monday	Onondaga Lake	Lake Special Weekly	F
June 22/Tuesday	Tributary	Biweekly	C
June 29/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
July 2010			
July 6/Tuesday	Onondaga Lake	Lake Special Weekly	F
July 7/Wednesday	Tributary	Biweekly	C
July 13/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
July 19/Monday	Onondaga Lake	Lake Special Weekly	F
July 20/Tuesday	Tributary	Biweekly	C
July 22/Thursday	River*	Monthly	H
July 27/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
August 2010			
August 2/Monday	Onondaga Lake	Lake Special Weekly	F
August 3/Tuesday	Tributary	Biweekly	C

2010 Non-Event Water Quality (Continued)
Sampling Schedule (April 2010 - March 2011)

DATE /DAY	PROGRAM	EVENT	APPENDIX
August 10/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
August 12/Thursday	River*	Monthly	H
August 16/Monday	Onondaga Lake	Lake Special Weekly	F
August 17/Tuesday	Tributary	Biweekly	C
August 24/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
August 30/Monday	Onondaga Lake	Lake Special Weekly	F
August 31/Tuesday	Tributary	Biweekly	C
September 2010			
September 7/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
September 9/Thursday	River*	Monthly	H
September 13/Monday	Onondaga Lake	Lake Special Weekly	F
September 14/Tuesday	Tributary	Quarterly Extended	C
September 21/Tuesday	Onondaga Lake	Double Lake (South & North Deep) (w/Lake Special Weekly)	D & F
September 27/Monday	Onondaga Lake	Lake Special Weekly	F
September 28/Tuesday	Tributary	Biweekly	C
October 2010			
October 5/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
October 11/Monday	Onondaga Lake	Lake Special Weekly	F
October 12/Tuesday	Tributary	Biweekly	C
October 19/Tuesday	Onondaga Lake	Lake South Deep (w/Lake Special Weekly)	D & F
October 26/Tuesday	Tributary	Biweekly	C
November 2010			
November 2/Tuesday	Onondaga Lake	Lake South Deep	D & F
November 8/Monday	Tributary	Quarterly Extended	C
November 16/Tuesday	Onondaga Lake	Double Lake (South & North Deep)	D & F
November 23/Tuesday	Tributary	Biweekly	C
November 30/Tuesday	Onondaga Lake	Lake South Deep	D
December 2010			
December 7/Tuesday	Tributary	Biweekly	C
December 14/Tuesday	Onondaga lake	Lake South Deep	D
December 21/Tuesday	Tributary	Biweekly	C
January 2011			
January 4/Tuesday	Tributary	Biweekly	C
January 11/Tuesday	Onondaga Lake	Winter**	E
January 19/Wednesday	Tributary	Biweekly	C
February 2011			
February 1/Tuesday	Tributary	Biweekly	C
February 8/Tuesday	Onondaga Lake	Winter**	E

2010 Non-Event Water Quality (Continued)
Sampling Schedule (April 2010 - March 2011)

February 14/Monday	Tributary	Biweekly	C
March 2011			
March 1/Tuesday	Tributary	Biweekly	C
March 8/Tuesday	Onondaga Lake	Winter**	E
March 15/Tuesday	Tributary	Biweekly	C
March 29/Tuesday	Tributary	Quarterly Extended	C

*** River sampling events to target low flows (at or less than 500 cfs at Baldwinsville). Sampling event dates 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 2010 results (concentrations and loads in lake and tributaries).

2. Statistical comparisons of Year 2010 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 4^{o} C	6 Hrs.
E. Coli	125 mL	P	Cool 4^{o} C	6 Hrs.
Chlorophyll *a*	2000 mL	P	Cool 4 ^{o} C	After Filtration (frozen 28 days)
Phaeophytin *a*	2000 mL	P	Cool 4 ^{o} C	
Phytoplankton	500 mL	P	Lugol's solution, Cool 4 ^{o} C	
Zooplankton	1000 mL	P	Ethanol (70% by Volume), Cool 4 ^{o} C	
Inorganic Tests				
Biochemical Oxygen Demand	1/2 Gallon	P	Cool 4 ^{o} C	48 Hrs.
Cyanide, Total	1000 mL	P	Cool 4 ^{o} C, NaOH to pH > 12, 0.6g ascorbic acid	14 Days
Kjeldahl and Organic Nitrogen	1000 mL	P	Cool 4 ^{o} C, H_2SO_4 to pH < 2	28 Days
Total Phosphorus	1000 mL	P	Cool 4 ^{o} C, H_2SO_4 to pH < 2	28 Days
Soluble Reactive Phosphorus	125 mL	P	Cool 4 ^{o} C	48 Hrs.
Total Dissolved Phosphorus	125 mL	P	Cool 4 ^{o} 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
Sodium	1000 mL	P	HNO_3 to pH<2	6 Months
Selenium	1000 mL	P	HNO_3 to pH<2	6 Months

TABLE 1 - SAMPLE COLLECTION AND PRESERVATION (Continued)				
ANALYTE	**VOLUME**	**CONTAINER**	**PRESERVATION**	**MAXIMUM HOLDING TIME**
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 4 ^oC H_2SO_4 to pH < 2	28 Days
Organic Carbon, Filtered Total	1/2 Gallon	P	Analyze within 24 hours or Cool 4 ^{o} C H_2SO_4 to pH < 2	28 Days
Inorganic Carbon, Total	1/2 Gallon	P	Cool 4 ^oC	48 Hours
Phenols	1000 mL	G	Cool 4 ^oC, H_2SO_4 to pH < 2	28 Days
Solids, Total	1/2 Gallon	P	Cool 4 ^oC	7 Days
Solids, Total Suspended	1/2 Gallon	P	Cool 4 ^oC	7 Days
Solids, Total Volatile	1/2 Gallon	P	Cool 4 ^oC	7 Days
Solids, Total Suspended	1/2 Gallon	P	Cool 4 ^oC	7 Days
Volatile	1/2 Gallon	P	Cool 4 ^oC	7 Days
Solids, Total Dissolved	1/2 Gallon	P	Cool 4 ^oC	7 Days
Silica - Dissolved	1/2 Gallon	P	Cool 4 ^oC	28 Days
Sulfate	1/2 Gallon	P	Cool 4 ^oC	28 Days
Sulfide	300 mL	G	Cool 4 ^oC, add zinc acetate plus sodium hydroxide to pH > 9	7 Days
Specials				
T-Alkalinity	500 mL	P	Cool 4 ^oC (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 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, 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 4°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 4°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, TOC-F, 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 22 - **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 4°C (no further preservation is required).

vii. Composite Parameters include:

BOD_5, NO_2, NO_3, Cl, SO_4, Turbidity (UML only).

4. 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 4°C (no further preservation is required).

5. 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 4°C.

6. 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.

7. 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 unstratified periods) UML (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 UML depth. Record the UML 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.

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

iii. 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.
Note: The UML composite depth shall be determined by the temperature profile. Should no distinct thermocline profile be present, use 0-6 meters in depth as the UML default.

9. 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 4°C.

10. **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 4°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).

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 4°C.

12. **Fecal Coliform**

i. A Fecal Coliform sample is collected at 0m. Two sterile 125-ml plastic containers will be used.

The first container will be filled from the source (at 0m). 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 4°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.

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, Sawmill Creek 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 and 12 feet using the Kemmerer tube-sampling device from mid-channel. The sample for Fecal Coliform will be collected from mid-channel at the surface.

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. 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 (0m), and Sulfide (15m).

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

4. 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).

5. 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

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

For samples sent to a contract laboratory for analysis, three 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, two copies will be shipped to the contract laboratory with the samples, for analysis. The contract laboratory will retain one copy and return a signed copy to the OCDWEP laboratory.

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

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.

The laboratory sample program meets the following criteria:

1. 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.

2. 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.

3. 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.

4. The samples are stored in a secured area at a temperature of approximately 4°C until analyses are to commence.

5. 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.

6. 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

1. Taped depth markings for the Secchi disk are calibrated annually.

C. UNDERWATER ILLUMINATION

1. 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

1. 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.

2. 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:

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

Where:

- x = the measured value of an individual reference sample
- $\bar{x}$ = the mean of the measured values
- N = the number of data points
- $(x - \bar{x})^2$ = 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

$\Sigma (X - \bar{X})^2 = 1022$

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

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 = $\bar{X} \pm 2SD$

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

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

SD = the standard deviation

WL = 207± (2 x 7.33)

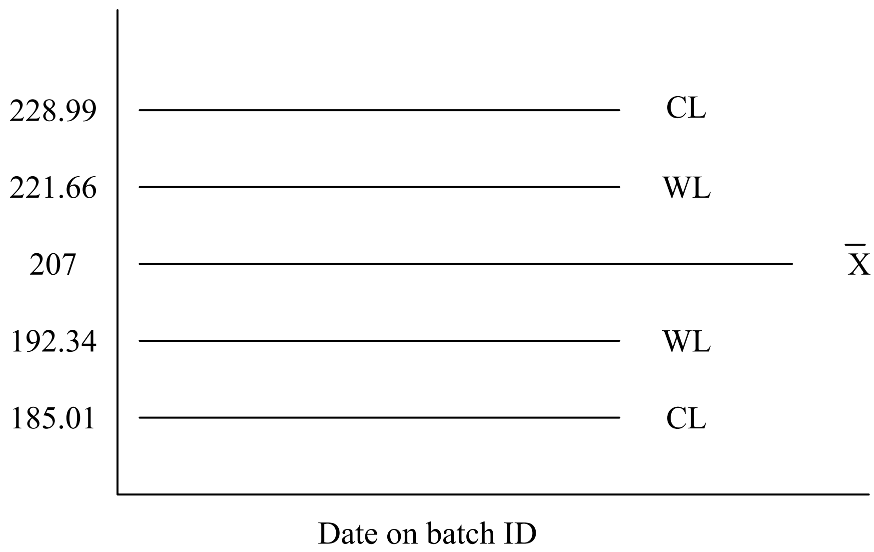
The warning limits (WL) in the example, are 221.66 for the upper warning limit and 192.34 for the lower warning limit.

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 difference (i.e. range) between duplicate analyses is determined as follows:

R = the difference (or range)

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 R. The acceptance limit is established using the following equation:

$UCL = 3.27\ R$

Where: UCL = the acceptance limit

R = the average range for a minimum of 5 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. BOD Incubator

The BOD Incubator maintains a temperature of 20°, +/- 1°C. Temperature readings are taken twice a day. This thermometer has graduations of 0.2°C. The same data is recorded as for refrigerators.

9. 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.

10. 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.

11. 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.

12. Automated Ion 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.

13. 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.

14. 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.

15. 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 near the detection 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. 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. The last 20 data points for the previous year are used to compute the new limits.

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. The last 20 data points for the previous year are used to compute the acceptable control limits.

8. External QA/QC

In as much as the OCDWEP laboratory is a NYSDOH-ELAP certified laboratory, it is also National Environmental Laboratory Accreditation Conference (NELAC) certified, and is obligated to follow all of the criteria for maintaining this certification under the auspices of the ELAP program. 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		
BOD	Reference Sample Chart	Every 10th sample or monthly if less than 10 samples per month are analyzed.
COD and 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 or Colorimetric 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 ±15%.
	Duplicates Tabulation	Double matrix spiked every 10th sample.
Mercury (FIMS)	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 ±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	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.
<u>Organic Analytes</u>		
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 2010 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 2010 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 2010 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 2010 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 RINSATE BLANKS

Wildco Beta Dunker, Churn, and Pump QA/QC equipment rinsate 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 2010 REVISIONS

1. Page 6: Updated Program Organization & Responsibility section.
2. Page 8-10: Update of Appendix A (Year April 2010-March 2011 Non-Event Based Water Quality Sampling Schedule).
3. Page 14: Table 1 – Sample Collection and Preservation:
   - Changed SRP maximum holding time to 48 hrs.
   - Changed TDP maximum holding time to 28 days
   - Added analyte Selenium
   - Added analyte Mercury (low-level)
   - Changed TOC & TOC-F preservation to H_2SO_4
   - Clarification of parameter name from Silica to Silica-Dissolved, as the analytical method used by the OCDWEP Environmental Laboratory has always been for determining the dissolved fraction because the samples are filtered.
   - Added holding time for Chlorophyll-*a*
4. Page 17: Conventional Parameters:
   - Added note that TOC & TOC-F are taken from the NP bottle.
   - Changed parameter SiO_2 to SiO_2-diss
5. Page 23: Section IV Field Sampling Procedures (Onondaga Lake Tributaries): Added Mercury (low-level) samples to be collected.
6. Page 25: Sample Containers: Added Mercury sample bottle information.
7. Page 32: Section IX Analytical Procedures (Microbiology: Chemicals and Reagents)

   Table IV: Changed medium to "Confirmation" broth.

   MF Agar in screw-caps flasks: Changed holding time to 2 weeks @ 4°C.
8. Page 76: Attachment C (Analytical Methodologies List) - Updated to reflect 2009 Minimum Reporting Limit (MRL), accuracy, and precision values. Also added the 2010 Analytical Methods.
9. Attachment A: Tributary Sampling Procedures by Site:
   - Deleted Onondaga Creek at Spencer Street, Bloody Brook at Old Liverpool Road and Onondaga Creek Salt Spring sampling procedures.
   - Added (1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique as described in EPA Method 1669 for all tributary sampling sites.

Attachments

Attachment A: Tributary Field Sampling Procedures – by sampling site

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

Attachment C: Analytical Methodologies

2009 AMP

2010 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 Procedures

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 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 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 Procedures

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 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 Procedures

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 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 Procedures

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 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 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 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 Procedures

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 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 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 at the V-notch weir, collect samples off the downside of the weir.

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 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 just behind v-notch weir.

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

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 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.

<u>10. Lake Outlet Sampling Procedure</u>

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

Bottle Requirements:

Lake Outlet 2-ft.	**Lake Outlet 12-ft.**
(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 "clean hands-dirty hands" technique as described in EPA Method 1669	(1) 250 mL glass bottle (Hg) using "clean hands-dirty hands" technique 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: Preserve the samples as per Section IV (Table 1-Sample Collection and Preservation).

Step 7: Place the samples on ice.

Step 8: 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 9: 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 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 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.

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	
Invoice#	
DEC Permit	
Req. By	

Origin of Sample (i.e., Name of Industry, Treatment Plant, Hauler, etc.)

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	Ini tial	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
2009 AMBIENT MONITORING PROGRAM

Parameter	Code	Methods *	Minimum Reportable Limit (mg/L)	Accuracy (%)	Precision (%)
Bio Oxy Demand 5-day	BOD_5	2:(5210 B)	2.0	101.3	8.0
Carbon. Bio Oxy Demand 5-day	$CBOD_5$	2:(5210 B)	2.0	90.6	21.0
Total Alk as $CaCO_3$	ALK-T	2:(2310 B)	1.0	97.2	3.4
Total Organic Carbon	TOC	2:(5310B)	0.5	99.7	1.1
Total Organic Carbon - Filtered	TOC-F	2:5310B)	0.5		
Total Inorganic Carbon	TIC	2:(5310B)	0.5	98.2	0.9
Total Kjeldahl Nitrogen as N	TKN	3:(10-107-06-2-D)	0.15	93.3	7.8
Low Ammonia Nitrogen as N	NH_3-N	2:(4500-NH3-H)	0.01	95.3	3.9
Organic Nitrogen as N	ORG-N	3:(10-107-06-2-D)	0.01		
Nitrate as N	NO_3	3:(10-107-04-1-C)	0.01	100.7	2.4
Nitrite as N	NO_2	3:(10-107-04-1-C)	0.01	98.9	1.4
Total Phosphorus (Manual)**	TP	2:(4500-P E)	0.003	99.4	3.9
Total Dissolved Phosphorus	TDP	2:(4500-P E)	0.003	99.4	3.9
Soluble Reactive Phosphorus	SRP (OP)	2:(4500-P E)	0.001	98.1	3.7
Silica - Dissolved	SiO_2-diss	2:(4500-Si-D)	0.5	102	7.8
Sulfates	SO_4	6:(426 C)	10.0	98.1	4.8
Total Sulfides	S=	1:(376.1)	0.2		
Total Solids	TS	2:2450 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)	10.0	106.6	11.4
Arsenic - furnace	As - GFA	4:(200.9)	0.002	101.8	4.1
Total Cadmium	Cd - GFA	4:(200.9)	0.0008	103.5	3.2
Total Calcium	Ca	2:(3111B)	1.0	99.5	1.6
Total Chromium	Cr	4:(200.7)	0.008(0.002)*	102.0	1.8
Chloride	Cl	3:(10-117-07-1-B)	1.0	102.3	2.4
Residual Chlorine	CL_2 RES	1:(330.4)	0.1		
Total Copper	Cu	4:(200.7)	0.01(0.0025)*	101.2	2.3
Total Cyanide	CN-T	3:(10-204-00-1-A)	0.003	94.2	9.6
Total Iron	Fe	4:(200.7)	0.04	103.3	2.7
Total Lead - furnace	Pb - GFA	4:(200.9)	0.002	99.5	4.5

ANALYTICAL PROCEDURES FOR WATER QUALITY ANALYSES
2009 AMBIENT MONITORING PROGRAM
(Continued)

Parameter	Code	Methods *	Minimum Reportable Limit (mg/L)	Accuracy (%)	Precision (%)
Total Magnesium	Mg	2:(3111B)	0.1	99.7	1.1
Total Manganese	Mn	4:(200.7)	0.02	102.1	2.4
Total Mercury (Cold Vapor)	Hg	1:(245.2)	0.00002	100	4.2
Selenium - furnace	Se - GFA	4:(200.9)	0.002	100.9	4.2
Total Sodium	Na	2:(3111B)	3.0	100.8	2.3
Total Nickel	Ni	4:(200.7)	0.015(0.00375)*	100.9	1.8
Potassium	K	2:(3111B)	0.020	100.2	4.0
Total Silver	Ag	4:(200.7)	0.01	100.6	1.6
Total Zinc	Zn	4:(200.7)	0.02(0.005)*	101.0	1.8
Turbidity		2:(2130B)	0.1	94.1	5.9
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/100mls) MPN		
E. Coliform	ECOLI-Colilert	2:(9223 B)	1.0 (cells/100mls) 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)

ANALYTICAL PROCEDURES FOR WATER QUALITY ANALYSES
2010 AMBIENT MONITORING PROGRAM

Parameter	Code	Methods *	Minimum Reportable Limit (mg/L)	Accuracy (%)	Precision (%)
Bio Oxy Demand 5-day	BOD_5	2:(5210 B)	2.0		
Carbon. Bio Oxy Demand 5-day	$CBOD_5$	2:(5210 B)	2.0		
Total Alk as $CaCO_3$	ALK-T	2:(2320 B)	1.0		
Total Organic Carbon	TOC	2:(5310B)	0.5		
Total Organic Carbon - Filtered	TOC-F	2:(5301B)	0.5		
Total Inorganic Carbon	TIC	2:(5301B)	0.5		
Total Kjeldahl Nitrogen as N	TKN	3:(10-107-06-2-D)	0.15		
Low Ammonia Nitrogen as N	NH_3-N	2:(4500-NH3-H)	0.01		
Organic Nitrogen as N	ORG-N	3:(10-107-06-2-D)	0.01		
Nitrate as N	NO_3	3:(10-107-04-1-C)	0.01		
Nitrite as N	NO_2	3:(10-107-04-1-C)	0.01		
Total Phosphorus (Manual)**	TP	2:(4500-P E))	0.003		
Total Dissolved Phosphorus	TDP	2:(4500-P E)	0.003		
Soluble Reactive Phosphorus	SRP (OP)	2:(4500-P E)	0.001		
Silica - Dissolved	SiO_2-diss	2:(4500-Si-D)	0.5		
Sulfates	SO_4	6:(426 C)	10.0		
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		
Arsenic - furnace	As - GFA	4:(200.9)	0.002		
Total Cadmium	Cd - GFA	4:(200.9)	0.0008		
Total Calcium	Ca	2:(3111B)	1.0		
Total Chromium	Cr	4:(200.7)	0.008(0.002)*		
Chloride- Lachat	Cl	3:(10-117-07-1-B)	1.0		
Residual Chlorine	CL2 RES	1:(330.4)	0.1		
Total Copper	Cu	4:(200.7)	0.01(0.0025)*		

ANALYTICAL PROCEDURES FOR WATER QUALITY ANALYSES
2010 AMBIENT MONITORING PROGRAM
(Continued)

Parameter	Code	Methods *	Minimum Reportable Limit (mg/L)	Accuracy (%)	Precision (%)
Total Cyanide	CN-T	3:(10-204-00-1-A)	0.003		
Total Iron	Fe	4:(200.7)	0.04		
Total Lead - furnace	Pb - GFA	4:(200.9)	0.002		
Total Magnesium	Mg	2:(3111B)	0.1		
Total Manganese	Mn	4:(200.7)	0.02		
Total Mercury (Cold Vapor)	Hg	1:(245.2)	0.00002		
Total Mercury – Low Level	Hg	1:(1631 E)	0.0000015		
Selenium - furnace	Se - GFA	4:(200.9)	0.002		
Total Sodium	Na	2:(3111B)	3.0		
Total Nickel	Ni	4:(200.7)	0.015(0.00375)*		
Potassium	K	2:(3111B)	0.020		
Total Silver	Ag	4:(200.7)	0.01		
Total Zinc	Zn	4:(200.7)	0.02(0.005)*		
Turbidity		2:(2130B)	0.1		
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)		

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. <u>After use in the field</u>, 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\2010\Tribs\Biweekly\ directory. Select **"export"** on the computer. The transfer will be completed.

5. Open *Excel* from the Windows menu, open Q:\AMP\2010\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\2010\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 (2010)

AMBIENT MONITORING PROGRAM

Prepared for the NYSDEC

Prepared by:

Onondaga County
Department Of Water Environment Protection

July 2010

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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 2010. 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 2010 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 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. Only minor clarifications were made to the QAPP, and no major program modifications were incorporated in to the 2010 monitoring season.

Table 1. Summary of Year 2010 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.	-No Change from previous year.
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 = 15 -Total No. of events = 6 -Total No. of samples = 90	-Daytime -Every 3 weeks. -July - October.	-No Change from previous year.
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- Profundal Zone	Experimental gill nets of standard NYSDEC dimensions.	Determine community structure, and species richness.	-One net per strata. -Nets set on bottom, parallel to shore at a water depth of 4-5m for two hours. -Total No. of events = 2 -Total No. of samples = 10	-During the day. -Twice per year, within one week of littoral electrofishing.	-No Change from previous year.
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).	-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 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's Consultant, Ecologic LLC, 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 pelagic larvae, juvenile seining, adult electrofishing, and adult gill nets.

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 Fish Sampling Program (2010)*, and subsequent programs, will provide OCDWEP with a successful fisheries assessment program.

3.0 PELAGIC LARVAE – Miller High Speed/Modified Double Oblique Tow

3.1 Procedures

Pelagic larvae will be collected using the Miller High Speed/Modified Double Oblique Tow during eight (8) sampling events occurring biweekly from April (water temperature between 7 and 8 °C) through the end of July. One (1) sample will be collected from each of eight (8) transects (four (4) in the north basin and four (4) in the south basin) in 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 for sampling feasibility.

3.1.2 Field:

Step 1. Proceed to (north basin or south basin) predetermined locations using the Global Positioning System (GPS). These locations were determined and set at the beginning of the 2002 sampling season. Collect water quality data from 0 to 6 meters, in 0.5 meter intervals, using a pre-calibrated water quality meter. 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.

Step 2. Proceed to the first transect (refer to Appendix A1) and record transect number, date, time, and actual GPS coordinates on the field data sheets.

Step 3. Attach one (1) sampling rig to the crane and record starting flow meter reading. Thoroughly inspect the net, collection chamber mesh, cable, connections and all hardware prior to deployment at each location. Any repairs or replacements must be completed prior to deployment.

Step 4. Place the boat in forward gear and accelerate to 3 miles per hour. Pay out sufficient cable to achieve the optimum depth (this is the 10-meter mark on cable). The direction of the travel shall be in a straight line heading in a northwest to southeasterly direction (or southeast to northeasterly direction depending on the transect or influence of the sun glare on visual contact with the cable marks).

Step 5. When the correct depth is achieved, accelerate the boat to approximately 5 miles per hour. Pay out additional cable to maintain the 10-meter cable deployment (from the water surface interface). Confirm the actual depth can be confirmed via the following method:

Measure the angle of the cable from vertical (the optimal angle range should be between 55°- 60°) using the WildCo clinometer, and record the angle measurement on the field data sheet. Using the "Angle of Cable Measured" (between 55°- 60°) and the "Length of Cable" let out (10 meters as measured from the water surface), verify on the following chart that the "Proper Vertical Depth" of the sampler has been achieved (optimum depth of approximately 5.0 to 5.5 meters):

Angle of Cable Measured from the Vertical (Degree)		**Proper Vertical Depth (Meters)**		
		5.0	**5.5**	
	53	8.3	9.1	Length of cable measured from the water surface to the sampler (meters)
	54	8.5	9.4	
Optimal Range	**55**	**8.7**	**9.6**	
	56	**8.9**	**9.8**	
	57	**9.1**	**10.1**	
	58	**9.4**	**10.4**	
	59	**9.7**	**10.7**	
	60	**10.0**	**11**	
	61	10.3	11.3	
	62	10.7	11.7	

Step 6. Once the maximum depth is achieved with 10-meeters of cable deployed, tow the sampler at a consistent speed (approximately 5 miles per hour) for 25 seconds heading northeast to southwest or vice versa.

Step 7. After 25 seconds has elapsed, begin retrieving the sampler until the next meter mark is visible and continue towing at that depth for 25 seconds. Repeat this procedure at each individual meter depth on the cable until the 1 meter mark is visible, at which time reduce boat speed to idle and retrieve the sampler. After retrieval, thoroughly inspect the net and collection chamber mesh for any tears that may have compromised the sample. If the sample has been compromised, the location will need to be resampled/repeated.

Step 8. Record ending flow meter reading on the field data sheet, and rinse the inside of the sampler and the net into the sampling bucket with the wash down pump or pump sprayer. Decant as much water as possible. Remove the sampling bucket and pour the contents into the pre-labeled sample jar. Rinse the remaining sample into the jar using tap water from a squirt bottle. Preserve the sample with 10% buffered formalin, filling the jar below the shoulder (wear Nitrile gloves, safety glasses, and a full face shield during this operation).

Step 9. Fill out chain of custody form, and place the sample and Chain of Custody in a clip board box (or equivalent) for safekeeping.

Step 10. Repeat the above process four (4) times in each basin.

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 and report to supervisor.

Step 4. Download water quality data.

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.

- Station data sheet.
- Facility code/station description.
- List of fish species codes/names (identification will be completed in the HCBF Biology laboratory location).
- Sample labels.
- Chain-of-custody forms (as appropriate).

Appendix A1 contains examples of the station data sheet, map of sampling stations, list of facility codes/station description, and list of species codes/names appropriate for use in pelagic larvae sampling.

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 from July to October, resulting in a total of six (6) 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. These sites are physically marked on the shoreline and their coordinates documented with a GPS unit. One (1) sample will be collected at each sampling site for a total of fifteen (15) 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.

- Station data sheet.
- Bulk fish data sheet.
- Individual fish data sheet.
- Map showing location of sampling stations.
- Facility code/station description.
- List of fish species codes/names.
- 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 NESTING SURVEY

5.1 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. 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.

5.1.1 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.

5.1.2 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.

5.1.3 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.

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.

- Station data sheet.
- Map showing location of sampling stations.
- Facility code/station description.
- List of fish species codes/names.

Appendix A3 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.

6.0 ADULT FISH – BOAT ELECTROFISHING

6.1 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. These transects are utilized for each sampling event. 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 (see attached list). 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).

6.1.1 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.

6.1.2 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.

6.1.3 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.

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.

- Station data sheet.
- Bulk fish data sheet.
- Individual fish data sheet.
- Map showing location of sampling stations.
- Facility code/station description.
- List of fish species codes/names.
- 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.

7.0 ADULT FISH – Littoral-Profundal (Fixed Deep Water) Gill Net Sampling

7.1 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 day-time hours, one (1) net will be randomly set in each of the five (5) strata (refer to Appendix A5). The nets will be set for two (2) hours on the lake bottom in 4 to 5 meters of water, resulting in collection of a total of ten (10) samples/sets during the year.

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.

7.1.2 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 5 meters depth of water with depth finder and collect water quality data from 0 to 5 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 parallel to shore in 5 meters of water (turn the boat into the prevailing wind if possible).

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.

Step 7. Allow for two hours to elapse before retrieval.

7.1.3 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.

7.1.4 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.

7.1.5 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.

7.1.6 Field Data Sheet Packet

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

- Station data sheet
- Bulk fish
- Individual fish
- Map showing location of sampling stations
- Facility code/station description
- List of fish species codes/names
- Sample labels
- Scale envelopes

Appendix A5 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.

8.0 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).

9.0 RECREATIONAL FISHERY – ANGLER DIARY

Angler diaries will continue to be used to assess the recreational fishery of Onondaga Lake. Angler catch rate and species composition of the catch, as well as angler attitude and opinions will be assessed. Potential anglers for participation in the angler diary program will be solicited at various fishing tournaments and through local sportsman organizations. The OCDWEP angler diary program uses record keeping forms similar to those used by the New York State Department of Environmental Conservation in their angler diary program.

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 Pelagic Larvae Sampling – Miller High Speed/Modified Double Oblique Tow (DOC No. BIO-010)*

APPENDIX A1:

Field Data Packet For Pelagic Larvae Sampling

Facility Code and Station Description

Facility Code	Site Abbreviation	Site Description
2700	NBMHT1	North Basin Miller High Speed Trawl 1
2701	NBMHT2	North Basin Miller High Speed Trawl 2
2702	NBMHT3	North Basin Miller High Speed Trawl 3
2703	NBMHT4	North Basin Miller High Speed Trawl 4
2704	SBMHT1	South Basin Miller High Speed Trawl 1
2705	SBMHT2	South Basin Miller High Speed Trawl 2
2706	SBMHT3	South Basin Miller High Speed Trawl 3
2707	SBMHT4	South Basin Miller High Speed Trawl 4

PELAGIC LARVAE -- MILLER TRAWL
Modified Double Oblique Tow

Date: ____________ **Basin:** ____________

Crew: ____________ **Site Abbreviation:** ____________

Time Start: ______ *(trawl)* **End:** ______ *(trawl)* **Bottle No:** ____________

GPS: North: 43^{o} ______ ***(Start)*** West: 76^{o} ______ **Fac. Code:** ______ **Preserv.Y/N** ______

North: 43^{o} ______ ***(End)*** West: 76^{o} ______ **# of Bottles:** ______ **Compass Brg:** ______

Flow Meter Start: ______ **Flow End:** ______ **Cable Angle:** ______ **At** ______ **Meters**

Total Trawl Time: ______ *(min:sec)* **Avg Speed:** ______ *(mph)*

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*

Water Quality Profile Taken? *Yes / No*

Comments: *(Gear Condition, Unusual Weather or Conditions, Equipment or Sampling Problems, etc.)*

Meters	Cable Angle	Meters	Cable Angle
10		5	
9		4	
8		3	
7		2	
6		1	

Measure/Check at 1 or 2 locations.

Data Validity Classification: *Good / Conditional / Invalid*

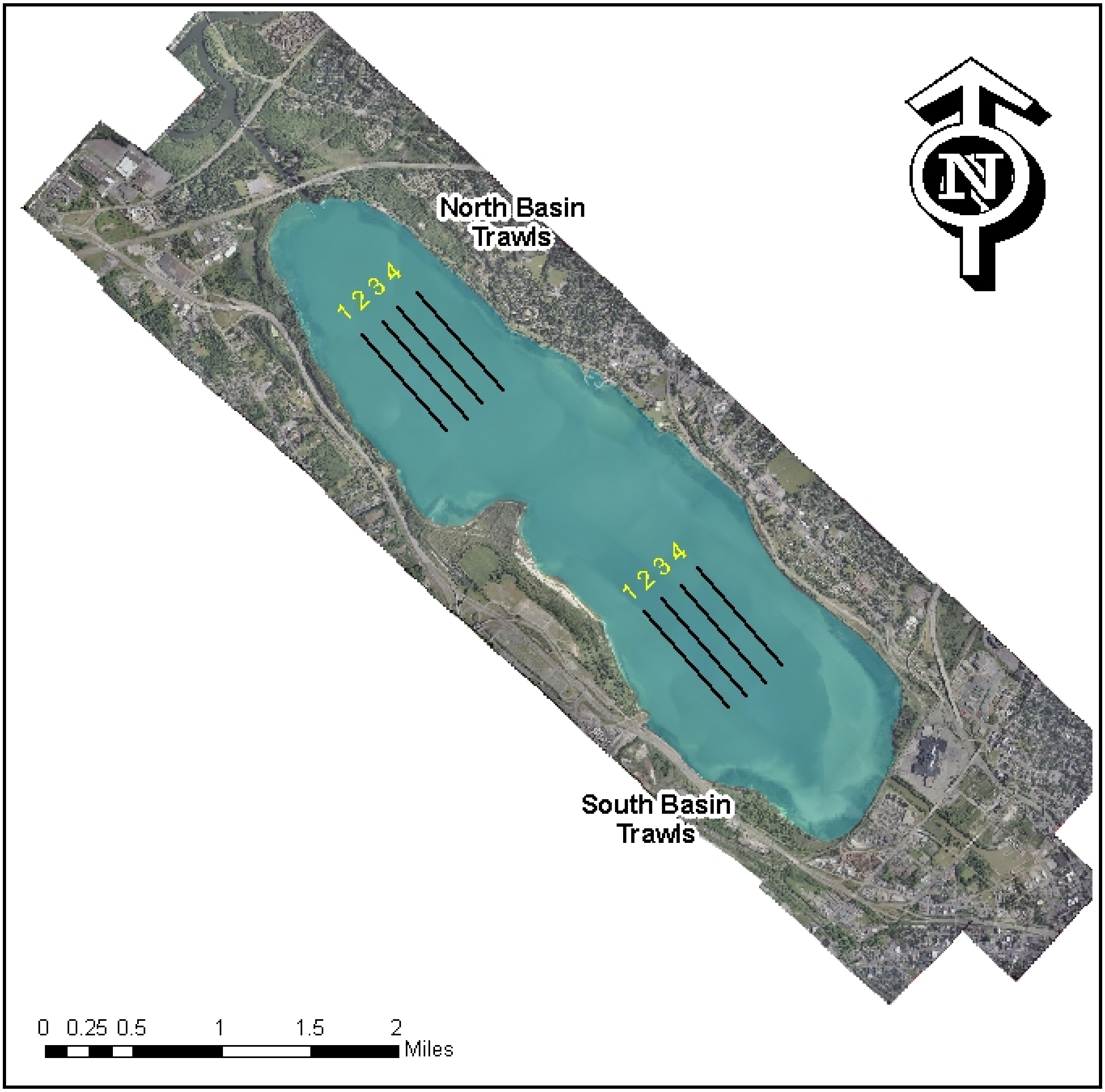
# of Attached Data Sheets: Bulk Fish ______ Larval Fish ______ (During Biology Lab ID)
C of C ______

Date Sorted: ______ **QA/QC Date:** ______
Initials: ______ **Initials:** ______

QAPP Signoffs (Initital and Date):
Field: ______ Office: ______ Data Entry: ______

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	970	NS (Bullhead sunfish, etc)
377	Golden shiner	545	Brook Silverside	999	SPECIES UNKNOWN
381	Emerald shiner	561	Brook stickleback		
385	Common shiner	575	White perch		



Trawl Tow Sites

LOCATION OF PELAGIC LARVAL TRAWL SITES ON ONONDAGA LAKE

APPENDIX A2:

Field Data Packet For Littoral YOY/Juvenile Fish Sampling

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

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^o ________ West: 76^o ________ *(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: ____________

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*

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):

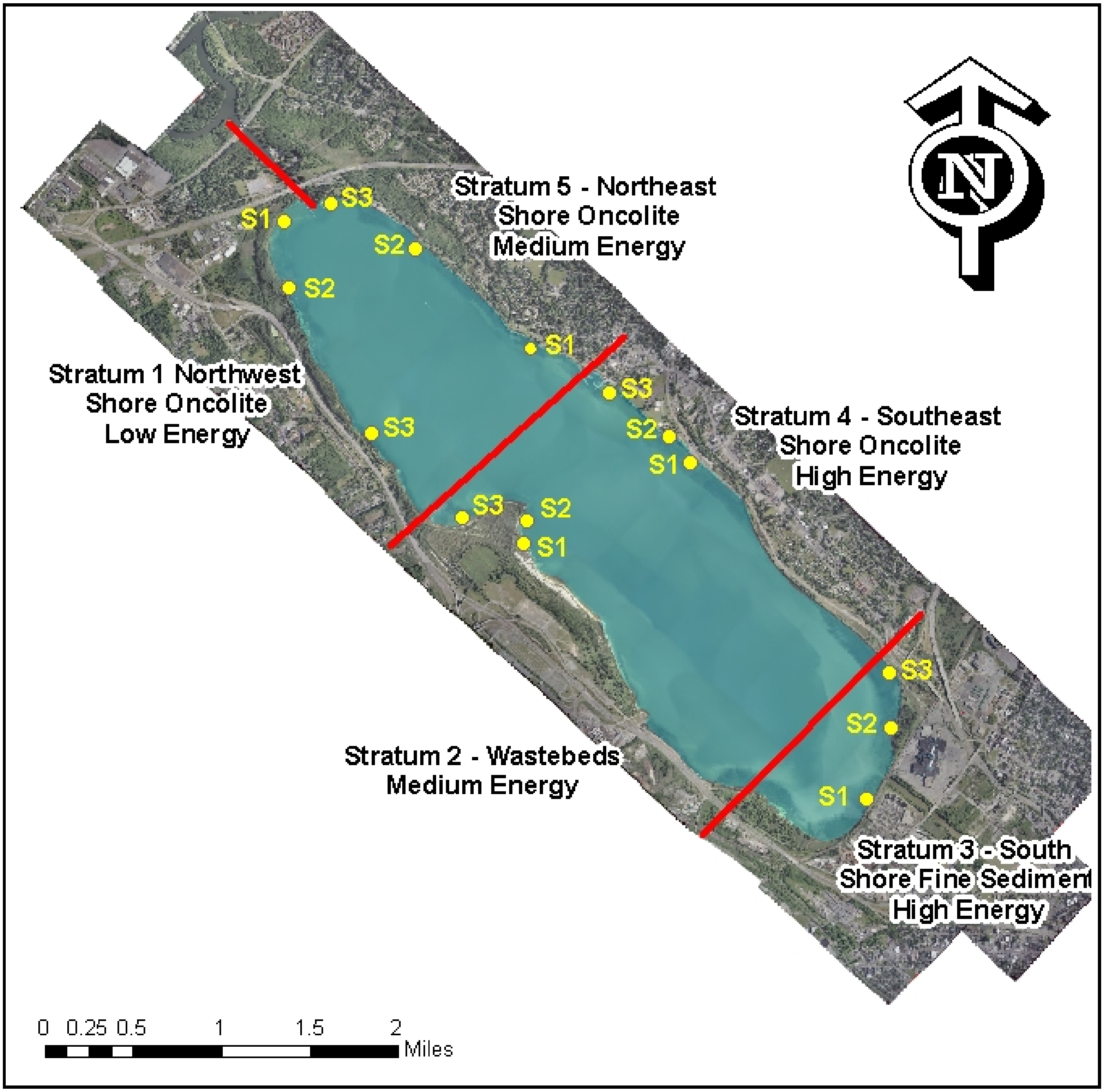
Field: ________________ Office: ________________________ Data Entry: ________________________

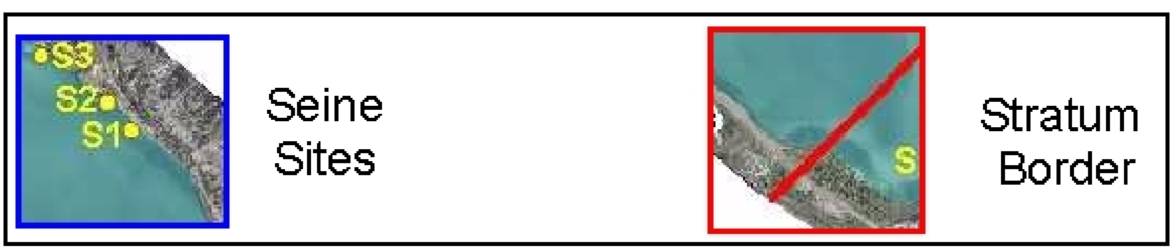
*** All fish with obvious DELTFM parameters must be listed on the individual fish data form.**

Revised by OCDWEP 2/2006

Species Codes and Common Names

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	970	NS (Bullhead sunfish, etc)
377	Golden shiner	545	Brook Silverside	999	SPECIES UNKNOWN
381	Emerald shiner	561	Brook stickleback		
385	Common shiner	575	White perch		





LOCATION OF YOY-JUVENILE SEINE SITES ON ONONDAGA LAKE

APPENDIX A3:

Field Data Packet For Nesting Surveys

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

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^o ________ West: 76^o ________ *(decimal minutes)*
Ending Coordinates North: 43^o ________ West: 76^o ________ *(decimal minutes)*

Weather: ______________________
OVercast PartlyCloudy HaZy CLear RAining

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: 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.)*

____

____

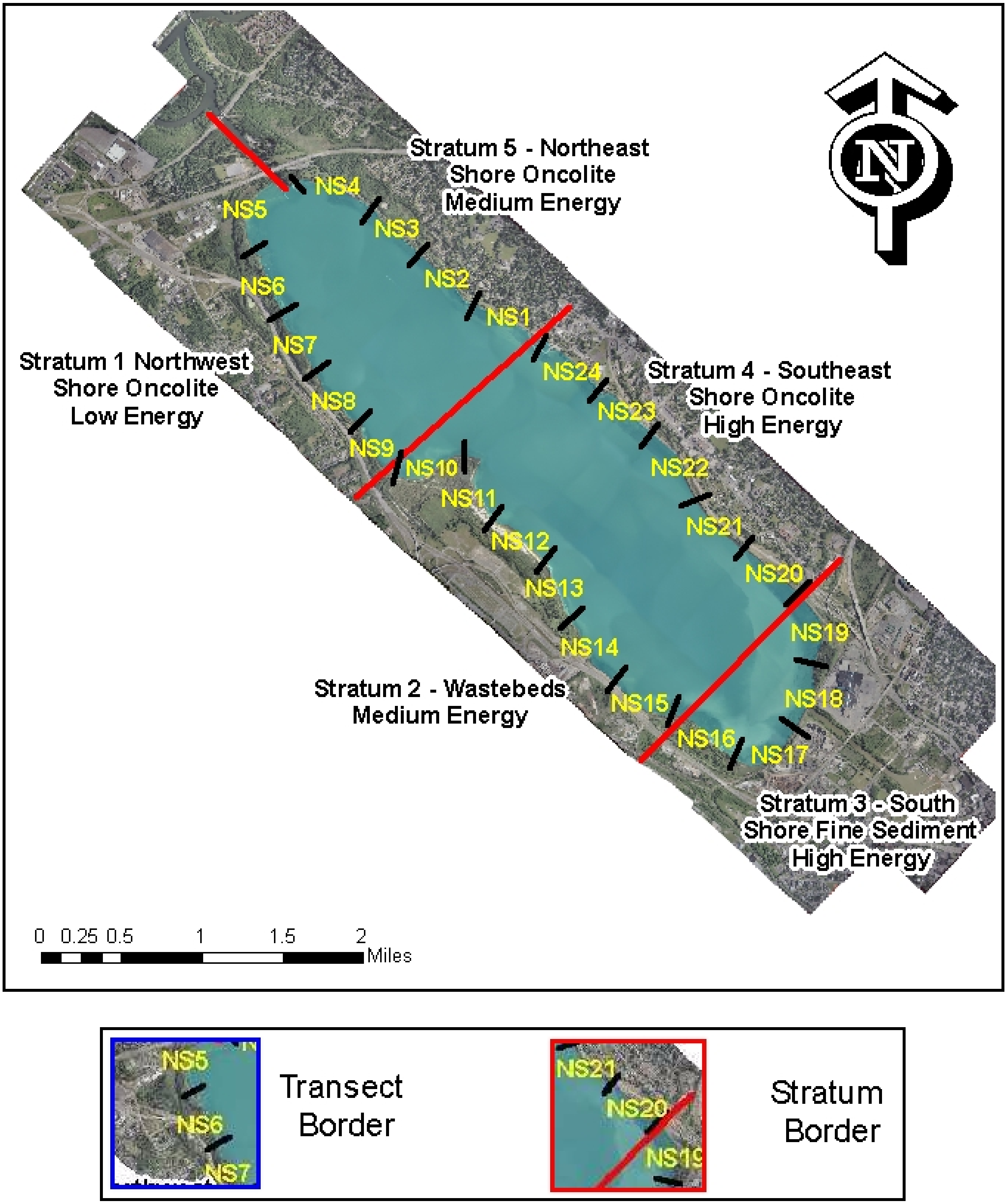
NUMBER OF NESTS OBSERVED

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*



LOCATION OF NESTING SURVEY TRANSECTS IN ONONDAGA LAKE

APPENDIX A4:

Field Data Packet For Littoral Adult Fish Sampling (Electrofishing)

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

Onondaga County Department of Water Environment Protection
Onondaga Lake Fish Monitoring Program

LITTORAL ADULTS -- BOAT ELECTROFISHER

Date: ____________ **Transect:** ____________
Crew: ____________ **Facility Code:** ____________

Start
Time : ____________
GPS: North: 43^o ______ West: 76^o ______

End
Time: ____________
GPS: North: 43^o ______ West: 76^o ______

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: ____________

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: ______________
____________ ____________ ______________

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

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):

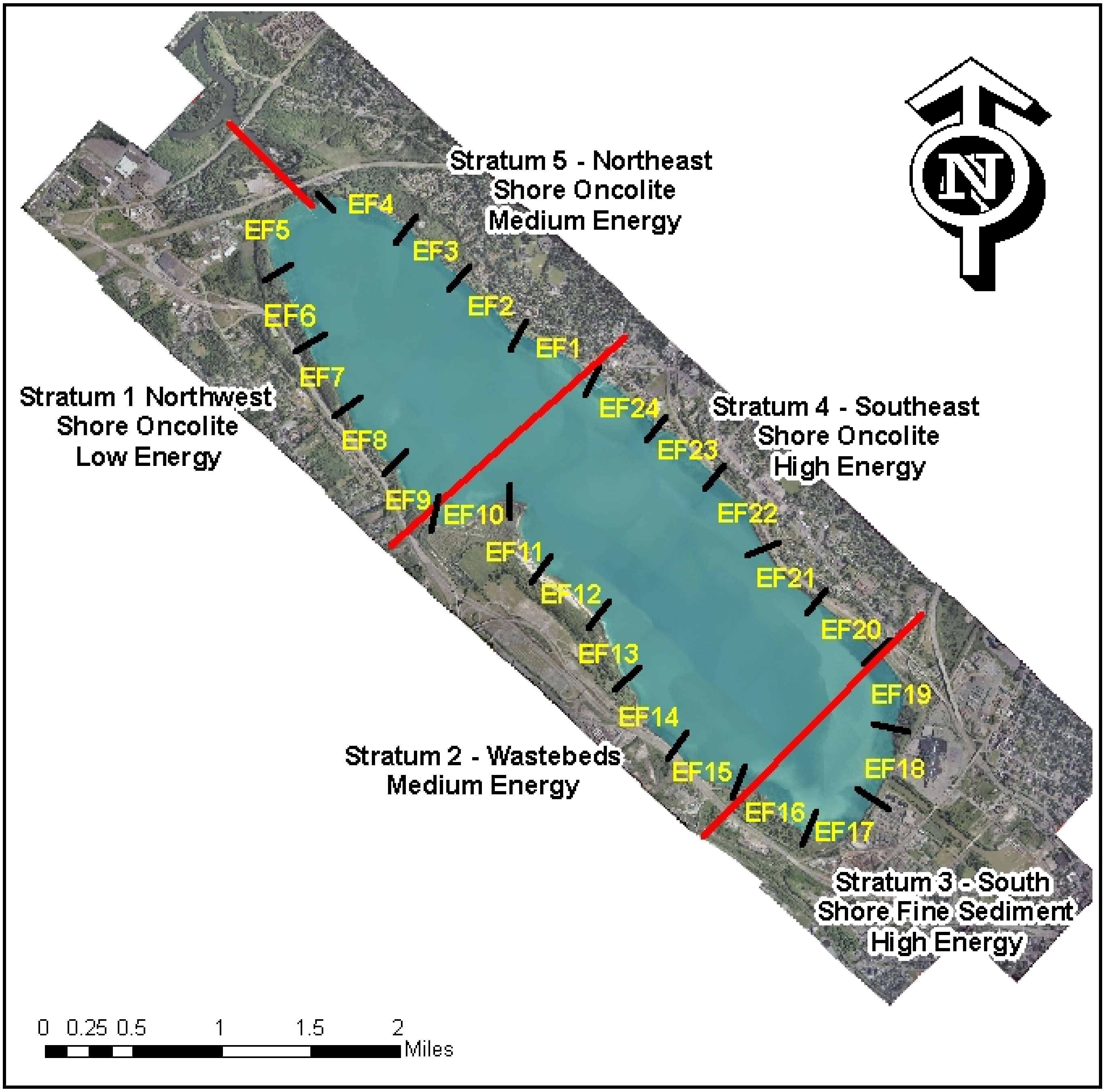
Field: _______________ Office: ______________________ Data Entry: ______________________

*** 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

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	970	NS (Bullhead sunfish, etc)
377	Golden shiner	545	Brook Silverside	999	SPECIES UNKNOWN
381	Emerald shiner	561	Brook stickleback		
385	Common shiner	575	White perch		



Transect Border

Stratum Border

LOCATION OF ADULT ELECTROFISHING TRANSECTS IN ONONDAGA LAKE

APPENDIX A5:

Field Data Packet For Pelagic Adult Fish Sampling (Gill Nets)

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

Onondaga County Department of Water Environment Protection
Onondaga Lake Fish Monitoring Program

PELAGIC ADULTS -- GILL NET

Haul Date: ________________ **Basin:** ____ **Facility Code:** ________________________

Net Set	**Net Hauled**
Date: ________________________	**Date:** ________________________
Crew: ________________________	**Crew:** ________________________
Time: ________________________	**Time:** ________________________
GPS Position: North: 43° ________ *(decimal minutes)* West: 76° ________	**GPS Position:** North: 43° ________ *(decimal minutes)* West: 76° ________
Water Depth ________________ *(meters)*	
Weather: ________________________ *OVercast PartlyCloudy HaZy CLear RAining SNowing*	**Weather:** ________________________ *OVercast PartlyCloudy HaZy CLear RAining SNowing*
Wind: ________ **from:** ________ *0-5mph 5-10 10-15 >15* *N,SE,SSE, etc.*	**Wind:** ________ **from:** ________ *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: ________________

________________ ________________ ________________

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: ____________

____________ ____________ ____________

Onondaga County Department of Water Environment Protection
Onondaga Lake Fisheries Assessment Program

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

Species Code	Common Name	Species Code	Common Name	Species Code	Common Name
0	No Catch	390	Spottail shiner	576	White bass
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268	Longnose gar	396	Redfin shiner	591	Rock bass
271	Bowfin	397.1	Notropis sp.	595	Green sunfish
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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
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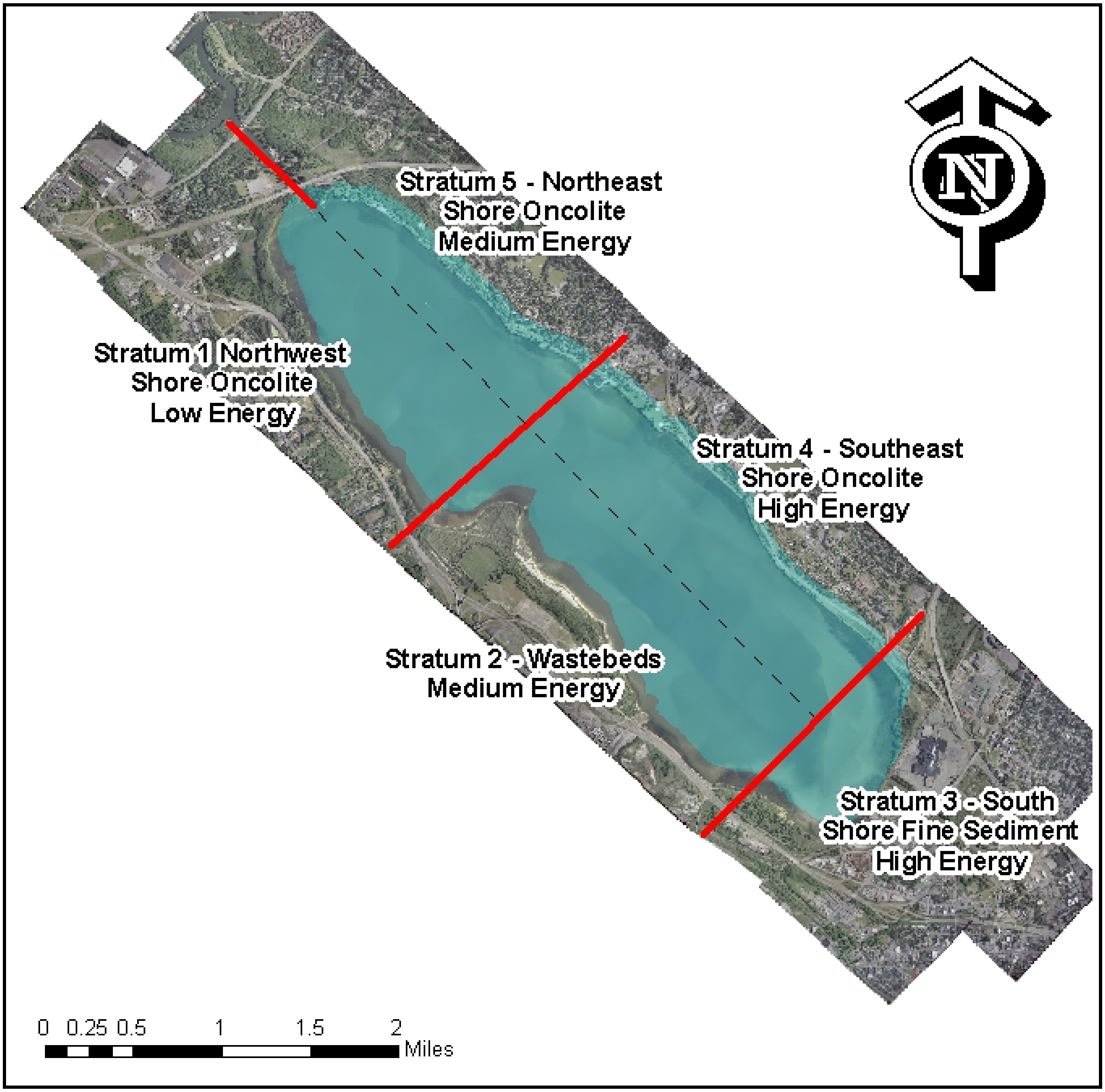
349	Chain pickerel	450.1	Freshwater Catfish	626	Walleye
350	Tiger muskellunge	461	Trout perch	628.1	Perch Family (Percidae)
350.1	Pike Family (Esocidae)	493	Burbot	700	Freshwater drum
365	Carp	531	Banded killifish	970	NS (Bullhead sunfish, etc)
377	Golden shiner	545	Brook Silverside	999	SPECIES UNKNOWN
381	Emerald shiner	561	Brook stickleback		
385	Common shiner	575	White perch		



Stratum Border

Note: One gill net is randomly placed in each of the five (5) strata at a depth of 4 to 5 Meters.

LOCATION OF LITTORAL-PROFUNDAL GILL NET SETS IN ONONDAGA LAKE

APPENDIX A6:

Game Fish List

Onondaga Lake Fisheries Assessment
Game Fish List

Largemouth bass	Smallmouth bass
Walleye	Black Crappie
White Crappie	Brown Bullhead
Yellow Bullhead	Channel catfish
Bluegill	All esocids (pike family)
Pumpkinseed	All salmonids (trout)
Yellow Perch	Rock bass

ATTACHMENT 3

QUALITY ASSURANCE PROGRAM PLAN

ONONDAGA LAKE MACROPHYTE ASSESSMENT PROGRAM
(2010)

AMBIENT MONITORING PROGRAM

Prepared for the NYSDEC

Prepared by:

Onondaga County
Department Of Water Environment Protection

July 2010

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, 2010.

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 2010 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;
- 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. A major modification to the macrophyte assessment program for 2010 is the elimination of the macroalgae monitoring. Only minor clarifications were made to the remainder of the QAPP for the 2010 monitoring season.

Table 1. Summary of year 2010 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.	-June or July when water clarity is approximately 3-meters on the secchi disk. -Early morning with low sun angle.	-No change from previous year.
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.
Onondaga Lake Littoral Zone Survey	Stratified Design. Line transects. Transects sampled from shore to 6m depth. 1 m^2 quadrats sampled for species composition and cover. 0.25 m^2 quadrats sampled for biomass.	Determine species composition, percent cover, frequency of occurrence, biomass, maximum depth, and distribution.	-20 line transects total (4 per stratum). -1 m^2 cover quadrats sampled every other meter along transect to 6m depth. -0.25 m^2 biomass quadrats sampled once per 30m of transect to a depth of 6m.	-August.	-No change from 2005.

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 (2010)* 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.

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.

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 summarizes the site description and coordinates for each 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 (Figure 2).

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 B1 contains examples of the field verification data sheet and map of sampling stations.

5.0 ONONDAGA LAKE LITTORAL ZONE FIELD SURVEY

A stratified random sampling design is used for macrophyte monitoring program. Stratification of samples gains precision by reducing variance while random selection ensures that the sampled macrophytes are representative of the lake-wide (or stratum-wide) population. The sites selected in 2000 have been, and will be, used in subsequent monitoring years (2005, and 2010). What follows is a brief discussion of the rationale behind the sampling design.

Macrophyte growth is affected by substrate type and wave energy. These two factors were used to divide the lake into five distinct strata as detailed in Appendix B2. The five strata are as follows:

Stratum 1: Oncolites, Low Energy [northwest shore];
Stratum 2: Wastebeds, Medium Energy [southwest shore];
Stratum 3: Fine Sediment, High Energy [south end];
Stratum 4: Oncolites, High Energy [southeast shore];
Stratum 5: Oncolites, Medium Energy [northeast shore].

(*based on substrate type [Auer et al. 1995, Madsen et al. 1996a] and wave energies [EcoLogic, 1999]).*

Four line transects were randomly located in each stratum, for a total of 20 in the entire lake (refer to Appendix B3). Each transect was placed perpendicular to shore and extended to a depth of 6 m.

Each transect is staked at the shoreward end with a steel fence post pounded into the nearshore sediment so that approximately one meter of the post is above water. A steel reinforcing bar (rebar) was pounded flush with the ground just above the high water mark. In the future, if needed, rebars on the shore can be located with a metal detector. Using a Garmin GPS, the following table summarizes the near-shore coordinates for the location of each transect.

Transect	Latitude (N)	Longitude (W)	Transect	Latitude (N)	Longitude (W)
1	43° 06’ 54.3”	76° 14’ 24.5”	11	43° 03’ 59.6”	76° 10’ 50.3”
2	43° 06’ 50.5”	76° 14’ 04.6”	12	43° 03’ 49.7”	76° 11’ 12.3”
3	43° 06’ 36.7”	76° 13’ 41.2”	13	43° 04’ 4.9”	76° 11’ 37.8”
4	43° 06’ 17.9”	76° 13’ 15.0”	14	43° 04’ 25.8”	76° 12’ 20.6”
5	43° 06’ 04.7”	76° 13’ 45.2”	15	43° 04’ 59.7”	76° 12’ 47.0”
6	43° 05’ 45.8”	76° 12’ 13.4”	16	43° 05’ 27.1”	76° 13’ 14.5”
7	43° 05’ 27.4”	76° 11’ 41.2”	17	43° 05’ 29.8”	76° 13’ 53.9”
8	43° 04’ 59.2”	76° 11’ 15.1”	18	43° 05’ 48.2”	76° 14’ 13.3”
9	43° 04’ 42.1”	76° 10’ 47.3”	19	43° 06’ 08.7”	76° 14’ 29.0”
10	43° 04’ 22.6”	76° 10’ 39.1”	20	43° 06’ 32.2”	76° 14’ 42.7”

Photographs of each site were taken from the water so that, in the future, transects can be located using shore characteristics.

5.1 Field Methods

5.1.1 Locate and Mark Transects

It is recommended that all transects be found and marked before the actual field effort begins.

Step. 1 The GPS coordinates provided in Table 1 should be used in conjunction with a transect map to locate the general area on the lake where each transect is located.

Step 2. Once on site, use the photos of the sites to get to the exact location of the transect. If the exact position of the transect cannot be determined, use a metal detector to find the rebar that was pounded into the ground just above the high water mark.

Step 3. If you still cannot determine the exact position of the transect, then a best estimate of its location should be made using the photos. Objects such as trees, poles or other permanent objects should be used to locate the transect as closely as possible to its original location.

Step 4. GPS coordinates should be collected at each transect. Photographs of the shoreline should be taken from offshore so shoreline vegetation and structure are clearly visible.

5.1.2 Sampling Procedure

Sampling should be conducted in August when biomass of most species is at an annual maximum. Sites do not need to be sampled in transect order. Instead, transects should be chosen based on the weather conditions of the day. Southeastern sites have the greatest fetch and can be greatly affected by waves, thus making sampling nearly impossible during windy days. It is recommended that these sites be sampled in the morning and when the wind speed is not great.

Step 1. Once at a site, drive the boat to a point 6 m deep that is perpendicular to the shore and the transect marker. Drop a buoy at this location. The transect marker and buoy, will act as the beginning and end of the transect.

Step 2. Attach one end of the 100 m tape measure to the stake marking the shore end of the transect. Extend the tape measure perpendicular to shore until a depth of 6m is reached. (measurement may have to be done in sections if the littoral zone is wider than 100 m.) At this point, attach the tape measure to the floating 6m buoy, drop another buoy, or drive in a stake and attach the tape to the stake.

Step 3. Prior to sampling macrophytes at a transect, use a random method to determine which side of the baseline the quadrats should be started.

Step 4. The divers should sample alternating 1 m^2 quadrats every 2 m along each transect, as indicated in Figure 2 (refer to Appendix B3).

Step 5. These 1 m^2 quadrats are sampled along either side of a measuring tape (baseline) stretched across the surface. A quadrat is delineated by having a diver lower a 1-m rod, perpendicular to the baseline, and placing it on the lake bottom. The other 3 sides of the quadrat are formed by placing the 1-m rod at a 90 ° angle from the previous position.

Step 6. Estimate total percent areal coverage for each macrophyte species and filamentous algae within each 1 m^2 quadrat. While still in the water, the divers should record the data on waterproof field sheets (example field sheets are attached to the end of this document). Coverage is the surface area occupied by a vertical projection of foliage and stems of different species of plants and/or filamentous algae to the lake bottom. Percent cover is calculated for each species observed in the quadrat. Algae should be included but reported separately. It is possible to have more than a total of 100% for a quadrat. For example, if there is a layer of algae or floating leaved plants at the surface they may cover 100% of the quadrat. But there may be submerged macrophytes underneath the surface that also cover portions of the quadrat. In a situation such as this, percent cover is estimated for each species of macrophyte plus filamentous algae (no one species can have more than 100% cover) so that the combined total of all species could be greater than 100%.

Step 7. The divers should continue sampling alternating quadrats at every two-meter interval to a depth of six meters.

Step 8. Divers should note on field forms the relative sediment composition along the transect and points where major changes in sediment composition occur.

Step 9. Once the percent cover sampling is complete, biomass samples need to be collected. Transects were divided into 30 m intervals starting from shore and a single point was randomly selected in each 30 m interval up to a water depth of 6 m. The selected quadrat numbers were kept constant for all transects so that the same point in every transect was sampled for biomass. The randomly selected quadrats were located at 15, 42, 61,120, 145, 162, 184, 221, 268, 290, 309, 351, 382, and 399 meters from shore. These locations should be sufficient to sample all macrophytes to a depth of 6 m. Once a depth of 6 m is reached there is no need to continue sampling quadrats. For example, in the 2000 baseline survey, Transect 17 was only sampled at 15, 42 and 61 meters since a depth of 6 m was reached 75 m from shore.

Step 10. At each pre-selected biomass location along the baseline, a 0.25 m^2 weighted quadrat (a square made from PVC tubing filled with lead shot) was randomly dropped. Divers harvested all macrophytes and algae within these quadrats and every second plant found exactly on the edge of the quadrats. Plants should be broken directly at the sediment surface and then placed in a 100 µm mesh nylon bags. The sample is then transferred to labeled plastic garbage bags on a nearby boat. Labels should include the transect and subplot number. This concludes the transect sampling for macrophytes.

Step 11. After sampling is complete the depth of the deepest macrophyte growth needs to be determined. Divers will indicate where macrophyte growth ends. A boat will then be positioned over that point and a depth taken.

Step 12. After completion of steps 1-11 the biomass samples need to be stowed safely away and the lake transect stakes need to be removed, since they are a potential hazard. Nearshore transect may be left in place in case transects need to be re-visited. The sampling crew should then proceed to the next transect of choice.

5.2 Laboratory Biomass Procedures

Step 1. Upon arrival at the laboratory facility all samples should be checked-in to ensure no samples are missing.

Step 2. Each sample is individually washed free of silt and debris, sorted by species and air-dried for a short time to remove excessive moisture.

Step 3. Wet weight is then calculated for each species in each subplot by placing the air-dried samples in a nylon bag (mesh size 0.75 cm) and spinning in a garment washer at 560 rpm for 6 to 7 minutes to remove moisture still present on the outside of the plants. Samples are then removed from the bag and each species weighed to the nearest 0.01 g.

Step 4. Select a subsample (no less than 10% of the whole sample) for each species in each subplot. Record wet weight for each subsample.

Step 5. Dry weight is measured by placing the subsample of each species in a forced air oven at 105 ° C for 48 hours or until a constant weight is achieved. The coefficient of variation for a series of subsamples should not exceeded 10%. Samples are then weighed (+/- 0.01g). Total dry weight is calculated by dividing the dry weight of the subsample by its wet weight, times the wet weight of the original total sample (APHA, 1989).

6.0 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.

7.0 LITERATURE CITED

OCDWEP *SOP For Macrophyte Field Verification of Aerial Photography (DOC No. BIO-012)*

APPENDIX B1

Field Data Packet for Macrophyte Species Verification of Aerial Photography

MACROPHYTE FIELD VERIFICATION SHEET

Date: ________________

GPS Coordinates: N: 43° ____________________
W: 76° ____________________

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:

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: ________________

GPS Coordinates: N: 43° ____________________
W: 76° ____________________

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:

MACROPHYTE SPECIES IDENTIFICATION		
Common Name	Scientific Name	Est. Percent Coverage (5-meter Radius)

Samples Collected For Laboratory Identification*
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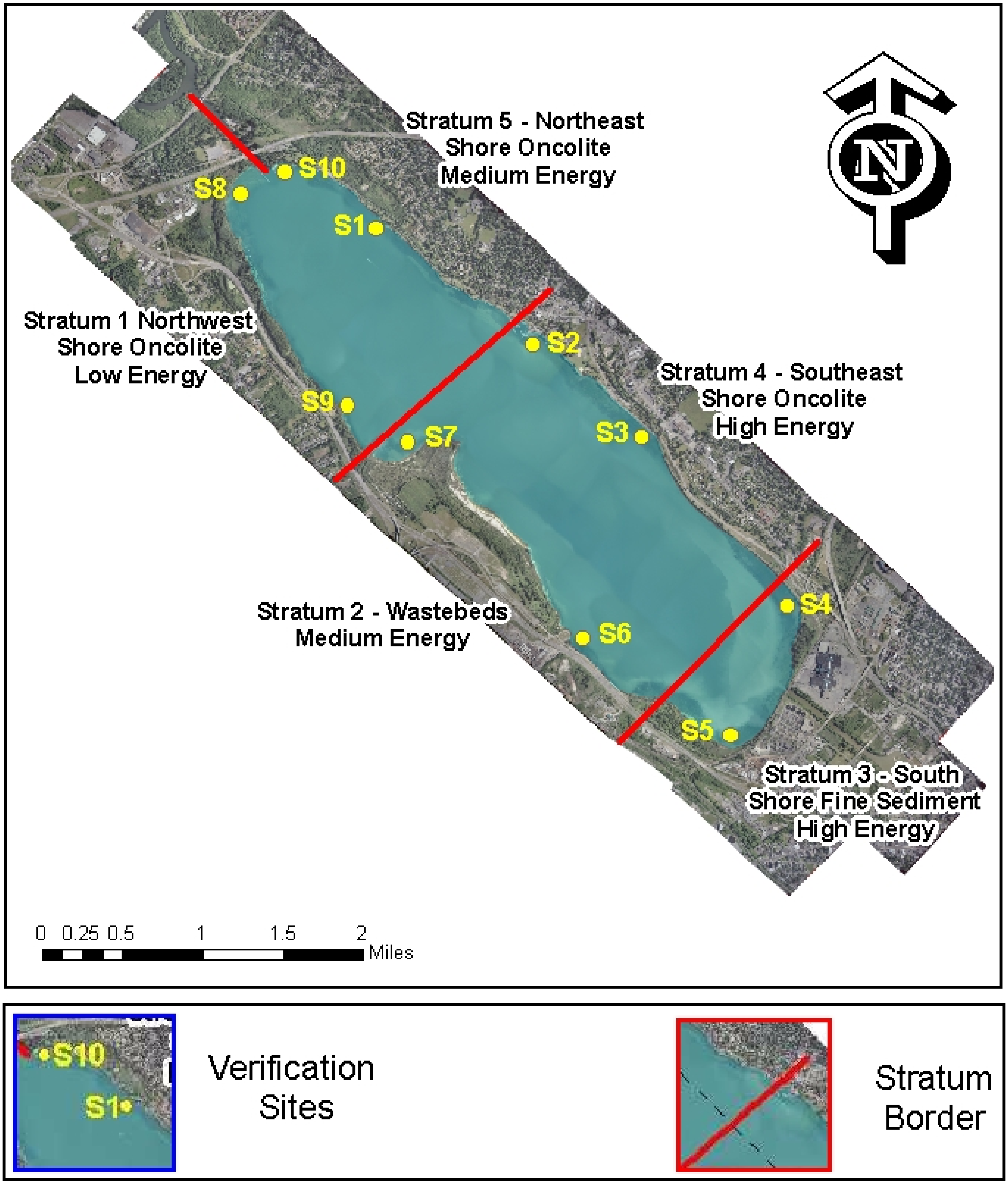


SITES FOR FIELD SPECIES VERIFICATION OF AERIAL PHOTOGRAPHY ON ONONDAGA LAKE

APPENDIX B2

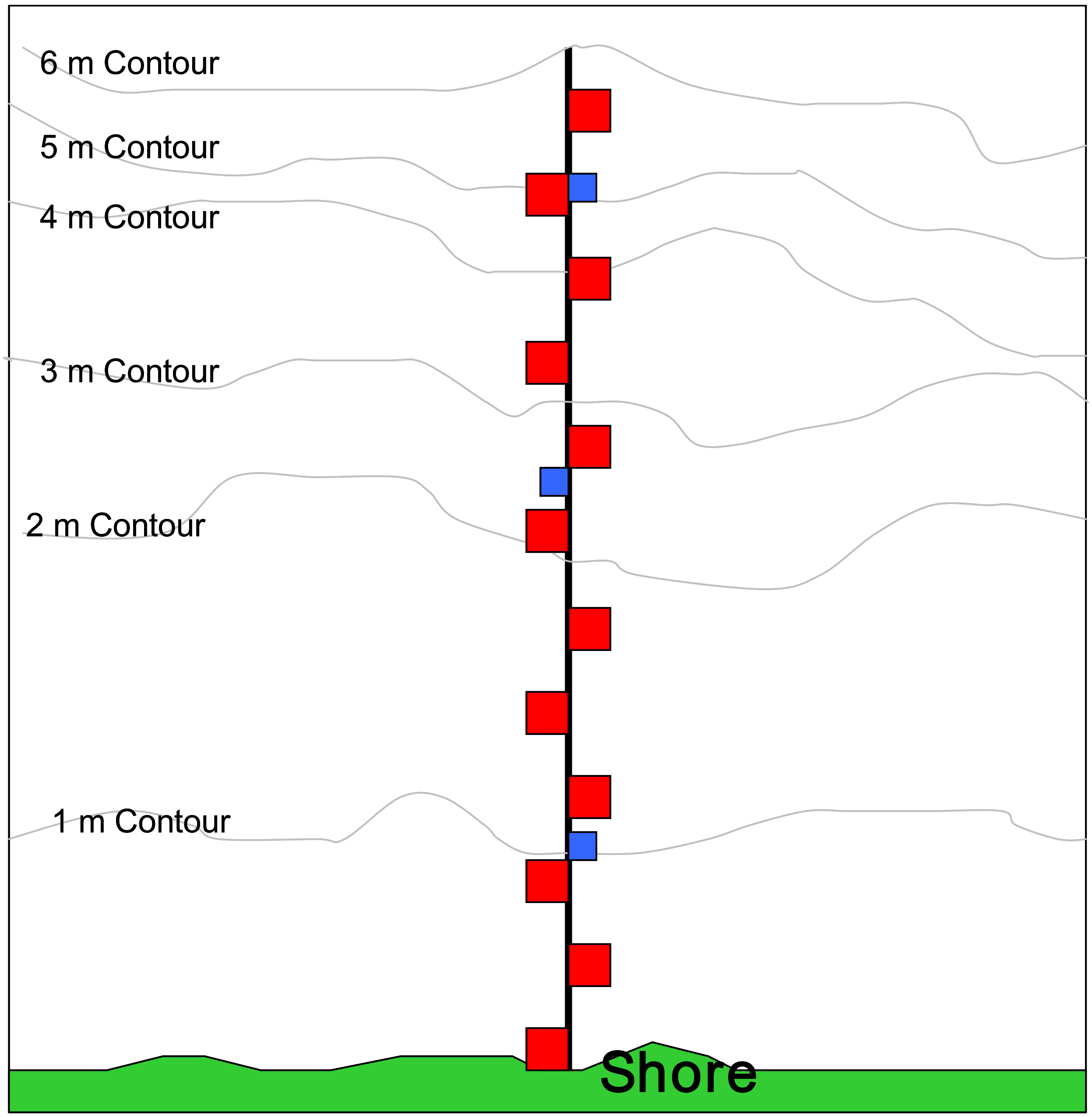
Field Data Packet for Onondaga Lake Littoral Zone Field Survey

Onondaga Lake Macrophyte Monitoring Subplot Data Sheet
Page __ of __

Transect #:	Date&Time:	Field Crew:

New Species	Notes:
Species 1=	
Species 2=	
Species 3=	

Subplot	Sago Pndwd	Water Stgrs	Elodea	Curly Pndwd	Coontl	Eurasn Milfoil	Small Pndwd	Fil. Algae	Sp. 1	Sp. 2	Sp. 3	Sediment Texture



LEGEND

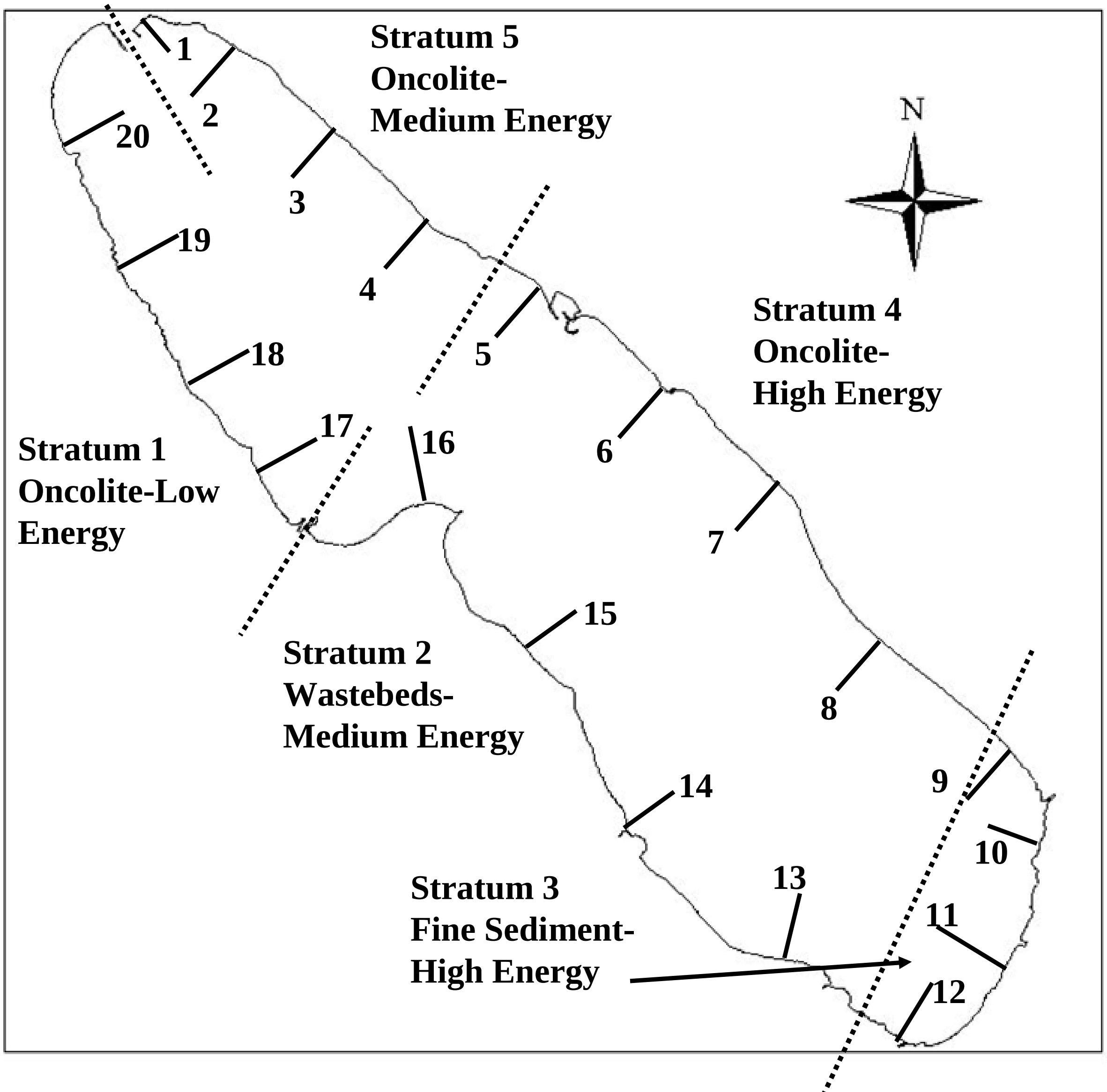
1 m^2 Frequency/Percent Cover Quadrats

0.25 m^2 Biomass Quadrats

Line Transect

Depth Contours

Diagram of Onondaga Lake macrophyte sampling design.



Legend

······ Strata borders

— Transect locations

Transect locations for the Onondaga Lake Littoral Zone Survey

ATTACHMENT 4

QUALITY ASSURANCE PROGRAM PLAN

ONONDAGA LAKE AND TRIBUTARY
MACROINVERTEBRATE ASSESSMENT PROGRAM (2010)

AMBIENT MONITORING PROGRAM

Prepared for the NYSDEC

Prepared and Revised by:

Onondaga County
Department Of Water Environment Protection

July 2010

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 and Tributary Macroinvertebrate Assessment Program, 2010.

The County's long-term monitoring program includes assessment of physical, chemical, and biological attributes of the aquatic resources. The baseline Onondaga Lake and Tributary Macroinvertebrate Assessment Program and subsequent annual evaluations, are expected to address the goals of the *Ambient Monitoring Program*.

Background

The year 2010 Macroinvertebrate Assessment Program was developed in consultation with expert technical advisors in limnology. The 2010 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 and Tributary Stream Macroinvertebrate 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 of the program;
- deletion of specific elements of the program;
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- 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 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 and tributary macroinvertebrate 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. Only minor clarifications were made to the QAPP, and no major program modifications were incorporated in to the 2010 monitoring season.

Table 1. Summary of year 2010 Onondaga Lake and Tributary Macroinvertebrate Assessment Program.

Component	Methodology/Gear	Sampling Objectives	Location and Number of Samples	Timing	Change from previous year
Onondaga Lake Littoral Zone Macroinv. Sampling	Petite Ponar Dredge in the littoral zone.	• NYSDEC Water Quality Assessment Protocol. • HBI - Hilsenhoff Biotic Index. • % Oligocheates.	• Five locations, one in each strata. • At each site 18 replicate petite ponar samples are collected.	June	No Change from 2005.
Tributary Macroinvertebrate Sampling	Kick Screen Sampling. Jab Net Sampling.	• NYSDEC Water Quality Assessment Protocol. • HBI - Hilsenhoff Biotic Index. • % Oligocheates.	• Four (4) Sites on Onondaga Creek. • Three (3) Sites on Ley Creek. • Three (3) Sites on Harbor Brook.	July during low flow conditions.	No Change from 2008.
Habitat Assessment	USEPA Rapid Bioassessment Protocol	Habitat Characterization	• Four (4) Sites on Onondaga Creek. • Three (3) Sites on Ley Creek. • Three (3) Sites on Harbor Brook.	July during low flow conditions.	No Change from 2008.

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 macroinvertebrate 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 Macroinvertebrate Assessment Program. Thus the use of the QAPP in conjunction with the formal Standard Operating Procedures (SOPs) for the biological monitoring program activities, the *Onondaga County Ambient Monitoring Program: Onondaga Lake and Tributary Macroinvertebrate Assessment Program (2010)* and subsequent programs documentation will provide OCDWEP with a successful program.

3.0 ONONDAGA LAKE LITTORAL ZONE MACROINVERTEBRATE SAMPLING

3.1 Procedures

Macroinvertebrate sampling is conducted at five locations in Onondaga Lake during June (refer to Appendix C.1 for locations). A total of 18 replicates per site are to be collected. Two boats will be utilized; one to collect the samples and another to wash the collected material in a washtub. The event will utilize the same technicians for ponar deployments to minimize any sampling bias.

Protocols for data collection shall be consistent with the New York State Department of Environmental Conservation, Divisions of Water’s, *Quality Assurance Work Plan for Biological Stream Monitoring in New York State,* dated June 2002. Specifically, Section II, 12.C, Ponar Sediment Sampling.

3.1.1 Pre-Field

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

Step 2. Assemble: field data sheet packet, Chain of Custody forms, 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 for sampling feasibility.

3.1.2 Field

Step 1. Proceed to the predetermined locations using the Global Positioning System (GPS). The sample boat should be positioned over 0.5 m of water for replicates 1-6 (1.0 m of water for replicates 7-12, and 1.5 meters for replicates 13-18) and anchored. The following table summarizes the coordinates for five macroinvertebrate sampling sites on Onondaga Lake.

Site #	Site Description	Coordinates
Site #1 – Oncolite Low Energy.	Maple Bay	43° 06.427’ N 76° 14.580’ W
Site #2 – Wastebeds Medium Energy.	Wastebeds	45° 05.084’ N 76° 12.822’ W
Site #3 – Fine Sediments High Energy.	South End (Metro)	45° 03.944’ N 76° 11.000’ W
Site #4 – Oncolite High Energy	Ley Creek	43° 04.669’ N 76° 10.897’ W
Site #5 – Oncolite Medium Energy.	Hiawatha Point	43° 06.249’ N 76° 13.226’ W

Step 2. Collect water quality data at the water surface using a pre-calibrated water quality meter. Log the depth and water quality data (for each site water depth - 0.5 m, 1.0 m, and 1.5 m) on the meter. All data will be downloaded at the end of the day. Standard water quality parameters include temperature, Dissolved Oxygen (percent and concentration), salinity, conductivity, pH, and ORP.

Step 3. The petite ponar should be set, lowered into the water, and allowed to free-fall for the last 0.5 m to the bottom. The impact with the bottom activates the closing mechanism, and the dredge is then slowly brought to the surface.

Step 4. Once at the surface, the petite ponar is placed over a labeled stainless steel pail and the jaws opened allowing the contents to drop into the pail. Lake water is used to rinse any remaining material stuck in the ponar into the pail.

The sample is rejected if the dredge was only partially filled with sediment. Possible causes of less than a full sample include non-vertical deployment, premature triggering of the closing mechanism, an object stuck in the jaws of the ponar, or hard sediments that are impenetrable by the petite ponar. If the sampling team observes bottom material draining from the dredge as it is brought out of the water, the sample will be rejected. To the extent possible, comparable substrates are collected for each replicate.

Each of the 6 replicate samples per site water depth (0.5 m, 1.0 m, and 1.5 m) are collected at different points on the sample boat to ensure that the same area is not sampled twice.

Step 5. Once the six samples are collected at the corresponding site water depth (0.5 m, 1.0 m, or 1.5 m), the boat is moved to the next depth interval. Before moving to the next depth interval, the six individual pails containing the samples are transferred to the wash boat for in-field processing as they are collected.

Step 6. Sediment from each replicate is examined and the texture documented on the field forms. Sediment texture designations include; silt, fine sand, coarse sand, Oncolite, hard wastebeds, soft wastebed and gravel. Any unique characteristics of the sediment such as odd odor or color are also noted for each replicate.

Step 7. The contents of each discrete sample replicate are placed into a U.S. Standard No. 30 mesh (0.590 mm opening) Nalgene™ sieve inside a washtub overhanging on the side of the boat. The sample is gently washed with lake water using a small impeller pump to remove small particles (clays and silts). The contents remaining in the sieve are transferred to labeled wide mouth plastic sample jars of various sizes depending on amount of material. A 10% solution of formalin will be added (wear Nitrile gloves, safety glasses and full face shield during this operation), and the sample jar shall be topped off just below the shoulder.

Step 8. Fill out chain of custody form, and place the sample and Chain of Custody in a box for safekeeping.

Step 9. Once all 18 replicates (6 each at 0.5 m, 1.0 m, and 1.5 m depths) are collected at a site and the samples are processed and stowed, proceed to the next station and complete steps 1 through 8.

3.1.3 End of Sample Day

Step 1. Review field notes and Chain of Custody 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.

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.

- Station data sheet.
- Facility code/station description.
- Sample labels.
- Chain-of-custody forms (as appropriate).

Appendix C1 contains examples of the station data sheet and map of sampling stations.

4.0 ONONDAGA LAKE TRIBUTARY MACROINVERTEBRATE SAMPLING AND HABITAT ASSESSMENT

4.1 Procedures

Tributary macroinvertebrate sampling is conducted at ten (10) locations in the Onondaga Lake watershed during low flow periods in July (refer to Appendix C.1 for a map of the locations). Tributary macroinvertebrate sampling will be completed in conjunction with the tributary Habitat Assessment activities at the following locations:

Site Name	Site Location	Site Abbreviation	Sample Type	Reference Coordinates
Onondaga Creek Site 1	Tully Farms Road	OCS1	Kick Screen	N 42° 49.49’, W 76° 08.20’
Onondaga Creek Site 2	Webster Road	OCS2	Kick Screen	N 42° 52.95’, W 76° 09.24’
Onondaga Creek Site 3	Dorwin Ave. Bridge	OCS3	Kick Screen	N 42° 59.137’, W 76° 08.961’
Onondaga Creek Site 4	Spencer Street	OCS4	Kick Screen	N 43° 03.349’, W 76° 09.670’
Harbor Brook Site 1	Velasko Road	HBS1	Kick Screen	N 43° 02.156’, W 76° 11.467’
Harbor Brook Site 2	Hiawatha Boulevard	HBS2	Kick Screen	N 43° 03.393’, W 76° 11.132’
Harbor Brook Site 3	Route 690	HBS3	Jab Net	N 43° 03.722’, W 76° 11.277’
Ley Creek Site 1	Townline Road Bridge	LCS1	Kick Screen	N 43° 05.453’, W 76° 06.987’
Ley Creek Site 2	7^{th} North Street	LCS2	Jab Net	N 43° 05.242’, W 76° 09.706’
Ley Creek Site 3	Park Street	LCS3	Jab Net	N 43° 04.496’, W 76° 10.359’

Protocols for data collection shall be consistent with the New York State Department of Environmental Conservation, Divisions of Water’s, *Quality Assurance Work Plan for Biological Stream Monitoring in New York State,* dated June 2002.

4.1.1 Pre-Field

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

Step 2. Assemble: field data sheet packet, Chain of Custody forms, 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 for sampling feasibility.

4.1.2 Field

4.1.2.1 Kick Screen Sampling Locations

Step 1: Four (4) full stream cross-section replicate samples will be collected at each site. Start by identifying the four (4) replicate sample locations, leaving roughly 5-meters between each replicate.

Step 2: Starting with the replicate furthest down stream in order to minimize disturbance of the subsequent sampling sites. Enter the water with a kick screen and move in a perpendicular direction towards the far shore/stream bank.

Step 3: Position the kick screen in the water approximately 0.5-meters downstream of the sampler's feet. The field data recorder will note the starting time.

Step 4: With the kick screen remaining in the water and resting upon the bottom substrate, the stream bottom is disturbed by foot (shuffle back and forth), so that dislodged organisms are carried into the net. If possible, roll over larger cobbles to dislodge organisms from their refuge. Sampling will continue for 5-minutes, with the objective of sampling the entire stream cross-section in a diagonal transect while heading upstream toward the near shore. The speed in which the kick screen is moved across the stream channel will be dependent upon the stream width, however, the speed shall be adjusted to ensure consistent sampling disturbance across the stream width.

Step 5: As acknowledged by the field data recorder, after the 5-minutes of sampling is completed, lift the net out of the water being careful that material in the net is not lost.

Step 6: Empty the contents of the net into the wash bucket, being sure to thoroughly rinse the net with the garden sprayer. Large rocks and sticks may only be removed from the sample after vigorous rinsing.

Step 7: Carefully pour the contents of the wash bucket into a 500 μm sieve, making sure wash bucket is thoroughly rinsed into the sieve.

Step 8: Once the contents are drained and rinsed, transfer the material on the sieve to the pre-labeled sample container, filling no more than 50% of the container volume. If more than one sample container is required, label the container with the same information as the first, and include the jar number (i.e. container 1 of 2, etc.). If any organisms are removed from the kick-screen, but not placed into the sampling container (i.e. cray-fish, minnow species, etc.), they must be listed on the Chain of Custody.

Step 9: The sample jar shall be topped off just below the shoulder with fixative (70% ethyl-alcohol), capped tightly, and gently inverted several times to distribute the fixative solution. Double check the label(s), making sure all required information is recorded.

Step 10: Fill out the appropriate chain for the sample and sign your name.

Step 11: Complete the remaining replicate samples following the steps contained in Section 3.1.2.1 Kick Screen Sampling Locations. Continue with the next furthest downstream site, and be certain not to overlap sample sites.

4.1.2.2 Jab Net Sampling Locations

Step 1: Attach a rope to each side of the shoreline. Use the zodiac to cross the stream and attach the rope to the far shore. The rope should be taut for this activity. Divide the stream width in to four (4) equal sections starting from the near shore, and mark the rope at these locations.

Step 2: Using the rope for stability, position the boat at the first far shore mark. Lower the kick screen net, through the water column, until the bottom substrate is reached.

Step 3: Using a jabbing motion, push the net into the sediment and rake across the bottom substrate until the net is filled.

Step 4: Slowly bring the net to the surface to avoid loss of material, and transport the sample to shore.

Step 5: Empty the contents of the net into the wash bucket, being sure to thoroughly rinse the net with the garden sprayer. Large rocks and sticks may only be removed from the sample after vigorous rinsing.

Step 6: Carefully pour the contents of the wash bucket into a 500 µm sieve, making sure wash bucket is thoroughly rinsed into the sieve.

Step 7: Once the contents are drained and rinsed, transfer the material on the sieve to the pre-labeled sample container, filling no more than 50% of the container volume. If more than one sample container is required, label the container with the same information as the first, and include the jar number (i.e. container 1 of 2, etc.). If any organisms are removed from the kick-screen, but not placed into the sampling container (i.e. cray-fish, minnow species, etc.), they must be listed on the Chain of Custody.

Step 8: The sample jar shall be topped off just below the shoulder with fixative (70% ethyl-alcohol), capped tightly, and gently inverted several times to distribute the fixative solution. Double check the label(s), making sure all required information is recorded.

Step 9: Fill out the appropriate chain for the sample and sign your name.

Step 10: Complete the remaining replicate samples following the steps contained in Section 3.1.2.2. Jab Net Sampling Locations. Continue with remaining replicates, and be certain not to overlap sample sites.

4.1.2.3 Habitat Assessment and Physicochemical Characterization Forms

Physical Characterization/Water Quality and Habitat Assessment Field Data Sheet forms will be completed in conjunction with tributary macroinvertebrate sampling at the following locations:

Site Name	Site Location	Site Abbreviation	Reference Coordinates
Onondaga Creek Site 1	Tully Farms Road	OCS1	N 42° 49.49', W 76° 08.20'
Onondaga Creek Site 2	Webster Road	OCS2	N 42° 52.95', W 76° 09.24'
Onondaga Creek Site 3	Dorwin Ave. Bridge	OCS3	N 42° 59.137', W 76° 08.961'
Onondaga Creek Site 4	Spencer Street	OCS4	N 43° 03.349', W 76° 09.670'
Harbor Brook Site 1	Velasko Road	HBS1	N 43° 02.156', W 76° 11.467'
Harbor Brook Site 2	Hiawatha Boulevard	HBS2	N 43° 03.393', W 76° 11.132'
Harbor Brook Site 3	Route 690	HBS3	N 43° 03.722', W 76° 11.277'
Ley Creek Site 1	Townline Road Bridge	LCS1	N 43° 05.453', W 76° 06.987'
Ley Creek Site 2	7th North Street	LCS2	N 43° 05.242', W 76° 09.706'
Ley Creek Site 3	Park Street	LCS3	N 43° 04.496', W 76° 10.359'

The procedures contained herein shall be considered general procedures to ensure completeness of the forms. All personnel who complete the Physical Characterization/Water Quality Field Data Sheets shall review, and reference for characterization accuracy, the USEPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers (Barbour et al 1997), specifically Chapter 5, Habitat Assessment and Physicochemical Parameters, pages 5-1 to 5-5. In addition, all personnel who complete the Habitat Assessment Field Data Sheets shall review and reference for habitat parameter accuracy, the USEPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers (Barbour et al 1997), specifically Chapter 5, Habitat Assessment and Physicochemical Parameters, pages 5-11 to 5-31.

4.1.2.4 General Procedures – Physical Characterization/Water Quality Field Data Sheet

Step 1: Complete the Physical Characterization/Water Quality Field Data Sheet form for each site (front and back). This form includes basic information such as location, date, time, personnel, methods, and sketch of characterization area.

Header Information – Complete all requested information, except River Mile, Stream Class, and STORET#. Latitude and longitude must be included.

Weather Conditions – Complete all requested information.

Site Location Map – A hand-drawn map is necessary to illustrate major landmarks or features of the channel morphology or orientation, vegetative zones, buildings, etc. that might be used to aid in data interpretation. Also indicate areas where macroinvertebrate samples were collected. Use the recent historical Physical Characterization/Water Quality Field Data Sheets to identify new or modified features or stream improvements (i.e. culverts, bank stabilization, dredging, etc.).

Stream Characterization – Complete all requested information, except catchment area.

Watershed Features – Complete all requested information.

Riparian Vegetation – Complete all requested information.

Instream Features – Complete all requested information. Section 4.3, In-stream Flow Measurements, will supplement this section.

Large Woody Debris (LWD) – Complete all requested information.

Aquatic Vegetation – Complete all requested information.

Water Quality – Complete all requested information and record in-situ water quality data in this section.
Sediment Substrate – Complete all requested information.

Inorganic and Organic Substrate Components - Complete all requested information.

Step 2: Take photographs at each location, and record photo numbers on the Physical Characterization/Water Quality Field Data Sheet, with a brief description of each photo.

4.1.2.5. General Procedures – Habitat Assessment Field Data Sheet (Low Gradient Streams)

Step 1: Complete the Habitat Assessment Field Data Sheet form for each site (front and back). All sampling locations are currently classified as low gradient. However, the field team shall verify if stream is high or low gradient prior to completing the corresponding forms. The forms should be completed by two (2) experienced personnel in order to reach consensus on the condition category score.

High-gradient or riffle/run prevalent streams are those in moderate to high gradient landscapes. Natural high-gradient streams have substrates primarily composed of coarse sediment particles (i.e., gravel or larger) or frequent coarse particulate aggregations along stream reaches. Low gradient or glide/pool prevalent streams are those in low to moderate gradient landscapes. Natural low-gradient streams have substrates of fine sediment or infrequent aggregations of more coarse (gravel or larger) sediment particles along stream reaches.

Header Information – Complete all requested information, except River Mile, Stream Class, and STORET#. Latitude and longitude must be included.

The following Habitat Parameters shall be completed for the entire stream width to complete the Condition Category within the designated range of Optimal, Suboptimal, Marginal, and Poor:

1. Epifaunal Substrate/Available Cover.
2. Pool Substrate Characterization.
3. Pool Variability.
4. Sediment Deposition.
5. Channel Flow Status.
6. Channel Alteration.
7. Channel Sinnosity.

Note: Write the Condition Category score in the corresponding Habitat Parameter column.

The following Habitat Parameters shall be completed for the Left Bank (LB) and Right Bank (RB) to complete the Condition Category within the designated range of Optimal, Suboptimal, Marginal, and Poor:

8. Bank Stability.
9. Vegetative Protection.
10. Riparian Vegetative Zone Width.

Note: Write the Condition Category score for each bank in the corresponding Habitat Parameter column.

Step 2: Complete the Total Score by adding all the individual Habitat Parameter Scores (including the individual scores for the Right Bank and Left Bank).

4.1.2.6 Flow Measurements

In-stream flow measurements will be completed for each site location.

Step 1: Complete the header information of the Discharge Calculation Field form.

Step 2: Measure the stream width and record on Discharge Calculation Field form.

Step 3: Divide the stream width into 2-foot increments (these will be the flow meter reading stations). During the collection of velocities, keep tape measure stretched across the stream either by attaching to a tree or utilization of another sampling technician.

Step 4: Using the Sontek Flow Tracker flow meter, connect flow meter to wading staff. Turn flow meter on and set to ft/sec.

Step 5: Wade into water, down stream of the flow meter, and proceed to first 2-foot mark. Using the wading staff, determine depth of water, and record on the field sheet.

Step 6: If the water depth is less than 2-feet, only one (1) velocity reading will be required at 0.60 depth (as measured from the top). To set the sensor at 0.60 depth, line up the foot scale on the sliding rod with the tenth scale at the top of the depth gauge rod. If, for example, the total depth is 1.7-feet, then line up the one (1) on the foot scale with the seven (7) on the tenth scale. This will set the sensor to 0.60 depth.

If the water depth is greater than 2-feet, two (2) velocity readings will be required at 0.20 and 0.80 depths. To set the sensor at 0.20 depth, multiply the total depth by two (2) and repeat the above procedure. To set the sensor to 0.80 depth, divide the total depth by two and repeat the above procedure.

Record the velocity (or velocities) on the discharge sheet and continue to the next 2-foot increments. Using the same procedures listed above, continue until the opposite bank is reached.

Note: For streams that are too deep to wade, the inflatable Zodiac boat will be used to obtain flow readings. Use rope attached to each shore to stabilize the boat so that flow measurements may be obtained.

Step 7: Using the formulas included on the Discharge Calculation Field form, calculate the average velocity, cross-sectional area, and discharge volume for each flow meter reading station. Upon completion of the calculations for the individual stations, sum the individual values to determine the total width, cross-sectional area, and discharge. The total average velocity is equal to the total discharge volume (CFS) divided by the total cross sectional area ($ft^{\wedge 2}$).

4.1.3 End of Sample Day

Step 1. Review field notes and Chain of Custody for completeness.

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.

- Station data sheet.
- Facility code/station description.
- Sample labels.
- Chain-of-custody forms (as appropriate).

Appendix C2 contains examples of the station data sheets and map of sampling stations.

5.0 LABORATORY SORTING OF LAKE AND TRIBUTARY SAMPLES

5.1 Sorting and Identification

The following instructions apply to samples collected by Kick Screens, Jab Nets, and Petite Ponars. A bound log-book shall be maintained to record sorting details and status. A Macroinvertebrate Tally Sheet shall also be completed for each sample location (Figure 4).

Step 1: Under the laboratory exhaust hood, pour the contents of sample into a sieve with a mesh size of 500 µm. Rinse with tap water to remove any fine particles left in the sample from the field.

Step 2: Transfer the sample to a sorting tray and distribute homogeneously over the bottom of the pan.

Note: Step 2 through Step 6 should be completed near the laboratory bench-top exhaust fan.

Step 3: With the use of an over-head illuminated magnifier, scan the sample and remove 100 random organisms. Large samples shall be quartered to prevent biasing the data by selecting the larger easily located organisms. As they are removed, sort the organisms into major groups. After the major groups are sorted, place individual groups into 4 dram vials containing 70% ethyl alcohol, and count them. All counts shall be listed on the tally sheet.

Note: If an entire sample is sorted and less than 100 organisms are found, make a note on the tally sheet stating that the entire sample was sorted.

Note: All organisms are identified to order, with the exception of chironomids and oligochaetes.

<u>The following procedures, 3 (a) and 3 (b), apply only to samples collected in the lake, not the tributaries</u>

3 (a) Count all the zebra mussels within the first 100 random macroinvertebrate sorted. Close attention should be given to the identification of any quagga mussels. Then, from the initial sample (or quarter), sort out an equal number of non-zebra mussel macroinvertebrates

Note: These additional macroinvertebrates should be placed in separate vials from the initial sorting. Distinguish on the container labels as 1st and 2nd sorting. The objective is to ensure a sample of 100 macroinvertebrate with zebra mussels, and a sample of 100 macroinvertebrates without zebra mussels.

3 (b) Once the 100 macroinvertebrate samples, without zebra mussels, is sorted, then any remaining zebra mussels from the initial sample (or quarter) will be removed, individually counted, and documented on the tally sheet.

Note: The additional zebra mussel count allows the calculation of the number of zebra mussels per square meter.

Step 4: With an alcohol proof pen make a small label to be placed into each 4 dram vial with the following information:

Date	Facility code
Site	Identification (order or family)

Step 5: Place vials into a whirl-pak, fill out chain of custody and log sample into log book. Place chain of custody and whirl-pak with vials into a one gallon zip lock bag and place into QA/QC box.

Step 6: Return remaining sample to original container and indicate on the cap that the sample was sorted, then initial and date.

5.2 Sorting and Identification – QA/QC

The following quality assurance and quality control procedures shall be utilized for every samples location, and every replicate corresponding to that location.

Step 1: Quality control checks will be performed by the Wastewater Technician II or designee, but not the original sorter.

Step 2: Identify all samples that did not have 100 organisms sorted. Double check the original sample for any organisms that may have been overlooked.

Step 3: With the logbook in hand, remove the first ten (10) samples sorted and identified. Following the steps listed below, determine if a sample passes of fails QA/QC. If all ten (10) "pass" the quality control, the sorter may randomly select one (1) out of the next ten (10) samples. If this sample passes, randomly select one (1) out of the next ten (10) samples again, utilizing this procedure for the entire sample.

If a sample fails quality control, the next ten (10) samples must be checked before the one (1) in ten (10) procedures can resume.

Step 4: Once the QA/QC is corrected or confirmed, record this information on the chain of custody and in the log book.

Following the sorting and QA/QC, the samples are shipped to a consultant for further identification to the lowest taxonomic level feasible.

6.0 CHRONOLOGY OF QAPP

The QAPP for the Macroinvertebrate 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 Macroinvertebrates. The periodic updating of the QAPP will provide a written record of sampling procedures over the entire life of the Macroinvertebrate Assessment Program. Annual revisions to the QAPP have incorporated various changes made to the macroinvertebrate 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.

7.0 LITERATURE CITED

USDA NRCS — *National Water and Climate Center Technical Note 99–1, Stream Visual Assessment Protocol, issued December 1998.*

USEPA — *Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition (EPA 841-B-99-002), Barbour et al 1997.*

NYSDEC DOW — *Quality Assurance Work Plan for Biological Stream Monitoring in New York State, June 2002.*

HILSENHOFF — *Rapid Field Assessment Of Organic Pollution With A Family-Level Biotic Index. J. N. Am. Benthol So., 7, 65-68, 1998.*

OCDWEP — *SOP for Macroinvertebrates - Lake and Tributaries (Doc. # BIO–004).*

OCDWEP — *SOP for Tributary Habitat Assessment (Doc. # BIO–005).*

APPENDIX C1:

Field Data Packet For Onondaga Lake Littoral Zone Macroinvertebrate Sampling

Onondaga County Department of WATER ENVIRONMENT PROTECTION

ONONDAGA LAKE MACROINVERTEBRATE FIELD SHEET

Date: ______________________ **Site #** ____________

Sample Start Time:______________ **Sample End Time:** ______________ **GPS Coordinates:** *(Actual)* **N:** ______________________ **W:** ______________________

Crew 1: ____
(Sample Collection -Petite Ponar Crew)

Weather: ____________
OVercast PartlyCloudy HaZy CLear RAining SNowing

Crew 2: ____
(Sample Wash-Sediment Texture-Containers)

Wind: ________ **from:** __________
0-5mph 5-10 10-15 >15 *N,S,E,W,SE,SW,NE,NW.*

Site Water Depth (0.5 M)

Replicate Number	Replicate #1	Replicate #2	Replicate #3	Replicate #4	Replicate #5	Replicate #6
Number of Sample Containers:						
Preservation Complete Check & Intitial:						
Sediment Texture:						
	(silt, fine sand, coarse sand, oncolite, hard wastebeds, soft wastebed, gravel)					
Sediment Comments: *(odors, color, other)*						

OTHER COMMENTS:

Site Water Depth (1.0 M)

Replicate Number	Replicate #7	Replicate #8	Replicate #9	Replicate #10	Replicate #11	Replicate #12
Number of Sample Containers:						
Preservation Complete Check & Intitial:						
Sediment Texture:						
	(silt, fine sand, coarse sand, oncolite, hard wastebeds, soft wastebed, gravel)					
Sediment Comments: *(odors, color, other)*						

OTHER COMMENTS:

Site Water Depth (1.5 M)

Replicate Number	Replicate #13	Replicate #14	Replicate #15	Replicate #16	Replicate #17	Replicate #18
Number of Sample Containers:						
Preservation Complete Check & Intitial:						
Sediment Texture:						
	(silt, fine sand, coarse sand, oncolite, hard wastebeds, soft wastebed, gravel)					
Sediment Comments: *(odors, color, other)*						

OTHER COMMENTS:

Sample Type (Circle One): Petite Ponar Kick Screen Jab Net

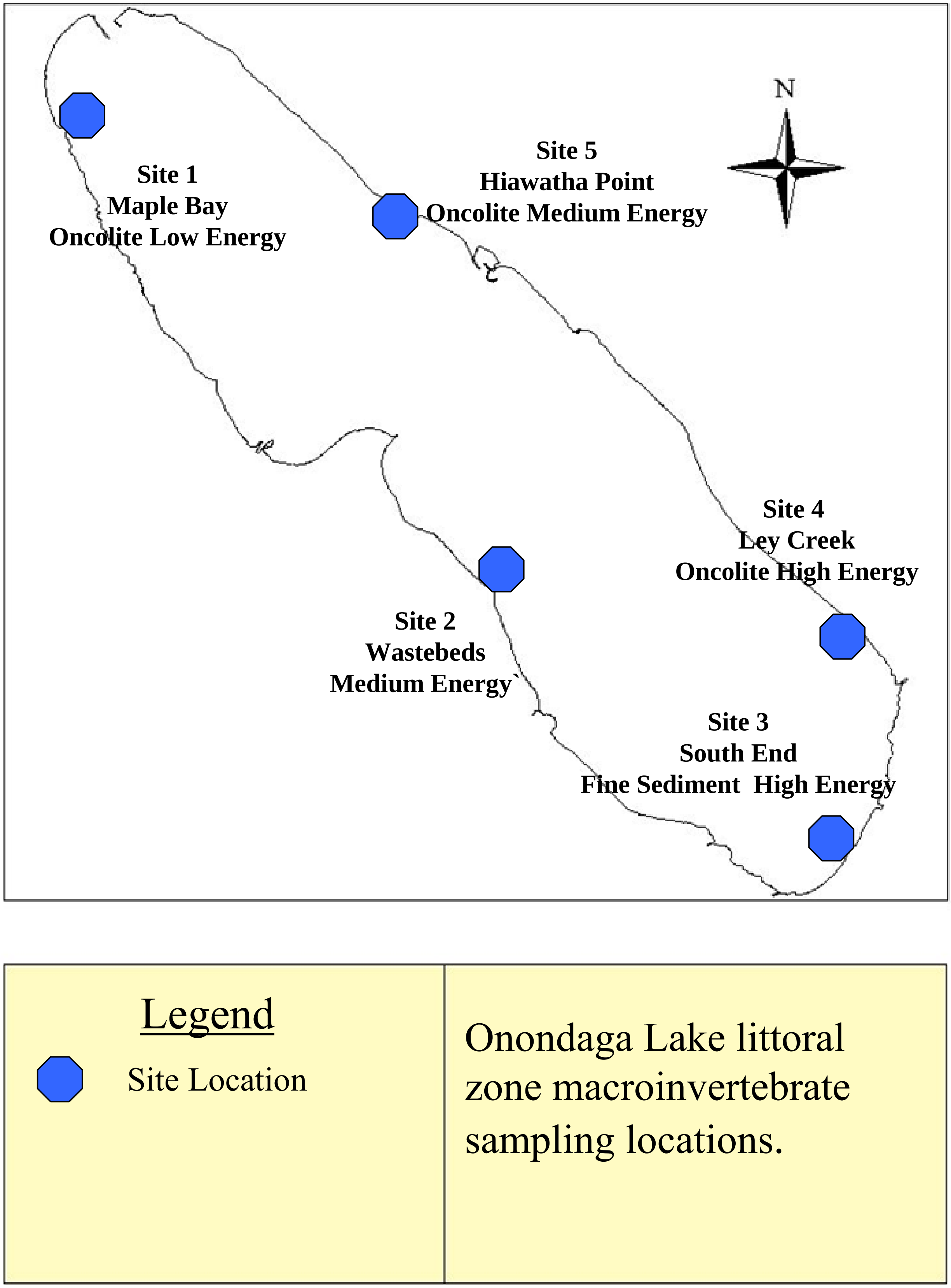
Facility Code:		Location and Site #	
Transect #		Replicate #	
Date Collected:		Sampler Initials:	
Date Sorted:		Sorter Initials:	
Date QA/QC:		QA/QC Initials:	

Chironomid	1st	2nd	
		Total	
Oligochete	1st	2nd	
		Total	
Amphipoda	1st	2nd	
		Total	
Coleoptera	1st	2nd	
		Total	
Isopoda	1st	2nd	
		Total	
Others	1st	2nd	
		Total	

Total Organisms Sorted
Note: Tally Zebra Mussels Seperately.

By Sorter	**By QA/QC**

Zebra Mussels	1st	Remainder of Sample (or Quarter)	
		Total	



Onondaga Lake littoral zone macroinvertebrate sampling locations.

APPENDIX C2:

Field Data Packet For Onondaga Lake Tributary Macroinvertebrate Sampling and Habitat Assessment

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

STREAM NAME	LOCATION	
STATION #_____ ____ RIVERMILE_________	STREAM CLASS	
LAT ______________ LONG _______ _______	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _______ __ TIME ____ _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS	**Now** / **Past 24 hours** ❑ storm (heavy rain) ❑ ❑ rain (steady rain) ❑ ❑ showers (intermittent) ❑ ____%❑ %cloud cover ❑____% ❑ clear/sunny ❑ **Has there been a heavy rain in the last 7 days?** ❑ Yes ❑ No **Air Temperature**____ __° C **Other**____________________________________
SITE LOCATION/MAP	**Draw a map of the site and indicate the areas sampled (or attach a photograph)**
STREAM CHARACTERIZATION	**Stream Subsystem** ❑ Perennial ❑ Intermittent ❑ Tidal **Stream Origin** ❑ Glacial ❑ Spring-fed ❑ Non-glacial montane ❑ Mixture of origins ❑ Swamp and bog ❑ Other__________ **Stream Type** ❑ Coldwater ❑ Warmwater **Catchment Area**__________km^2

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 1 A-5

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ❑ Forest ❑ Commercial ❑ Field/Pasture ❑ Industrial ❑ Agricultural ❑ Other ____________ ❑ Residential	**Local Watershed NPS Pollution** ❑ No evidence ❑ Some potential sources ❑ Obvious sources **Local Watershed Erosion** ❑ None ❑ Moderate ❑ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ❑ Trees ❑ Shrubs ❑ Grasses ❑ Herbaceous **dominant species present** ______________________________	
INSTREAM FEATURES	**Estimated Reach Length** _______m **Estimated Stream Width** _______m **Sampling Reach Area** _______m² **Area in km² (m²x1000)** _______km² **Estimated Stream Depth** _______m **Surface Velocity** _______m/sec **(at thalweg)**	**Canopy Cover** ❑ Partly open ❑ Partly shaded ❑ Shaded **High Water Mark** _______m **Proportion of Reach Represented by Stream Morphology Types** ❑ Riffle_______% ❑ Run_______% ❑ Pool_______% **Channelized** ❑ Yes ❑ No **Dam Present** ❑ Yes ❑ No
LARGE WOODY DEBRIS	**LWD** _______m² **Density of LWD** _______m²/km² (LWD/ reach area)	
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ❑ Rooted emergent ❑ Rooted submergent ❑ Rooted floating ❑ Free floating ❑ Floating Algae ❑ Attached Algae **dominant species present** ______________________________ **Portion of the reach with aquatic vegetation** _____%	
WATER QUALITY	**Temperature**_______ °C **Specific Conductance**_______ **Dissolved Oxygen** _______ **pH** _______ **Turbidity** _______ **WQ Instrument Used** ____________	**Water Odors** ❑ Normal/None ❑ Sewage ❑ Petroleum ❑ Chemical ❑ Fishy ❑ Other____________ **Water Surface Oils** ❑ Slick ❑ Sheen ❑ Globs ❑ Flecks ❑ None ❑ Other____________ **Turbidity (if not measured)** ❑ Clear ❑ Slightly turbid ❑ Turbid ❑ Opaque ❑ Stained ❑ Other________
SEDIMENT/ SUBSTRATE	**Odors** ❑ Normal ❑ Sewage ❑ Petroleum ❑ Chemical ❑ Anaerobic ❑ None ❑ Other____________ **Oils** ❑ Absent ❑ Slight ❑ Moderate ❑ Profuse	**Deposits** ❑ Sludge ❑ Sawdust ❑ Paper fiber ❑ Sand ❑ Relict shells ❑ Other____________ **Looking at stones which are not deeply embedded, are the undersides black in color?** ❑ Yes ❑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

A-6 *Appendix A-1: Habitat Assessment and Physicochemical Characterization Field Data Sheets - Form 1*

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #________ RIVERMILE________	STREAM CLASS	
LAT____________ LONG ____________	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE ________ TIME ________ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score __________

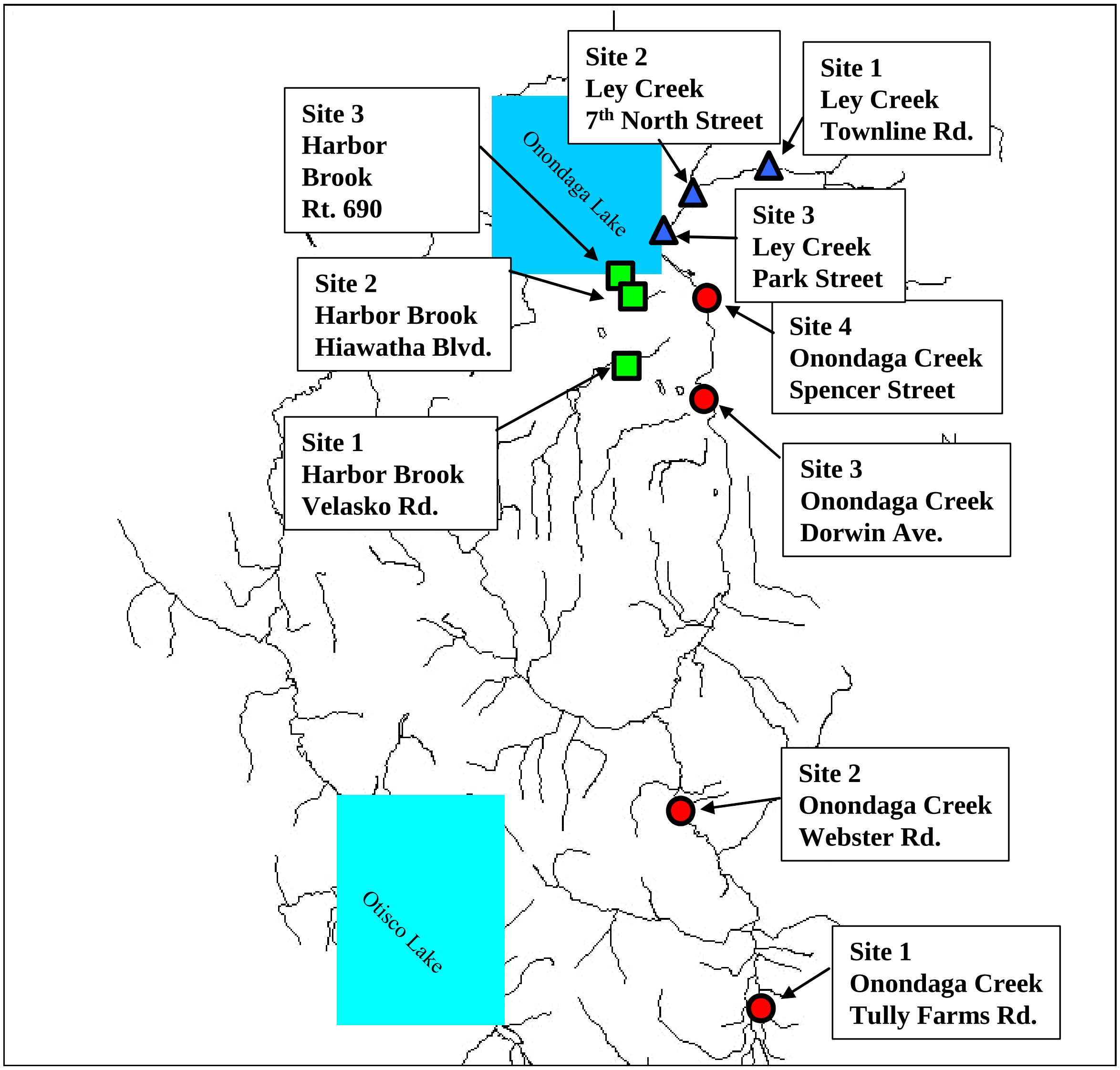
Sample Type (Circle One): Petite Ponar Kick Screen Jab Net

Facility Code:		Location and Site #	
Transect #		Replicate #	
Date Collected:		Sampler Initials:	
Date Sorted:		Sorter Initials:	
Date QA/QC:		QA/QC Initials:	

Chironomid	1st	2nd	
		Total	
Oligochete	1st	2nd	
		Total	
Amphipoda	1st	2nd	
		Total	
Coleoptera	1st	2nd	
		Total	
Isopoda	1st	2nd	
		Total	
Others	1st	2nd	
		Total	

Total Organisms Sorted Note: Tally Zebra Mussels Seperately.		
	By Sorter	**By QA/QC**

Zebra Mussels	1st	Remainder of Sample (or Quarter)	
		Total	



Legend

- Onondaga Creek sites (red circle)
- Harbor Brook sites (green square)
- Ley Creek sites (blue triangle)

Onondaga Lake Tributary Macroinvertebrate Monitoring Locations.

ATTACHMENT 5

DATA ANALYSIS AND INTERPRETATION PLAN

ONONDAGA LAKE AND WATERSHED

VERSION 2.8 REVISED NOVEMBER 2010

AMBIENT MONITORING PROGRAM

Prepared for the NYSDEC

Prepared and Revised by: Onondaga County

Department Of Water Environment Protection

November 2010

Data Analysis and Interpretation Plan
Onondaga Lake and Watershed
Ambient Monitoring Program

Onondaga County Department of Water Environment Protection
650 Hiawatha Boulevard West
Syracuse, New York 13204-1194

Version 2.8
REVISED November 2010

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Data Analysis and Interpretation Plan (DAIP)

1. OBJECTIVE 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 collected from Onondaga Lake and its watershed. Results are used to evaluate water quality conditions and assess whether the 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). This document will be revised and updated as new information becomes available, new issues emerge, or new tools are developed to help with 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.
- 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 phased over a 15-year period. One of the factors considered in developing the phasing plan was uncertainty regarding how Onondaga Lake would respond to reductions in the loading of wastewater-related contaminants. Onondaga County was required to design, fund, and implement a monitoring program that would provide the data and information needed 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; results will provide the foundation for the Metro SPDES permit, which will include the CSOs.

2.1. Required Actions by Onondaga County and NYSDEC

Specific compliance requirements for Onondaga Lake and its watershed are referenced in the ACJ. The following summary was prepared by John Ferrante of Central New York Regional Planning and Development Board while he was under contract to NYSDEC on Onondaga Lake issues.

****

COMPLIANCE REQUIREMENTS FOR THE AMENDED CONSENT JUDGMENT

The following list contains the primary legal and programmatic actions that are required in the Amended Consent Judgment. This list is not meant to be comprehensive of all ACJ requirements but identifies only those of a technical nature. The Party responsible for implementing each action and bringing it to an acceptable conclusion is identified after each requirement. The source document is the Amended Consent Judgment signed and entered into the Court on January 20, 1998.

SOURCE **REQUIREMENT**

Page 4-5: Insure that Onondaga Lake and its tributaries achieve best usage designated for Class B and C water pursuant to 6 New York Code of Rules and Regulations (NYCRR) Parts 701 and 703. Applicable NY State Water Quality Standards and Guidelines:

1. Dissolved Oxygen: 6NYCRR Sec. 703.3
2. Ammonia: 6 NYCRR Sec. 703.5
3. Turbidity: 6 NYCRR Sec. 703.2
4. Floatable Solids: 6 NYCRR Sec. 703.2
5. Phosphorus: 6 NYCRR Sec. 703.2
6. Technical & Operational Guidance Series (TOGS) 1.1.1 Water Quality Standards and Guidelines
7. Nitrogen: 6 NYCRR Sec. 703.2
8. Bacteria: 6 NYCRR Sec. 703.4

Responsible Party: New York State Department of Environmental Conservation

Page 5: The State is required "…to determine, as soon as sufficient data and other information are available, whether water quality standards and guidelines for Onondaga Lake can be achieved with the continued discharge of Metro's effluent into the Lake;…"

Responsible Party: New York State Department of Environmental Conservation

Paragraph 9: Onondaga County is responsible for complying with the following Stage III effluent discharge limits from the Metro wastewater treatment plant (*or as amended based on revised Total Maximum Daily Load (TMDL))*

1. Ammonia: 1.2 mg/l (June 1 – October 31 [30 day average])
   2.4 mg/l (November 1 – May 31 [30 day average])
2. Phosphorus: 0.02 mg/l [12 month rolling average]

Responsible Party: Onondaga County

Paragraph 10: Report on the ability of the County (based on demonstrated information) to achieve compliance with effluent limitations specified in ACJ, paragraph 9, or as amended based on a revised TMDL allocation.

Responsible Party: Onondaga County

Paragraph 11: Failure to demonstrate ability (per paragraph 10) by February 1, 2009, cease causing or contributing to the violation of water quality standards in Onondaga Lake by diverting Metro's effluent to the Seneca River <u>or</u> by implementing another engineering alternative which fully complies with the water quality standards no later than December 1, 2012.

Responsible Party: Onondaga County

Paragraph 12: Reassess Total Maximum Daily Load (TMDL) allocation for Onondaga Lake "on or about" January 1, 2009 and modify Stage III effluent limits as needed to reflect revised TMDL.

Responsible Party: New York State Department of Environmental Conservation

Paragraph 13: Metro construction compliance requirements and schedule per paragraphs 5 – 11, Appendix A

Responsible Party: Onondaga County

Paragraph 14: Design, construct, and maintain and modify and/or supplement, as necessary, a CSO control and upgrade program in accordance with DEC CSO guidance, as set forth in TOGS 1.6.3 (CSO Control Strategy).

Responsible Party: Onondaga County

Paragraph 15: Develop and implement an oxygenation demonstration project in Onondaga Lake.

Responsible Party: Onondaga County ***{note: this requirement has been suspended pending stipulation that it be withdrawn from the ACJ based on current water quality conditions}.***

Paragraph 16: Monitor conditions in the Lake and its tributaries, and evaluate the effect that alterations in Metro and CSO operations are having on the water quality.

Responsible Party: Onondaga County

Paragraph 24: Enter into an agreement with CNYRPDB and provide funding for an Environmental Benefits Project (as set forth in Paragraph 25.C)

Responsible Party: Onondaga County

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2.2. Water Quality Classification and Designated Use

Lakes and streams are classified according to their designated best use (for example, water supply, swimming, fish propagation, aesthetic enjoyment, and fish survival). Onondaga Lake is classified as B and C waters (Figure A5-1 and Table A5-1) 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 A5-1, 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.

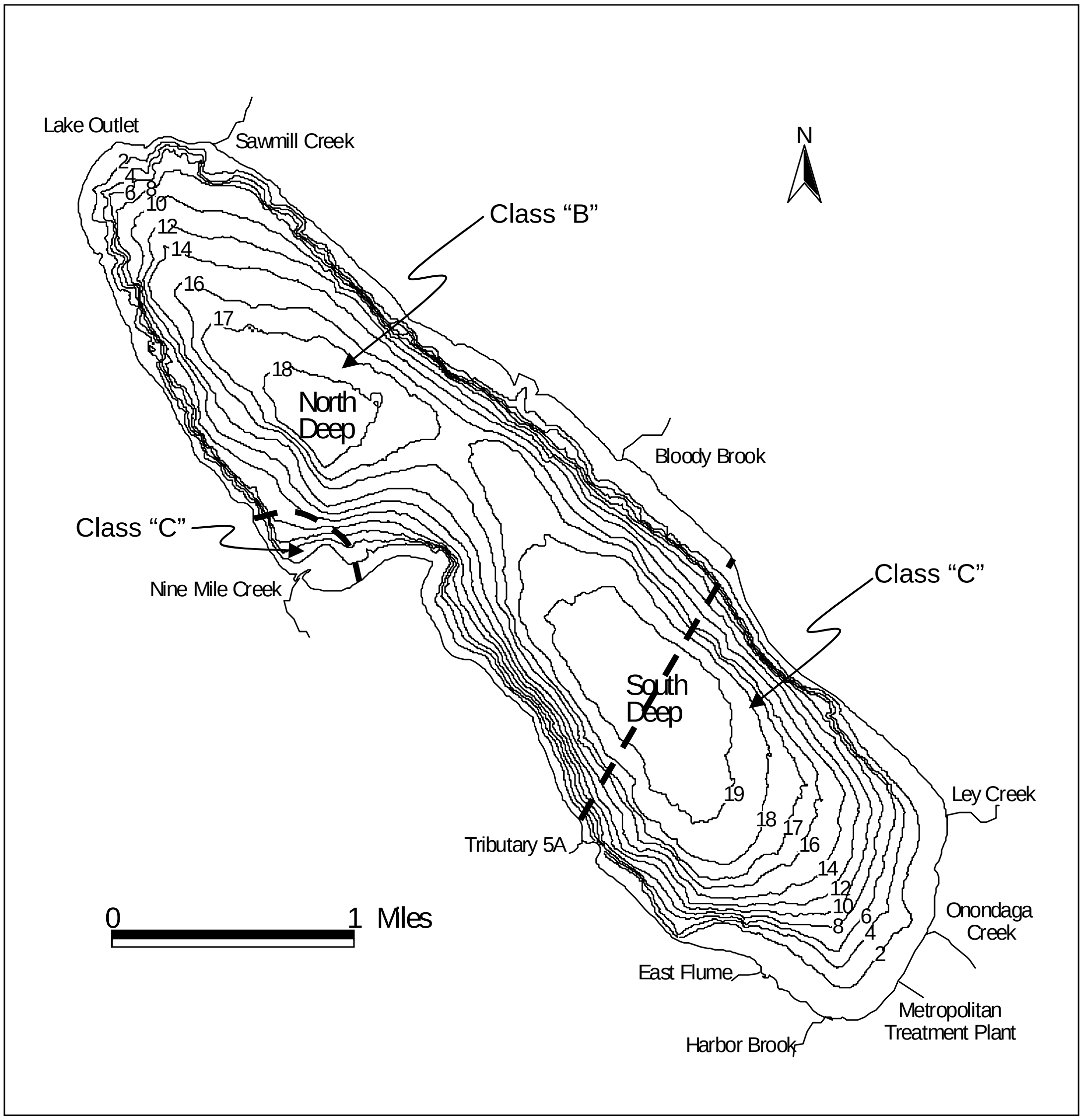


Figure A5-1. Regulatory Classifications and Bathymetry of Onondaga Lake.. (Note: Contour lines are in meters.)

Table A5-1. 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. Tribs. 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

Table A5-1. Summary of Regulatory Classification of Onondaga Lake and Tributary Streams.

Water body	Description of Segment	Regulatory Classification	Standards
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 July 2004); on-line linkage
http://www.dec.ny.gov/regs/4539.html#17588

2.3. Compliance Assessment

The regulatory goal of the ACJ is to bring Onondaga Lake and its tributaries into compliance with best usage designated for Class B and C waters pursuant to 6 NYCRR Parts 701 and 703. Applicable NY State Water Quality Standards and Guidance that will be used to assess the extent to which these actions are successful include the following:

1. Dissolved Oxygen: 6NYCRR Sec. 703.3
2. Ammonia: 6 NYCRR Sec. 703.5
3. Turbidity: 6 NYCRR Sec. 703.2
4. Floatable Solids in CSO Discharges: 6 NYCRR Sec. 703.2
5. Phosphorus: 6 NYCRR Sec. 703.2
6. Water Quality Standards & Guidelines (NYSDEC Technical & Operational Guidance Series TOGS 1.1.1)
7. Nitrogen: 6 NYCRR Sec. 703.2
8. 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 15-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 A5-2.

Table A5-2. 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 Water Quality Standards & Guidelines 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 95% of combined sewage volume. Modeling Lake: Onondaga Lake model (development began in 2005)

Table A5-2. Summary of management questions and decision analysis.

Management Question:	Decision Analysis Components and Regulatory References	Spatial and Temporal Scale of Assessment	Tools for Assessment
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 Water Quality Standards & Guidelines (*latest revision to NYS standards*) NYSDEC revised TMDL for phosphorus and ammonia: **January 1, 2009**	Phosphorus and other trophic state parameters: Summer average, upper waters, South Deep (per NYSDEC guidance). 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 • Use lake model to project compliance under critical conditions 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: on hold*	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.

- 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 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: The most significant change to the County's monitoring efforts is the addition of 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 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 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. Appendix D of the ACJ is abstracted below.

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 A5-3. 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 A5-4, which is subdivided into these sections:

A. Onondaga Lake Chemical/Water Quality Monitoring Program
B. Onondaga Lake Physical Parameters
C. Onondaga Lake Chlorophyll-a, Phaeophytin-a, Phytoplankton, Zooplankton, Macrophytes and Littoral Macroinvertebrates.
D. Onondaga Lake Fisheries Program
E. Tributary Program Summary
F. Seneca River Program Summary

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. Events-based schedule.
2. High flow monitoring to partition point and nonpoint sources of phosphorus to the Lake (minimum of 5 days).
3. Collect storm event data upstream and downstream of CSO discharges to Onondaga Creek, Harbor Brook and Ley Creek.
4. Assess compliance with water quality standards in Onondaga Cr, Harbor Br, and Ley Cr.
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.

III. Onondaga Lake Monitoring Program

1. Assess compliance with ambient water quality standards including bacterial concentrations 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 sharing protocols with NYSDEC for County to track contaminants in fish flesh.
7. Acquire and track data by others regarding nature of littoral (shallow area) 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 A5-3. 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 Onondaga 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	Stream mapping using NRCS Visual Stream Assessment Protocol in CSO-subwatersheds (Periodic): Onondaga, Ley and Harbor Brook. Baseline, 2000 and 2002; post-improvements scheduled for 2008 and 2012; note: may be modified based on CSO construction schedule or major hydrologic event Macroinvertebrate surveys (Periodic): CSO-affected subwatersheds every 2 years, even years.	Quantify baseline conditions and provide basis to measure change. Calculate standard indices (using NYSDEC protocols) that use numbers and types of benthic macroinvertebrates to indicate status of water quality and habitat conditions. Test for improvement 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 listed in TOGS 1.1.1 Calibrate and verify models

Table A5-3. Elements of the AMP in relation to ACJ-Required Monitoring Objectives. (continued)

ACJ Statement of Required Program Objective	Ambient Monitoring Program Elements	Data Used To
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 conditions in relation to inputs and trends Calibrate USGS watershed model of land use and nutrient export (using AMP tributary data) Construct conceptual model and mass-balance model Calculate "fish space metrics" to track changes in available habitat for cold water, cool water and warm water fish Develop and calibrate Onondaga Lake model
Through interaction with NYSDEC and appropriate peer reviewers, 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 (begun in 2005)
Define ambient water quality conditions in the Seneca River between Cross Lake and the Three Rivers junction.	Annual surveys during low flow conditions at Seneca River Buoy 316.	Assess current conditions, provide data for model verification Assess compliance with ambient water quality standards

Table A5-3. Elements of the AMP in relation to ACJ-Required Monitoring Objectives. (continued)

ACJ Statement of Required Program Objective	Ambient Monitoring Program Elements	Data Used To
Evaluate and quantify the assimilative capacity of the Seneca River and quantify effects of zebra mussels. Quantitative Environmental Analysis, LLC. *Final Phase 2 Report Three Rivers Water Quality Model.* Prepared for: Onondaga County Department of Water Environment Protection Syracuse, NY, Onondaga Lake Cleanup Corp., Syracuse, NY. Job Number: ONOsen: 227. August 2005.	River modeling work group and peer review (Annual program) Surveys during low flow conditions in the fall (depends on hydrologic conditions)	Assess current conditions, data set for model verification
	Periodic zebra mussel assessment (surveys completed in spring and summer 2007)	Support TRWQM model of assimilative capacity of River, including zebra mussel activity. Domain is Cross Lake to Phoenix Dam. Assess current conditions, compile data for model verification

Table A5-4. Detailed Reporting of AMP Program, Data Analysis and Interpretation Strategy.

A. Onondaga Lake Chemical/Water Quality Monitoring Program

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[1] composite LWL composite	South Deep: Biweekly (Apr-Dec) and monthly in winter, as conditions allow North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Wildco Beta horizontal sampler/ Churn
Bacteria Fecal Coliform, E. Coli	• Abundance of indicator organisms • Percent of measurements meeting swimming standards	• Potential presence of pathogens • Compliance with standards • Use attainment. • Trend analysis • Effectiveness of CSO control measures. • Model support	South Deep North Deep Nearshore sites	0m	South Deep: Biweekly (Oct 15-March) and 5 samples/month (April 1-October 15) North Deep: Quarterly Weekly (Feb-Mar) ("winter lake") Nearshore: 5 samples/month (April 1-October 15)	Grab sample into sterile bottle

1 UML and LWL composite samples are based on the thermocline depth determined through the field profile (temperature, pH, dissolved oxygen, and specific conductance). Two periods are defined as default conditions that vary depending on the lake's annual stratification and mixing: October 1 – May 31, (not strongly stratified) and June 1 – Sept 30 (strongly stratified). During the October 1 – May 31 period, default UML includes the 0, 3 and 6 m depths; default LWL includes the 9, 12, 15 and 18 m depths. During the June 1 – September 30 period, default UML includes 0 and 3 m depths (always); 6 m may be excluded based on field conditions. The LWL during the summer period typically includes 12, 15, and 18 m; 9m is excluded as it is consistently in the metalimnion. Occasionally, the thermal structure during summer leads the field team to exclude the 12 m depth as well.

Table A5-4. Detailed Reporting of AMP Program. (continued)

A. Onondaga Lake Chemical/Water Quality Monitoring Program (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
BOD-5	Concentration	• Indicator of oxygen-demanding material • Model support • Trends	South Deep North Deep	UML composite LWL composite	South Deep: Biweekly (Apr-Dec) and monthly in winter, as conditions allow North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Wildco Beta horizontal sampler/ Churn
Carbon: TOC, TOC-F, 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) and monthly in winter, as conditions allow North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Submersible Pump
Mercury: Total and Methyl Mercury (low-level)	Concentration	• Compliance • Trends	South Deep North Deep	3m & 18m	April, June, August, October	Teflon Dunker Modified USEPA Method 1669
Metals: Cd, Cr, Cu, Ni, Pb, Zn, As, K	Concentration	• Compliance • Charge balance computations (K)	South Deep North Deep	UML composite LWL composite	Quarterly	Wildco Beta horizontal sampler/ Churn

Table A5-4. Detailed Reporting of AMP Program. (continued)

A. Onondaga Lake Chemical/Water Quality Monitoring Program (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Metals/Salts: Ca, Na, Mg, Mn, Fe, Cl, SO_4	Concentration	• Charge Balance (data quality) • Trends • Geochemical Analysis • Electrochemical (redox) • Density stratification • Phytoplankton community structure	South Deep North Deep	UML composite LWL composite	<u>South Deep</u>: Biweekly (Apr-Dec) and monthly in winter, as conditions allow <u>North Deep</u>: Quarterly Weekly (Feb-Mar) ("winter lake")	Wildco Beta horizontal sampler/ Churn
Nitrogen: NO_3, NO_2	• Concentration • Compliance with NYS standard (100 ug/l Nitrite in upper waters for warmwater fishery)	• Compliance with AWQS[2]. • Measure in-lake nitrification and nitrogen cycling • Use attainment (warm water fishery)	South Deep North Deep	UML composite LWL composite	<u>South Deep</u>: Biweekly (Apr-Dec) and monthly in winter, as conditions allow <u>North Deep</u>: Quarterly Weekly (Feb-Mar) ("winter lake")	Wildco Beta horizontal sampler/ Churn

[2] AWQS – Ambient Water Quality Standard

Table A5-4. Detailed Reporting of AMP Program. (continued)

A. Onondaga Lake Chemical/Water Quality Monitoring Program (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Nitrogen: TKN, NH3-N, Org-N, TKN-Filtered	Concentration	• Compliance with standards • Measure in-lake nitrification, nitrogen cycling • Compute N:P ratios • Habitat for biota • Trend analysis • TMDL. Analysis • Model support	South Deep North Deep	Discrete Depths (0m, 3m, 6m, 9m, 12m, 15m, 18m)	South Deep: Biweekly (Apr-Dec) and monthly in winter, as conditions allow North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Submersible Pump
Phosphorus**:** TP, SRP, TDP	Concentration	• Trophic status • Trends • Compliance with NYS guidance value of 20 µg/l summer average, upper waters guidance value (support for site-specific analysis) • 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 (NYS guidance value)	South Deep: Biweekly (Apr-Dec) and monthly in winter, as conditions allow North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Submersible Pump

Table A5-4 Detailed Reporting of AMP Program. (continued)

A. Onondaga Lake Chemical/Water Quality Monitoring Program (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Silica	Concentration	Trophic levels interaction (potential for silica to limit diatom production)	South Deep North Deep	Discrete depths (0m, 6m, 12m, 18m)	South Deep: Biweekly (Apr-Dec) and monthly in winter, as conditions allow North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Submersible Pump
Solids: TS, TSS, TDS	Concentration	• Compliance • Trend analysis • Chemical stratification • Correlation with turbidity (water clarity)	South Deep North Deep	Discrete depths (0m, 6m, 12m, 18m)	South Deep: Biweekly (Apr-Dec) North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Submersible Pump
Sulfides	Concentration	• Anoxia • Model support (diagenesis)	South Deep North Deep	Discrete depths (12m, 15m, 18m)	Only when anoxic conditions are present South Deep: Biweekly North Deep: Quarterly	Wildo Beta horizontal sampler

Table A5-4 Detailed Reporting of AMP Program. (continued)

B. Onondaga Lake Physical Parameters

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Turbidity	Light scattering (NTU)	• Trend analysis • Correlation with other indices affecting water clarity	South Deep	Discrete depths (2m, 6m)	Daily at 15 minute intervals (Apr-Dec)	YSI Buoy
			South Deep North Deep	South Deep: UML composite Discrete depth (0m) North Deep: UML composite	South Deep UML: Biweekly (Apr-Dec) and monthly in winter, as conditions allow South Deep 0m: Weekly May-Sept North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	Wildco Beta horizontal sampler/ Churn

Table A5-4. Detailed Reporting of AMP Program. (continued)

B. Onondaga Lake Physical Parameters (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Field data: pH, Temperature, Salinity, Conductivity, Dissolved Oxygen, ORP	• Volume-days of Anoxia • Rate of depletion from LWL • DO during fall mixing • Volume-days of hypoxia • 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) and monthly in winter, as conditions allow North Deep: Quarterly Weekly (Feb-Mar) ("winter lake")	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

Table A5-4. Detailed Reporting of AMP Program. (continued)

B. Onondaga Lake Physical Parameters (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Secchi Disk Transparency	• Average Secchi, percent of measurements meeting 1.2 m (nearshore), 1.5 m (South Deep)	• Secchi disk transparency: Compliance with NYSDOH[3] guidance value for bathing beaches (1.2 m or 4 ft). • Trends • Trophic Status • Indicator of water clarity • Aesthetics (1.5 m or 5 ft) • 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 Weekly (Feb-Mar) ("winter lake") Nearshore: Weekly (May–Sep)	Secchi Disk
LiCor Underwater Illumination Profile	• Extinction coefficient	• Trends • Trophic Status • Indicator of water clarity • Aesthetics (1.5 m or 5 ft) • Use attainment	South Deep North Deep	From lake surface to depth at which light is 1% of surface illumination	Biweekly (Apr-Dec)	LiCor Datalogger

[3] NYSDOH – New York State Department of Health

Table A5-4. Detailed Reporting of AMP Program. (continued)

C. Onondaga Lake chlorophyll-a, phaeophytin-a, phytoplankton, zooplankton, macrophytes, and littoral macroinvertebrates

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Chlorophyll-*a* & Phaeophytin-*a*	• Concentration • Magnitude and frequency of bloom conditions	• Use attainment. • Aesthetic quality • Site-specific guidance • Assess trophic status and algal productivity. • Trends • Compare to phytoplankton and zooplankton. • Evaluate variability. • Lake model calibration and validation	South Deep North Deep	UML composite and Photic Zone[4]	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)

4 The Photic Zone is defined as two times the Secchi disk transparency depth measured the day of sampling.

Table A5-4. Detailed Reporting of AMP Program. (continued)

C. Onondaga Lake chlorophyll-a, phaeophytin-a, plankton, macrophytes, and littoral macroinvertebrates (continued)

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) and monthly in winter, as conditions allow 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	-	Annual	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 A5-4. Detailed Reporting of AMP Program. (continued)

C. Onondaga Lake chlorophyll-a, phaeophytin-a, plankton, macrophytes, and littoral macroinvertebrates (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Littoral macroinverte-brates	Lakewide and by strata: • NYSDEC indices • Percent oligochaetes and chironomids • Species richness	Change from baseline conditions, lakewide and by strata	18 samples, in 5 strata (90 total)	From shoreline to 1.5 m depth	2000, 2005, 2010 (June surveys)	Field surveys

Table A5-4. Detailed Reporting of AMP Program. (continued)

D. Onondaga Lake Fisheries Program

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
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 entire littoral zone (along depth contour)
Pelagic Larvae	• Species identification • Length frequency	• Community Structure • Growth rate, compared to regional lakes and to historical Onondaga Lake data • Condition factor • Species Richness • Pollution tolerance	South basin North basin	5.5 meter double oblique tow	Biweekly (April-August)	Miller Trawl

Table A5-4. Detailed Reporting of AMP Program. (continued)

D. Onondaga Lake Fisheries Program (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Littoral Juvenile	• Number and species of juveniles captured • Catch per unit effort	• Community Structure • Size/length distribution • Species Richness • Evidence of recruitment • Pollution tolerance	15 sites lakewide	~ 1m	Every three weeks (July-October)	¼" mesh bag seine sweep
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, October	Night Electrofishing Angler diary program
Pelagic Adults	• Number and species captured • Catch per unit effort	• Community Structure • Size/length distribution • Species Richness • Evidence of recruitment • Pollution tolerance	5 sites (1 per station)	4-5 m water (2 hour set)	May, October	Littoral - Profundal Gill Nets Experimental: hydro-acoustics Angler diary program

Table A5-4. Detailed Reporting of AMP Program. (continued)

D. Onondaga Lake Fisheries Program (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Deformities, Erosions, Lesions, Tumors, Fungal and Multiple Anomalies (DELT-FM)	Number and types of anomalies	Change over time (trend)	Lakewide	All (most are adults captured by electrofishing)	Screening on all captured fish	Visual analysis by trained field teams

Table A5-4. Detailed Reporting of AMP Program. (continued)

E. 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; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Bacteria: Fecal Coliform	Abundance	• Potential presence of pathogens • Trends • Effectiveness of CSO control measures	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques

Table A5-4. Detailed Reporting of AMP Program. (continued)

E. Tributary Program Summary (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
BOD-5	Concentration	• Load • Indicator of oxygen-demanding material	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Wildco Beta horizontal sampler/churn
Carbon: TOC, TOC-F, TIC	Concentration	• Trends • Trophic status • Oxygen demand • Load	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Cyanide	Concentration	Compliance	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Quarterly High flow events as occur	Depth Integrated Sampling Techniques

Table A5-4. Detailed Reporting of AMP Program. (continued)

E. Tributary Program Summary (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
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; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only Spencer location monitored for K only	Quarterly High flow events as occur	Depth Integrated Sampling Techniques
Metals/Salts: Ca, Na, Mg, Mn, Fe, Cl, SO4, SiO2	Concentration	• Compliance (if AWQS) • Load • Data quality (major ions used in charge balance) • Geochemical analysis	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only Spencer location monitored for Ca, Na, Mg, Cl, TALK and SO_4	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Nitrogen: TKN, NH_3-N, Org-N, TKN-Filtered	Concentration	• Trends • Support TMDL • Load	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Nitrogen: NO_3, NO_2	Concentration	• Compliance with AWQS • Load • Trends	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques

Table A5-4. Detailed Reporting of AMP Program. (continued)

E. Tributary Program Summary (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
Phosphorus: TP, SRP, TDP	Concentration	• Trends • Support TMDL • Load • Bioavailability	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Solids: TSS, TDS	Concentration	Compliance with AWQS	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Turbidity	Concentration	Transport dynamics	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	Depth Integrated Sampling Techniques
Field data: pH, Temperature, Salinity, Specific conductance, Redox potential, dissolved oxygen	Average, maximum and minimum values	• Compliance • Model support • Trend analysis. • Use attainment.(habitat) • pH indicator of CO2 production and decomposition.	Routine: Ninemile; Hiawatha; Velasko; Kirkpatrick; Dorwin; Adams; Ley; Trib5A; Metro; EF; Outlet; Bloody Brook (2 sites): 2009 Sawmill Creek: high flows only	Biweekly (January-December) High flow events as occur	

Table A5-4. Detailed Reporting of AMP Program. (continued)

E. Tributary Program Summary (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Frequency Sampling Interval	Method
Stream benthic Macroinvertebrates (BMI) & Stream Characteristics	• NYSDEC water quality Index • NRCS Visual Stream Assessment Protocol	Change from baseline conditions	4 sites in Onondaga Creek 3 sites in Ley Creek 3 sites in Harbor Brook	BMI: every other year, from 1998 – 2012 Stream mapping: assessment completed in 2000, 2002, 2008, planned for 2012	Various methods, most BMI collected using kick screens

Table A5-4. Detailed Reporting of AMP Program. (continued)

F. 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 • Model support	16 sites (Seneca, Oneida & Oswego Rivers)	1 meter below water surface 1 meter above the river sediments	Monthly (July – September)	Wildco Beta horizontal sampler
Carbon: TOC, TDC	Concentration	• Trends • Trophic status • Indicator of oxygen-demanding material • Model support	16 sites (Seneca, Oneida & Oswego Rivers)	1 meter below water surface 1 meter above the river sediments	Monthly (July – September)	Wildco Beta horizontal sampler Tube sampler "Depth Integrated Tube samples"
Chlorophyll-*a*	Concentration	• Trophic status • Trends • Model support	16 sites (Seneca, Oneida & Oswego Rivers)	Through the water column. Tube composite through the photic zone and a grab at 1-meter above the river sediments.	Monthly (July – September)	

Table A5-4. Detailed Reporting of AMP Program. (continued)

F. Seneca River Program Summary (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Metals/Salts: Cl	Concentration	• Trends • Geochemical analysis • Model support	16 sites (Seneca, Oneida & Oswego Rivers)	1 meter below water surface 1 meter above the river sediments	Monthly (July – September)	Wildco Beta horizontal sampler
Nitrogen: TKN, NH3-N, TKN-Filtered, NO3, NO2	Concentration	• Compliance • N dynamics • N:P ratios • Trends • Model support	16 sites (Seneca, Oneida & Oswego Rivers)	1 meter below water surface 1 meter above the river sediments	Monthly (July – September)	Wildco Beta horizontal sampler
Phosphorus: TP, SRP, TDP	Concentration	• Trophic status and algal productivity • Trends • Model support	16 sites (Seneca, Oneida & Oswego Rivers)	1 meter below water surface 1 meter above the river sediments	Monthly (July – September)	Wildco Beta horizontal sampler
Solids: TSS, VSS	Concentration	• Trends • Model support • Indicator of water clarity	16 sites (Seneca, Oneida & Oswego Rivers)	1 meter below water surface 1 meter above the river sediments	Monthly (July –September)	Wildco Beta horizontal sampler

Table A5-4. Detailed Reporting of AMP Program. (continued)

F. Seneca River Program Summary (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Turbidity	Light scattering (NTU)	• Trends • Model support • Indicator of water clarity	16 sites (Seneca, Oneida & Oswego Rivers)	1 meter below water surface 1 meter above the river sediments	Monthly (July – September)	Wildco Beta horizontal sampler
			Buoy 316 (Seneca River)	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	16 sites (Seneca, Oneida & Oswego Rivers)	0.5 m increments	Monthly (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

Table A5-4. Detailed Reporting of AMP Program. (continued)

F. Seneca River Program Summary (continued)

Parameter	Data Analysis and Reporting	Data Interpretation Strategy	Sites	Depths	Frequency Sampling Interval	Method
Secchi Disk Transparency		• Model support • Indicator of water clarity • Use attainment	16 sites (Seneca, Oneida & Oswego Rivers)	Depth at which the disk is no longer visible from the surface		Secchi Disk
LiCor Underwater Illumination Profile		• Trends • Model support • Indicator of water clarity	16 sites (Seneca, Oneida & Oswego Rivers)	Licor data – 20 cm intervals from river surface to depth at which light is 1% of surface illumination	Monthly (July – September) & with diurnal cycles	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. There is 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. (Appendix 10)

- 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 will be examined through the Onondaga Lake modeling project, which began in 2005.

3.4. 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 A5-5. 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 A5-5. 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 Monitoring 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 A5-5. Summary of Hypotheses Underlying the AMP. (continued)

Monitoring Parameter	Hypothesis	Type of Hypothesis: Compliance with SPDES permit	Type of Hypothesis: Compliance with AWQS or guidance value	Type of Hypothesis: Significant Trend or Shift in Monitoring Data	Data Used for Assessment
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 measurements through water column 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 measurements through water column 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 measurements through water column and high-frequency measurements at buoy at South Deep station

Table A5-5. 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	
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 (load as a function of total precipitation, and total storm flow)
	Implementation of Stage I and II improvements to the wastewater collection and treatment system (including CSO projects) and progress with stormwater management will reduce concentration of indicator organisms in Onondaga Lake	*	*	*	Indicator bacteria abundance at nearshore stations during summer and following storms. Annual average concentration at South Deep, 0m depth
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.

Table A5-5. 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	
Phytoplankton community	Metro improvements and watershed phosphorus load reductions result in lower biomass of phytoplankton in Onondaga Lake			*	Biweekly samples of UML phytoplankton community, numbers, size and identifications (PhycoTech)
	Metro improvements and watershed phosphorus 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)
Macroalgae	Metro improvements and watershed phosphorus load reductions result in reduced areal coverage of macroalgae in nearshore areas of Onondaga Lake			*	Weekly surveys during recreational period (June –Sept) at nine nearshore stations.

Table A5-5. 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 Monitoring Data	
Macrophytes	Metro improvements and watershed phosphorus load reductions indirectly result in increased areal coverage of macrophytes in the littoral zone of Onondaga Lake			*	Percent cover, biomass, and maximum depth of growth. Surveys: 2000, 2005, 2010 plus annual aerial photo evaluation (% cover)
	Metro improvements and watershed phosphorus load reductions indirectly result in increased number of macrophyte species in Onondaga Lake			*	Macrophyte species richness Detailed surveys: 2000, 2005, 2010
Littoral macroinvertebrates *Note: effects may be in strata 2, 3, and 4*	Implementation of load reductions at Metro and CSO remediation will increase species richness of littoral benthic macroinvertebrates			*	Littoral macroinvertebrate species richness. Detailed surveys: 2000, 2005, 2010
	Implementation of load reductions at Metro and CSO remediation will decrease the relative abundance of oligochaetes			*	Littoral macroinvertebrate dominance, percent oligochaetes. Detailed surveys: 2000, 2005, 2010

Table A5-5. 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 Monitoring Data**	
Littoral macroinvertebrates (continued) *Note: effects may be in strata 2, 3, and 4*	Implementation of load reductions at Metro and CSO remediation will improve the NYSDEC Biological Assessment Profile as compared to baseline conditions.			*	NYSDEC calculated index Detailed surveys: 2000, 2005, 2010
	Implementation of load reductions at Metro and CSO remediation will improve the littoral macroinvertebrate HBI as compared to baseline conditions, indicating increased importance of pollution-sensitive organisms in the community			*	Hilsenhoff Biotic Index (HBI) Detailed surveys: 2000, 2005, 2010

Table A5-5. 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			*	<u>Annual monitoring program:</u> 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 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

3.5. 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.

3.6. 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 towards compliance with applicable standards and guidelines, and progress towards 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 A5-6. Note that the metrics are grouped into categories that address 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 A5-6. 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)
	Macroalgae proliferation	Percent cover of littoral zone, measured at nine nearshore stations June 1 – August 31 annually
Aquatic Life Protection	Ammonia N	Percent of measurements in compliance with standards.
	Nitrite N	Percent of measurements in compliance with standards.
	Dissolved Oxygen	DO at fall mixing.
		Duration of DO concentrations < 4 mg/l (data source: measurements at 15-minute intervals from probe on buoy)
	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[5]	Nesting surveys, larval sampling (Miller tows), 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).

[5] 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. 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 2012.

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 A5-2:

Stratum 1. Oncolite substrate with low wave energy (NW portion of the lake).

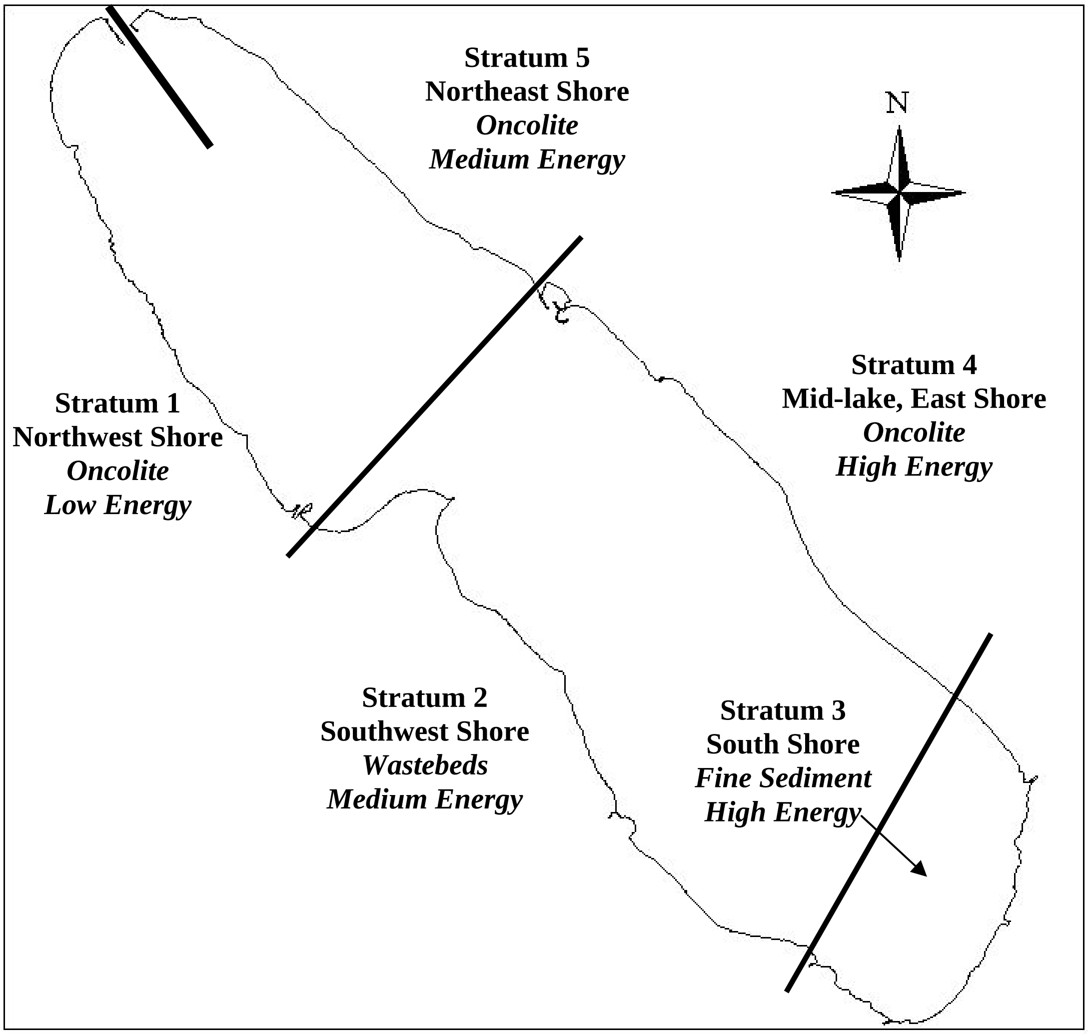
Stratum 2. Wastebed substrate with moderate wave energy (SW shore)

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)

The current schedule for biological monitoring through the 15-year AMP program is summarized in Table A5-7. This schedule may change as completion dates for CSO projects become firm or new issues arise. This table will be updated with subsequent revisions of the DAIP.



Strata Boundaries

Figure A5-2. Map of Onondaga Lake showing boundaries of five sampling strata based on a combination of sediment texture and wave energy.

Table A5-7. Summary of Schedule and Methodologies Used for the Biological Monitoring Program *(Subject to annual NYSDEC review and approval; last updated March 2005)*

Program	Component	Methods	Schedule	Comments
Fish	Adult	Littoral Electrofishing	Annual	Entire lake shoreline, transects alternate between collecting all fish encountered and gamefish only, 2 surveys; May, Sept.
		Littoral-profundal Gill Nets	Annual	One net each stratum, set on bottom at 5m depth, 2 events; May, Sept.
		Angler Diaries	Annual	Dependant on number of diaries returned
	Young-of-the-Year	Littoral Seines	Annual	15 sites, three sites per stratum, every 3 weeks, May-Oct, 8 events total
	Larvae	Pelagic Miller High Speed Trawls	Annual	Daytime samples, 4 transects N/S, oblique tows, ~surface to 5m depth, bi-weekly, May-Aug., 8 events total
	Nests	Visual Observation	Annual	Entire Shoreline, June
Macroinvertebrates	Lake Littoral Zone	Petite Ponar	2000 2005 2010	Five sites, one in each stratum, June, 18 replicates, identified to species level
	Tributary	Kick Net and Jab Net	Bi-annual	Four sites in Onondaga Creek, three sites in Ley Creek and Harbor Brook, July samples, 4 replicates, identified to species level
	As part of Tributary Mapping	Kick Net	2000 2008 2012	One site per mile of stream, 26 sites in Onondaga Creek, 9 in Ley Creek, 7 in Harbor Brook, one sample per site, identified to family level in the field
Macrophytes	Field Survey	Quadrats along Line Transects	2000 2005 2010	20 line transects, four per stratum, $1/2m^2$, quadrats spaced every other m along the transect, from shore to 6m depth, species presence, percent coverage and biomass, August
	Lakewide Survey of Cover	Aerial Survey	Annual (if water clarity permits)	Low altitude aerial photographs of entire lake, color film, digital images. Includes ground-truthing. Images are imported to GIS and areas of macrophyte growth delineated.

Table A5-7. Summary of Schedule and Methodologies Used for the Biological Monitoring Program. (continued)

Program	Component	Methods	Schedule	Comments
Zooplankton	Lake	Vertical Net Haul	Annual	Bi-weekly at South Deep, April to Nov., Quarterly at North Deep, UML sample plus 15m vertical net haul. Winter sampling if possible.
Phytoplankton	Lake	Tygon tube	Annual	Bi-weekly at South Deep, April to Nov., Quarterly at North Deep, UML sample. Monthly in winter, as conditions allow

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 A5-8).

- 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.

- Associated with nuisance conditions. Some species can be considered to be a nuisance to humans. Some of these are directly perceptible, such as blue-green algal blooms, others become apparent to lake users through indirect effects in the food web. For example, the recent dramatic increase in the fish species alewife (Alosa pseudoharengus) has reduced the population of large-sized zooplankton (their preferred food source) in the lake; this reduction in large-sized zooplankton decreased the effective grazing pressure on algae. As a result, water clarity 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 A5-8. 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). These investigators compiled data from 169 lakes to develop an overall rating based on tolerance to eutrophication, turbidity, human activity in the watershed and species introductions. Their tolerance categories include: intolerant, moderately intolerant, moderate, moderately tolerant, and tolerant.
		Indicator Species	Indicator species are those that can be used to assess environmental condition. Presence of organisms known to be tolerant or sensitive to environmental degradation offer important information. Adult fish as indicator species are most useful if populations exist and are less useful if only a few individuals are encountered.
	Young-of-the-Year	Indicator Species	Young-of-the-year organisms are excellent indicators of environmental change, as the early life history stages are usually most susceptible to disturbance and pollution.
Macroinvertebrates	Lake Littoral Zone & Tributary	NYSDEC Biological Assessment Profiles	NYSDEC Biological Assessment Profiles are an Index of Biotic Integrity developed specifically for macroinvertebrates in New York State. An overall assessment of water quality for each site is calculated by averaging results of four individual metrics obtained through a scaled ranking of the index values. After all index values for a site are converted to a common scale value, they are averaged to obtain a score denoting overall assessment of water quality. The score results in a designation of one of four categories: non-impacted, slightly impacted, moderately impacted, or severely impacted.
		HBI	The Hilsenhoff Biotic Index (HBI) is considered by many investigators to be the most reliable index of composition of the macroinvertebrate community and water quality status (Novak and Bode 1992). HBI indicates the effects of organic pollution and is based on species-specific tolerance levels.
		Percent Oligochaetes	As oligochaetes are often found in high relative proportions in areas impaired by organic enrichment, their percent contribution to the community can be a good measure of the relative amount of organic enrichment at different locations. More importantly, the change in the percent contribution of oligochaetes over time, will be a good measure of the change in organic enrichment at the study sites.

Table A5-8. Summary of Pollution Tolerance Metrics Used for the Biological Monitoring Program. (continued)

Program	Component	Pollution Tolerance Metric	Comments
Macroinvertebrates (continued)	As part of Tributary Mapping	FBI	The Family Level Index (FBI) is based upon the tolerance values and theories the HBI but is conducted in the field with family level identifications.
Macrophytes	Field Survey	Indicator Species	Determination of environmental impact based on macrophytes is difficult. However some species have known tolerances to water quality variables. For example *Potamogeton pectinatus* (a species that has been common in Onondaga Lake since at least the early 1990's) 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 periodic 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.

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, are under development.

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.

A conceptual model of the phosphorus, nitrogen, and dissolved oxygen dynamics in Onondaga Lake was drafted by QEA, LLC and first presented in the Onondaga County 2001 Annual AMP report. Figures from the 2001 AMP Annual Report are included below:

- Figure A5-3 is the phosphorus cycle
- Figure A5-4 is the nitrogen cycle
- Figure A5-5 is the dissolved oxygen (DO) cycle.

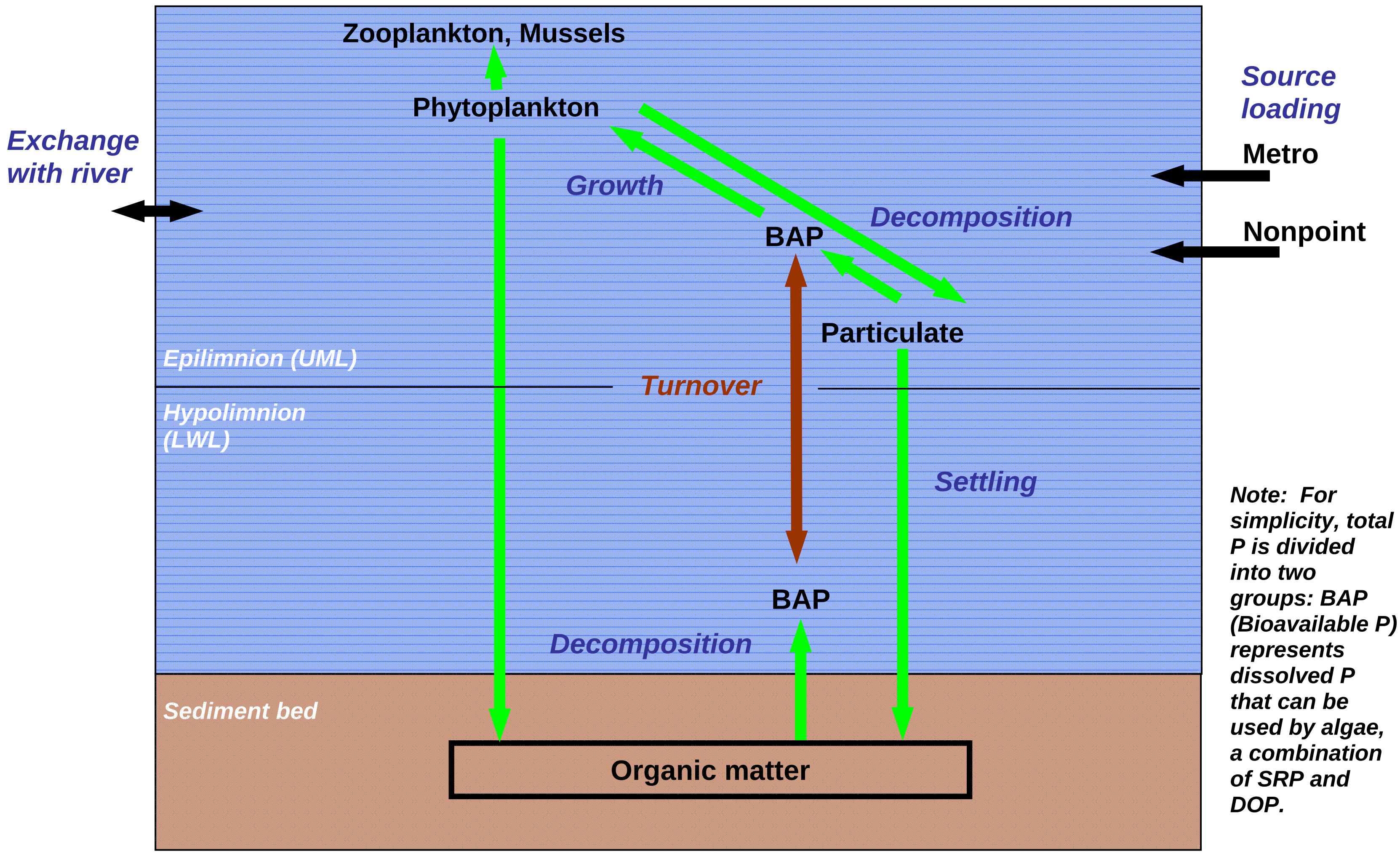


Figure A5-3. Conceptual model of phosphorus dynamics in Onondaga Lake under present conditions. Seasonal importance of primary pathways indicated by colors: Summer, Fall.

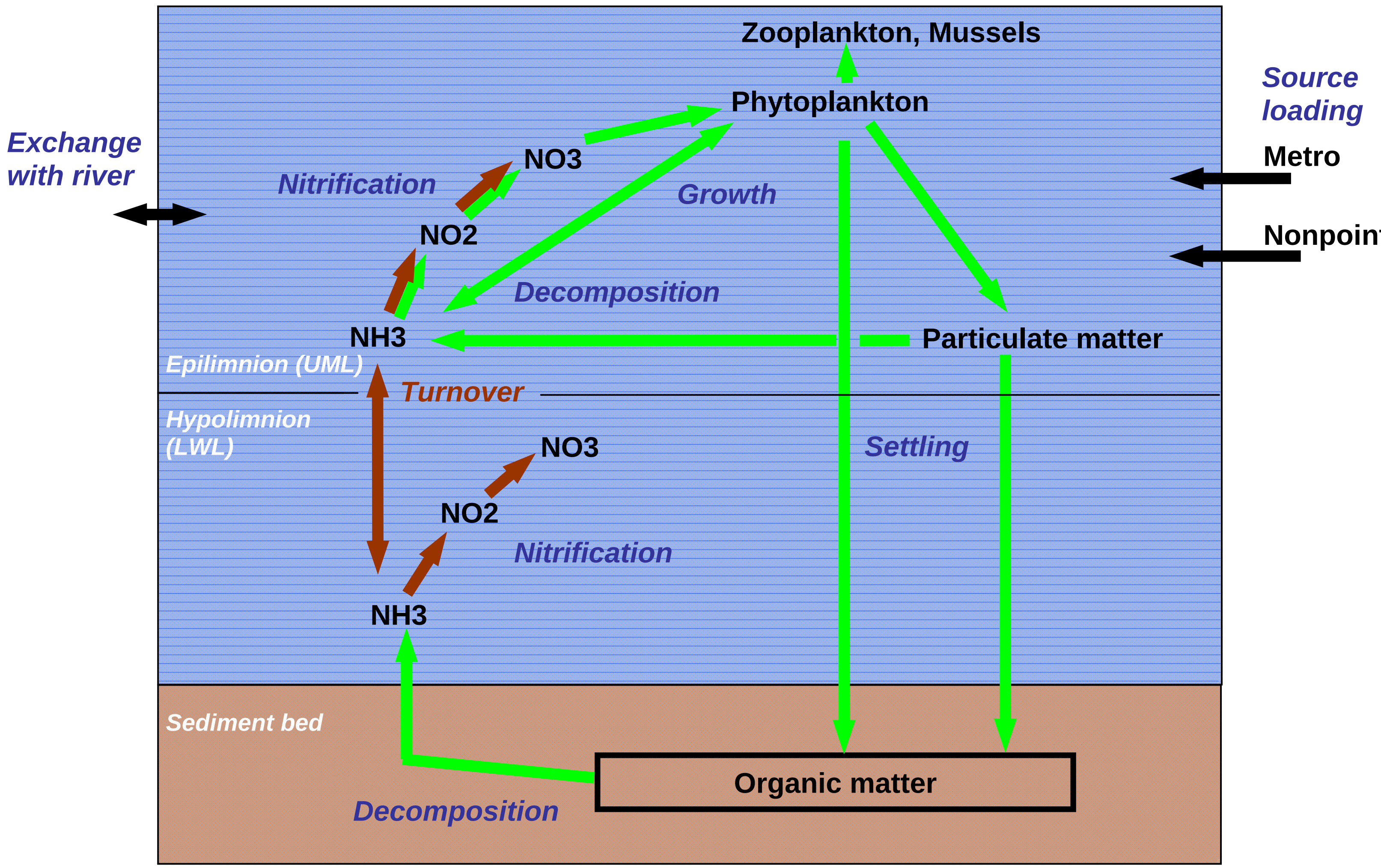


Figure A5-4. Conceptual model of nitrogen dynamics in Onondaga Lake under present conditions. Seasonal importance of primary pathways indicated by colors: Summer, Fall.

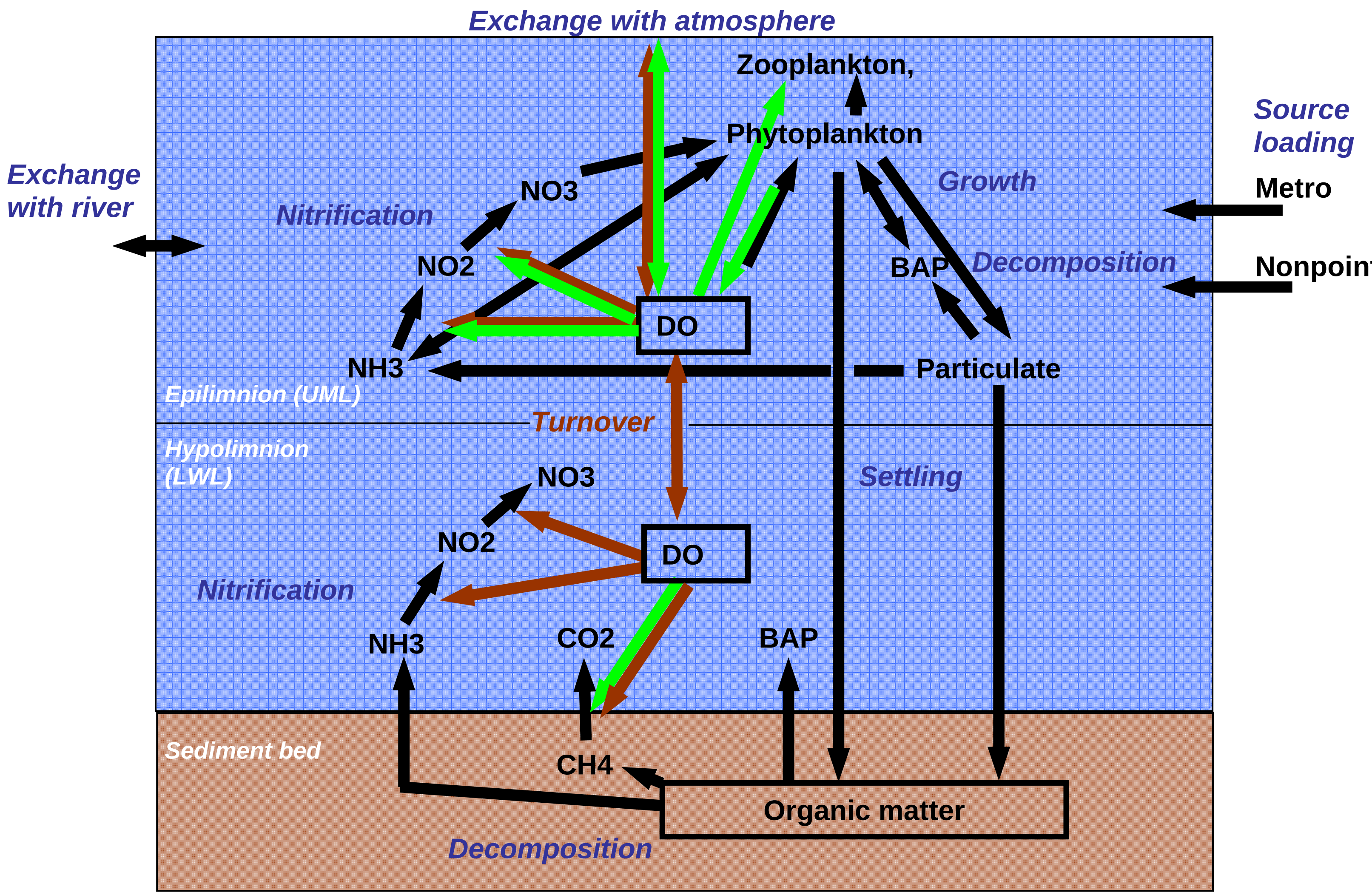


Figure A5-5. Conceptual model of dissolved oxygen dynamics in Onondaga Lake under present conditions. Seasonal importance of primary pathways indicated by colors: Summer, Fall.

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:

1. Estimating the magnitude and precision of loads from each source;
2. Assessing long-term trends in load and inflow concentration from each source and source category (point, nonpoint, total);
3. Evaluating the adequacy of the monitoring program, based on the precision of loads computed from concentration and flow data;
4. 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;
5. Developing simple input/output models for other constituents; and
6. 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 ammonia and phosphorus inputs to Onondaga Lake on or about January 1, 2009. The TMDL will define the total loading of ammonia and 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 ammonia and phosphorus.

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 are the basis for model calibration.

5.5. Three Rivers Water Quality Model (TRWQM)

A water quality model of the Three Rivers system was developed by 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 Model

Onondaga County has completed a Request for Proposals and selection process for development of a water quality/eutrophication model of Onondaga Lake. QEA, LLC will complete the lake model that will be used for the NYSDEC TMDL allocation and final effluent limits. This water quality model will link the watershed model and the TRWQM. The model will be developed using data from the AMP and will be the primary means of determining the level of treatment and location of the Metro discharge. Model development will be a collaborative effort that includes Onondaga Lake Partnership as well as expert peer reviewers. While the primary focus is on water quality, the model will incorporate biological influences on the lake ecosystem. The overall goal will be 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).

6. LITERATURE CITED

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