LITERATURE CITED

Belgrade, Town of. 1987. Comprehensive Land Use Plan. Town Office of Belgrade. February 2, 1987.

Brian, K. 1998. Maine Shoreland Zoning; A Handbook for Shoreland Owners. Kent Associates, Gardiner Maine.

Boyd, Claude E. 2000. Water Quality: An Introduction. Boston: Kluwer Academic Publishers. 330pp.

Bunce, N. J. 1990. Environmental Chemistry. Wuerz Publishing Limited. Winnipeg, Canada. 327 pp.

Carlson, R.E. and J. Simpson. 1996. A Coordinator's Guide to Volunteer Lake Monitoring Methods. North American Lake Management Society.

CEAT. 1995. Land Use Patterns in Relation to Lake Water Quality in the Long Pond Watershed. Department of Biology, Colby College, Waterville, ME.

CEAT. 2005. A Watershed Analysis of Togus Pond: Implications for Water Quality and Land Use Management. Department of Biology, Colby College, Waterville, ME.

CEAT. 2006. A Watershed Analysis of China Lake: Implications for Water Quality and Land Use Management. Department of Biology, Colby College, Waterville, ME.

Chapman, D. (ed.) .1996. Water Quality Assessments: A Guide to the Use of Biota, Sediments, and Water in Environmental Monitoring (2nd edd.) E and FN Spon, London, England. 626 pp.

Cole, Gerald A. Textbook of Limnology. Saint Louis: The C.V. Mosby Co., 1975.

Cooke, G. D., E. B. Welch, S. A. Peterson, P. R. Newroth, Restoration and Management of Lakes and Reservoirs, 2nd Edition. Boca Raton, FL. Lewis Publishers, 1993. pp. 166.

Davis, R. B., J. H. Bailey, M. Scott, G. Hunt, S. A. Norton. 1978. Descriptive and comparative studies of Maine lakes. Life Sciences and Agriculture Experiment Station. NTIS. Technical Bulletin 88. 337 pp.

Dennis, J. 1986. Phosphorus export from a low density residential watershed and an adjacent forested watershed. Maine Department of Environmental Protection.

Dreher, D. and M. Murphy. 1996. Shoreline Buffer Strips. Illinois Environmental Protection Agency, Springfield, Illinois. Accessed 9-27-2006 from http://www.epa.state.il.us/water/conservation-2000/lake-notes/shoreline-buffer-strips/index.html.

EPA. 1990. United States Environmental Protection Agency. Chapter 4: Predicting Lake Water Quality. The Lake and Reservoir Restoration Guidance Manual.

EPA. 2004. Wetlands Overview. United States Environmental Protection Agency. Washington, D.C.http://www.epa.gov/owow/wetlands/pdf/overview.pdf Accessed 10/30/06

EPA 2006a. Macrophytes as Biological Indicators. United States Environmental Protection Agency. Washington, D.C. http://www.epa.gov/bioindicators/html/macrophytes.html Accessed 11/27/2006

EPA. 2006b. Wetlands Definitions. United States Environmental Protection Agency. Washington, D.C.http://www.epa.gov/owow/wetlands/what/definitions.html Accessed 10/30/06

ESRI. 2006. ArcInfo Key Features. ESRI, Redlands, CA. http://www.esri.com/software/arcgis/arcinfo/about/features.html Accessed 11/19/06

Hem, J.D. 1970. Study and Interpretation of the Chemical Characteristics of Natural Water. United States Government, Printing Office,Washington D.C.

Horton, G. 2001. Dictionary of Water Words: A Compilation of Technical Water, Water Quality, Environmental, Natural Resource, and Water-Related Terms. Great Basin Research, Reno, NV.

KCSWCD. 1990. Soil Potential Ratings for Low Density Development in Kennebec County, ME. United States Department of Agriculture, Soil Conservation Service, Kennebec County Soil and Water Conservation District, University of Maine, Orono, ME. 61 pp.

KCSWCD. 2000. Camp Road Maintenance Manual. Kennebec County Soil and Water Conservation District. Augusta, ME.

King, W. D. and D. P. Laliberte. 2005. The Effects of *Gloeotrichia enchinulata* on Great Pond and Long Pond, Maine. Colby College. Waterville, ME.

Mattson, M. D. and R. A. Isaac. 1999. Calibration of phosphorus export coefficients for total maximum daily loads of Massachusetts lakes. *Lake and Reserv. Manage.* 15(3): 209-219.

MDEP. 1998. Maine Shoreland Zoning; A Handbook for Shoreland Owners. Maine Department of Environmental Protection, Augusta, ME.

MDEP. 2003a. Maine Erosion and Sedimentation Control BMP: Vegetated Buffers. Maine Department of Environmental Protection, Augusta, ME.

MDEP. 2003b. Safe Home Program: Household Wastewater. University of Maine, Cooperative Extension. Maine Department of Environmental Protection, Augusta, ME.

MDEP. 2004. Integrated Water Quality Monitoring and Assessment Report. Maine Department of Environmental Protection, Augusta, ME. http://www.maine.gov/dep/blwq/docmonitoring/305b/2004_Final_305b_Section1.pdf. Accessed 11/05/06.

MDEP. 2005. Phosphorous Control Action Plan and Total Maximum Daily (Annual Phosphorous) Load Report: Togus (Worromontogus) Pond Public Draft Review. Maine Department of Environmental Protection, Augusta, ME

MDIFG. 1967. Maine Lakes Volume 5: Kennebec County. Published under appropriation No. 7750.

MDIFW. 2005. 2005 Fish Stocking Report. Maine Department of Inland Fisheries and Wildlife, Sidney, ME. http://www.state.me.us/ifw/fishing/fishstockingreports/2005/index.htm. Accessed 10/30/06.

MDIFW. 2006. Invasive Aquatic Plants. Maine Department of Inland Fisheries and Wildlife, Sidney, ME. http://www.state.me.us/ifw/wildlife/milfoil.htm Accessed 10/30/06.

MEGIS.2006. Maine GIS Data Catalogue. Maine Office of GIS, Augusta, ME. http://www.apollo.ogis.state.me.us/catalog. Accessed 10/12/06.

MGS. 2005. Surficial Geologic History of Maine. Maine Geologic Survey. http://www.maine.gov/doc/nrimc/mgs/explore/surficial/facts/surficial.htm. Accessed 10/29/06.

MPCA (Minnesota Pollution Control Agency). 19 Oct. 2006. “Glossary.” URL: http://www.pca.state.mn.us/gloss/glossary.cfm?alpha=N&header=1&glossaryCat=0 (12 Nov. 2006.).

Morgan, R.P.C. 2005. Soil Erosion and Conservation. Blackwell Science, Ltd., Malden, MA. 304pp.

NOAA. 2006. Annual Climatological Summary. National Oceanographic and Atmospheric Administration. http://cdo.ncdc.noaa.gov/ancsum/ACS. Accessed 10/02/06.

NRCS. 2006. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/app/. Accessed 10/16/2006.

Nürnberg, G. K. 1988. Prediction of phosphorus release rates from total and reductant- soluble phosphorus in anoxic lake sediments. *Can. J. Fish. Aquat. Sci.* 45: 453- 462.

O'Sullivan. The Lakes Handbook, Volume 2: Lake Restoration and Rehabilitation. P.E. and C.S. Reynolds. Malden, MA: Blackwell Science Ltd., 2005. 560 pp.

PEARL. 2006a. Water Quality Data for Long Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5272. Accessed 9/20/06.

PEARL. 2006b. Explanation of Dissolved Oxygen. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.spatial.maine.edu/glossary/misc/do.htm. Accessed 10/30/06.

PEARL. 2006c. Water Quality Data for Great Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5274. Accessed 9/20/06.

PEARL. 2006d. Water Quality Data for Whittier Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5336. Accessed 9/20/06.

PEARL. 2006e. Water Quality Data for Watson Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5338. Accessed 9/20/06.

PEARL. 2006f. Water Quality Data for Kidder Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5334. Accessed 9/20/06.

PEARL. 2006g. Water Quality Data for Beaver Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5342. Accessed 9/20/06.

PEARL. 2006h. Water Quality Data for Round Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5340. Accessed 9/20/06.

PEARL. 2006i. Water Quality Data for McIntire Pond. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://www.pearl.maine.edu/Lake2.asp?Watercode=5328. Accessed 9/20/06.

PEARL, 2006 j. What is pH?. Pearl Group, Mitchell Center, University of Maine, Orono, ME. http://pearl.spatial.maine.edu/windows/community/Water_Ed/pH/pH_whatisit.htm. Accessed 11/11/06.

Pearsall 1993. Understanding Maine's Lakes and Ponds: A Guide for the Volunteer Monitoring Program. Maine Department of Environmental Protection, Division of Environmental Evaluation and Lakes Studies, Augusta, ME. 46 pp.

Plantinga, A.J., T. Mauldin, and R.J. Alig. 1999. Land use in Maine: Determinants of past trends and projections of future changes. United States Department of Agriculture Forest Service, Pacific Northwest Research Station, Portland, OR. www.fs.fed.us/pnw/pubs/rp_511.pdf. Accessed 11/04/05.

Reckhow, K. H., Chapra, S. C. 1983. Engineering approaches for lake management. Boston, MA: Butterworth, 276-285.

SOS. 2005. Chapter 581: Regulations Relating to Water Quality Evaluations. URL: http://www.maine.gov/sos/cec/rules/06/096/096c581.doc) (28 Oct. 2006).

American Water Works Association. Standard Methods: For the Examination of Water and Wastewater, 21st edition. Baltimore, MD, 2005.

Stednick, John D. 1991Wildland Water Quality Sampling and Analysis. Boston: Academic Press, Inc., 217 pp.

Strunk, J. M. and C. F. Wallace Jr. 1973. Inventory of Lake Studies in Maine. Water Resources and Planning Division, Maine State Planning Office. Appropriation # 4248.5.

Tomar, Mamta. 1999. Quality Assessment of Water and Wastewater. New York: Lewis Publishers, 260 pp.

USGS. 2006. EROS, Sioux Falls, SD. United States Geological Survey. http://edc.usgs.gov/products/aerial/doq.html. Accessed 10/10/06.

VLMP. 2006. Maine Center for Invasive Aquatic Plants. Maine Volunteer Lake Monitoring Program. Auburn, ME. http://www.mainevlmp.org/mciap/mciap.htm. Accessed 10/30/06.

Wetzel, Robert G. 2001.Limnology: Lake and River Ecosystems, 3rd Edition. New York: Academic Press, 1006 pp.

Wetzel, Robert G. and Gene E. Likens. 2000.Limnological Analyses, 3rd Edition. New York: Springer-Verlag New York, Inc., 429pp.

APPENDICES

APPENDIX A. WATER-QUALITY MEASUREMENTS AND TESTS

Physical, Chemical and Biological tests preformed between Jun-06 and Oct-06 at various sample sites on Long Pond North (see Figure 28 for site locations).

Measurement or Test	Sample Date	Sample Site
Physical Measurements		
Temperature	22-Jun-06, 27-Jun-06, 5-Jul-06, 11-Jul-06, 18-Jul-06, 25-Jul-06, 1-Aug-06, 8-Aug-06, 14-Aug-06, 30-Aug-06	1, 2, 3, 4
	6-Jun-06, 15-Jun-06, 2-Oct-06	1, 2
DO	22-Jun-06, 27-Jun-06, 5-Jul-06, 11-Jul-06, 18-Jul-06, 25-Jul-06, 1-Aug-06, 8-Aug-06, 14-Aug-06, 30-Aug-06	1, 2, 3, 4
	6-Jun-06, 15-Jun-06	1, 2
	2-Oct-06	1
Transparency	6-Jun-06, 2-Oct-06	1
	13-Jun-06, 6-Jul-06, 12-Jul-06, 18-Jul-06,	1, 2, 3
	22-Jun-06, 27-Jun-06, 1-Aug-06, 8-Aug-06	1, 2, 3, 4
	14-Aug-06	1, 2, 4
	30-Aug-06	1, 3
Turbidity	6-Jun-06, 27-Jun-06, 5-Jul-06, 11-Jul-06	1
	13-Jun-06	1, 2, 3
	22-Jun-06, 18-Jul-06, 25-Jul-06, 1-Aug-06, 8-Aug-06, 14-Aug-06, 30-Aug-06	1, 2, 3, 4
	27-Jun-06	1, 3, 4
	6-Jul-06, 12-Jul-06	2, 3, 4
Chemical Analyses		
pH	22-Jun-06, 27-Jun-06, 5-Jul-06, 11-Jul-06, 18-Jul-06, 25-Jul-06, 1-Aug-06, 8-Aug-06, 14-Aug-06, 30-Aug-06	1, 2, 3, 4
	6-Jun-06, 15-Jun-06, 2-Oct-06	1, 2
Total Phosphorus	6-Jun-06, 11-Jul-06	1
	13-Jun-06, 5-Jul-06	1, 2, 3
	22-Jun-06, 27-Jun-06, 18-Jul-06, 25-Jul-06, 1-Aug-06, 8-Aug-06, 14-Aug-06, 30-Aug-06	1, 2, 3, 4
Biological Analyses		
Chlorophyll-*a*	22-Jun-06, 27-Jun-06, 5-Jul-06, 11-Jul-06, 18-Jul-06, 25-Jul-06, 1-Aug-06, 8-Aug-06, 14-Aug-06, 30-Aug-06	1, 2, 3, 4
	6-Jun-06, 15-Jun-06, 2-Oct-06	1, 2

APPENDIX B. QUALITY ASSURANCE

The Long Pond North study followed a quality assurance plan developed by CEAT to standardize the procedures used. The following document was modified from CEAT (2006).

Bottle Preparation:

1. To make the acid rinse, use 1 L of E-pure and 1 L concentrated hydrochloric acid. The result is a 1:1 ratio HCl:E-pure water.
2. All phosphorus-sample bottles were triple acid rinsed before use to avoid contamination of the sample

Approaching Site:

1. When approaching the test site, accelerate, then turn off the engine and coast to the sampling site to limit stirring the surface water.
2. Always sample into the wind and from the bow of the boat.

Surface Sampling:

1. Remove the cap from the sample bottle without touching the lip or the edge of the cap.
2. Invert and immerse the bottle to approximately 0.5 m. Turn the bottle on its side and move it horizontally through the water away from the boat.
3. Tilt the bottle upright, remove from water, and replace the cap. Place the bottle in the cooler on ice.

Secchi Disk:

1. Use the Aqua-scope to view the disk.
2. Lower the disk on the shady side of the boat until it disappears from view, then record the depth.
3. Bring the disk back to the surface and repeat the process two more times.

Measuring Depth:

1. Use LCD Digital Sounder (Depth Finder) or boat sonar.
2. Put the lanyard of the depth finder around your wrist.
3. Put the depth finder in the water and push the switch towards the bottom of the lake (in the direction of the arrow). Hold for three seconds.
4. Point the depth finder straight down. Record this depth.
5. Repeat the process once.

Turbidity:

1. Measure turbidity using the HACH 2100 Portable Turbidimeter (HACH 1999).
2. Used cleaned sample cells included with the portable turbidimeter.

3. Conduct analysis in the field using the calibrated instrument (calibrated with three standards). Follow surface sampling procedure.
4. Samples were read on site.

<u>YSI 560 MDS (Multiparameter Display System) Sonde</u>

The YSI MDS Sonde was calibrated and used as directed in the YSI 6-Series operating manual (YSI 2002). The sonde was used to measure the following parameters in the field: Chlorophyll-*a*, Nitrates, Ammonium, pH profile, Temperature, Dissolved Oxygen, and Depth.

<u>pH:</u>

A. Calibration: Before any test is performed, the probe of the 650 MDS Sonde must be calibrated using a 2-point calibration method at pH 4 and pH 7. This should be done once during the testing day, provided the calibration entered into the meter is not accidentally deleted.
    1. Press the POWER button. The pH meter automatically enters the measurement.
    2. Press CALIBRATE and ISEI pH. Then press 2 POINT.
    3. Enter the Sonde standard pH value and insert probe into pH 7 solution. Go to Sonde menu.
    4. After calibration, rinse the sensor thoroughly with E-pure water.
    5. Repeat calibration for pH 4.
    6. Check that the probe is working properly by measuring aerated deionized water. The meter should give a value of 5.56.
    7. Be sure to rinse the probe with distilled water prior to and following each measurement.
B. Measurement.
    1. Immerse the Sonde 0.5 m to 1.0 m below the surface.
    2. Go to SONDE RUN in the 650 main menu. Wait for the probe to stabilize.
    3. Highlight "Log One Sample" and press the ENTER arrow at one meter intervals.
C. Quality Assurance.
    1. Take the pH reading twice at each site to assure accuracy.

<u>Dissolved Oxygen:</u>

1. Calibrate the probe of the 650 MDS Sonde in the saturated air chamber after the proper warm-up time.
2. Lower the Sonde into the water, shaking it gently to make sure there are not bubbles around the probe.
3. Immerse the probe until covered. Record measurements as described above.

<u>Mid-depth and Bottom Sample:</u>

1. Pull the rubber stoppers out of the ends of the bottom sampler.
2. Hook metal cables to the two small pegs located at the top of the sampler.
3. After taking the depth reading, lower the sampler to mid-depth to sample.
4. Release the sliding weight to close water sampler.

5. Pull out the water sampler. Open the air valve and the black tap by pushing the outside ring of the tap in. Drain the tap for a few seconds.
6. Fill the sample bottle and place it in the cooler on ice.
7. Empty the water sampler. Repeat the sampling procedure for the bottom sample.
8. Take the bottom sample one meter above the bottom to avoid sediment contamination.

Epicore Samples:

1. Rinse the tube three times by lowering it down into the lake water and pulling it back out.
2. For sites with sufficient depth for a thermocline, lower the tube one meter below the epilimnion into the thermocline (determined from the DO/temperature profile).
3. For shallow depths, lower the tube to one meter from the bottom.
4. The tape marks on the tube indicate one meter.
5. Crimp the tubing just above the water (best done by bending it tightly, twisting, and then holding it in one hand).
6. Pull the tubing up, making sure that the excess tubing goes into the water and not the boat. Be careful not to touch the end through which the water comes out.
7. Allow the water to drain into the labeled epicore mixing bottle, being careful not to touch the inside of the tube, the cap, or the end of the tube.
8. Be sure to keep the non-pouring end of the tube up, so the water does not drain out of it, and so that it does not take up surface water.
9. Hold up the crimped area and undo the crimp. Continue to raise the tubing and move towards the draining end.
10. Repeat the process three times, draining all of the water into the epicore mixing bottle.
11. Pour about 125 mL each of this water into two PPM flasks (fill to just below the neck). Be careful not to contaminate the samples by touching the inside of the bottles or the inside of the caps.
12. Discard the remaining water from the mixing bottle and rinse it with E-pure water. Place all samples into the cooler on ice.

Quality Control Sampling:

1. Spike E-pure samples with a known amount of concentrated standard and run against a standard curve to confirm the accuracy of technician before water samples were analyzed. This accuracy test is repeated until the values of the test samples are within 10% of each other.
2. Duplicate samples every tenth sample to test the accuracy of sampling procedures.
3. Split samples every tenth sample in the laboratory to test the lab procedure.
4. Run one control with each set of samples analyzed.

Total Phosphorus:

1. Collect and make splits and duplicates for every ten samples.
2. Make standard solutions of known concentrations with each testing to ensure lab precision.

3. Use reagent blanks to make a standard curve to determine the concentration of phosphorus studied. The standard curve should have a minimum of six points.
4. The accuracy of the Absorbic Acid method used for total phosphorus analysis has a detection point less than 1 ppb.
5. Preserve water samples for analysis by digesting with sulfuric acid and ammonium peroxydisulfate, and then autoclave at 15 psi for 30 mintues.
6. Conduct analysis within 28 days of sampling date.

APPENDIX C. PHYSICAL MEASUREMENTS AND CHEMICAL ANALYSES OF LONG POND WATER QUALITY

Physical tests: Temperature (˚C) and dissolved oxygen concentration (ppm) at sites 1-4 (see Figure 28 for site locations). Data collected using a YSI Sonde.

	6-Jun-06		15-Jun-06		22-Jun-06		27-Jun-06		5-Jul-06		11-Jul-06		18-Jul-06	
Depth (m)	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**
Site 1														
0	19.26	8.73	18.02	11.65	22.33	10.35	22.37	13.12	23.87	10.84	25.69	10.81	27.66	10.41
1	17.64	8.95	18.04	10.22	22.29	9.36	22.55	9.97	23.77	9.22	25.63	10.09	26.92	8.85
2	17.24	8.93	18.02	10.14	22.18	9.35	22.38	9.88	23.51	9.23	25.59	10.08	26.78	8.96
3	17.14	8.87	17.97	10.06	21.71	9.39	22.23	9.86	23.37	9.17	25.15	8.33	25.16	9.35
4	16.82	8.76	17.92	10.03	20.10	9.73	22.07	9.83	23.27	9.10	24.86	10.14	25.09	7.34
5	15.99	8.72	17.835	10.35	19.81	9.47	20.1	9.98	22.34	8.88	24.45	9.925	24.83	9.22
6	15.47	8.72	17.8	10.49	19.47	9.48	19.48	9.08	22.3	8.77	22.04	10.17	21.83	9.40
7	14.99	8.51	17.76	10.34	18.27	9.26	17.83	9.47	18.84	8.29	20.18	10.59	19.70	7.74
8	14.30	8.52	17.41	10.22	17.94	9.23	16.04	9.56	15.98	8.31	17.6	9.86	17.49	7.02
9	13.89	8.28	14.58	10.07	14.49	9.84	14.04	8.42	14.70	6.81	15.56	8.74	15.05	6.73
10	11.52	8.46	13.74	9.19	13.56	8.86	13.58	7.98	13.40	6.83	14.16	7.98	13.38	6.26
11	11.07	7.65	11.53	9.32	13.08	8.24	12.93	7.69	12.96	6.41	13.69	7.25	13.18	5.71
12	10.81	7.31	10.7	8.12	12.59	7.84	12.32	7.36	12.18	6.16	12.58	6.88	12.36	5.19
13	10.54	7.25	10.68	7.94	11.98	7.48	11.73	7.05	10.93	5.79	11.7	6.56	11.93	4.80
14	10.335	7.01	10.52	7.84	11.54	7.11	11.45	6.82	10.84	5.25	10.95	6.11	11.73	4.63
15	9.99	6.89	10.19	7.74	11.47	6.97	11.22	6.65	10.8	4.98	10.88	5.44	11.48	4.29
16	-	-	9.92	7.49	11.34	6.77	11.12	6.47	10.73	4.69	10.75	4.63	11.38	4.11
17	-	-	9.86	7.17	11.07	6.68	11.03	6.21	10.67	4.52	10.73	4.44	10.93	3.72
18	-	-	9.83	7.08	10.73	6.43	-	-	10.66	4.31	10.69	4.12	10.89	3.45

APPENDIX C. (Continued)

	6-Jun-06		15-Jun-06		22-Jun-06		27-Jun-06		5-Jul-06		11-Jul-06		18-Jul-06	
Depth (m)	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**
Site 2														
0	-	-	-	-	22.23	10.05	22.06	12.73	23.89	13.19	24.97	11.43	27.26	11.84
1	-	-	-	-	22.14	9.22	21.68	10.24	23.50	9.99	24.62	8.75	26.49	9.36
2	-	-	-	-	21.99	9.25	20.88	10.02	23.16	9.84	24.32	8.83	26.05	9.38
3	-	-	-	-	20.96	9.45	20.25	9.83	23.12	9.69	24.18	8.78	25.87	9.32
4	-	-	-	-	19.91	9.64	19.6	9.8	22.86	9.55	24.00	8.69	25.64	9.25
5	-	-	-	-	19.62	9.65	18.98	9.58	22.77	9.53	23.75	8.68	25.22	9.34
6	-	-	-	-	18.83	9.60	18.02	9.49	21.87	9.28	22.96	8.63	21.65	9.50
7	-	-	-	-	18.03	9.34	17.15	9.16	19.67	9.49	21.27	8.07	19.53	8.30
8	-	-	-	-	16.53	8.83	16.15	8.79	15.97	8.64	17.71	8.09	17.63	7.39
9	-	-	-	-	15.78	8.56	12.67	8.79	15.06	7.67	16.52	7.12	15.67	6.44
Site 3														
0	-	-	-	-	23.05	11.81	23.26	12.88	24.41	10.86	26.04	8.70	29.11	11.08
1	-	-	-	-	23.05	9.41	23.25	10.12	24.27	8.99	25.89	8.77	28.63	8.95
2	-	-	-	-	23.04	9.33	23.18	10.09	24.06	9.01	25.8	8.80	28.50	8.85
3	-	-	-	-	23.02	9.26	23.10	9.98	23.81	9.01	25.6	8.77	28.40	8.88
4	-	-	-	-	22.78	9.06	23.08	9.93	23.70	8.94	25.05	8.72	25.72	9.51
5	-	-	-	-	22.57	9.30	23.05	9.87	22.93	8.89	22.91	9.20	23.82	9.34
6	-	-	-	-	18.52	10.51	23.03	9.81	21.92	8.76	21.78	8.39	22.50	8.73
7	-	-	-	-	16.38	9.93	22.91	9.76	20.29	8.71	20.76	7.95	21.18	7.91
8	-	-	-	-	15.61	9.13	22.87	9.67	18.92	8.01	20.34	7.55	19.99	6.92
Site 4														
0	-	-	-	-	23.15	10.41	23.75	12.71	24.65	9.62	26.32	8.43	29.47	8.66
1	-	-	-	-	23.15	9.57	23.72	9.85	24.37	9.32	26.07	8.51	28.93	8.79
2	-	-	-	-	23.09	9.42	23.7	9.74	24.28	9.29	25.98	8.52	28.74	8.65
3	-	-	-	-	23.04	9.34	23.59	9.62	23.9	9.13	25.88	8.46	28.52	8.54
4	-	-	-	-	22.65	9.50	23.13	9.58	23.71	9.04	25.14	8.33	27.77	8.57
5	-	-	-	-	22.16		23.03		-		23.35		-	

APPENDIX C. (Continued)

	25-Jul-06		1-Aug-06		8-Aug-06		14-Aug-06		30-Aug-06		2-Oct-06	
Depth (m)	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**	**Temp.**	**DO**
Site 1												
0	25.27	9.82	26.79	10.46	25.02	10.93	22.61	7.68	21.41	9.38	16.99	8.445
1	25.26	9.26	25.99	10.43	25.15	10.82	22.57	7.78	21.37	9.11	17.00	8.34
2	25.22	9.24	25.97	10.47	25.14	10.82	22.50	7.82	21.19	9.05	17.00	8.55
3	25.16	9.28	25.70	10.45	25.13	10.8	22.50	7.79	20.96	8.91	17.00	8.60
4	25.08	9.25	25.55	10.44	25.12	10.81	22.45	7.78	20.77	8.66	17.00	8.63
5	24.41	9.25	25.19	10.17	25.06	10.82	22.41	7.68	20.74	8.48	17.00	8.79
6	22.85	8.83	24.82	10.04	25.04	10.76	22.40	7.68	20.73	8.45	17.00	8.78
7	20.03	7.36	21.35	9.19	21.86	9.97	22.38	7.79	20.70	8.43	17.00	8.75
8	17.76	6.15	17.83	6.97	17.97	7.94	17.74	1.85	20.14	5.26	17.00	8.73
9	15.83	5.34	15.15	6.23	15.88	5.21	16.48	1.76	16.37	1.46	17.00	8.76
10	13.87	4.97	14.38	4.11	14.62	4.09	14.81	1.40	14.42	0.44	17.00	8.69
11	12.89	4.54	13.17	3.94	13.71	3.80	13.47	1.22	12.74	0.28	17.00	8.73
12	12.22	4.31	12.33	3.53	12.72	3.19	12.77	1.13	12.07	0.25	17.00	9.33
13	11.64	3.90	11.91	3.34	12.11	2.94	11.68	0.75	11.78	0.18	15.43	7.83
14	11.60	3.59	11.52	3.19	11.68	2.74	11.51	0.62	11.36	0.15	13.85	0.95
15	11.53	3.52	11.29	2.90	11.16	1.93	11.15	0	11.19	0.13	11.69	0.62
16	11.26	3.43	11.18	2.56	11.09	1.37	11.12	0	11.10	0.10	11.62	0.40
17	10.93	3.02	11.08	2.23	11.06	0.90	11.12	0	11.08	0.10	11.51	0.32
18	-	3.02	11.05	1.97	11.05	0.79	11.12	0.1	11.02	0.10	11.48	0.25
19	-	-	11.01	1.77	11.04	0.73	-	0.1	10.99	0.09	11.34	0.25
20	-	-	11.01	1.64	11.02	0.67	-	0.1	-	0.09	-	0.25

APPENDIX C. (Continued)

Depth (m)	25-Jul-06 Temp.	DO	1-Aug-06 Temp.	DO	8-Aug-06 Temp.	DO	14-Aug-06 Temp.	DO	30-Aug-06 Temp.	DO	2-Oct-06 Temp.	DO
Site 2												
0	25.44	14.55	26.44	10.2	24.92	11.29	23.18	-	21.46	9.53	16.92	-
1	25.41	9.67	25.85	9.96	24.96	10.81	22.93	-	21.42	9.18	16.95	-
2	25.27	9.67	25.68	10.02	24.96	10.79	22.76	-	21.38	9.17	16.95	-
3	25.11	9.59	25.62	9.99	24.96	10.79	22.62	-	21.33	9.17	16.95	-
4	24.88	9.43	25.57	10.01	24.96	10.88	22.54	-	21.28	9.17	16.95	-
5	23.64	9.51	25.12	9.99	24.95	10.86	22.52	-	21.26	9.18	16.95	-
6	22.29	8.61	23.97	9.30	24.94	10.83	22.51	-	20.90	9.18	16.95	-
7	19.67	7.74	21.63	8.34	24.93	10.86	22.11	-	20.80	9.00	16.95	-
8	16.41	6.33	18.06	6.57	24.87	10.88	18.21	-	20.76	8.805	-	-
9	16.16	5.32	16.45	5.24	-	10.88	16.28	-	20.73	8.81	-	-
Site 3												
0	25.04	11.73	26.76	9.74	22.92	10.42	22.92	-	21.55	9.35	-	-
1	25.04	9.75	26.65	9.77	22.82	10.49	22.82	-	21.48	9.08	-	-
2	24.99	9.81	26.48	9.78	22.84	10.55	22.84	-	21.00	9.10	-	-
3	24.93	9.76	26.25	9.76	22.63	10.59	22.63	-	20.91	9.00	-	-
4	24.91	9.75	26.11	9.80	22.50	10.51	22.50	-	20.85	8.91	-	-
5	24.87	9.76	25.82	9.80	22.44	10.00	22.44	-	20.82	8.83	-	-
6	24.80	9.66	23.95	9.54	22.35	8.83	22.35	-	20.80	8.91	-	-
7	24.76	9.65	20.32	7.72	22.04	6.79	22.04	-	20.79	9.02	-	-
8	22.48	9.64	19.21	5.95	21.97	5.08	21.97	-	-	9.00	-	-
	17.49	-	-	-	-	-	-	-	-	-	-	-
Site 4												
0	25.12	11.69	26.65	9.67	25.60	10.78	22.91	-	21.58	9.01	-	-
1	25.11	9.70	26.34	9.61	25.74	10.82	22.88	-	21.25	8.95	-	-
2	25.08	9.64	26.26	9.64	25.69	10.76	22.73	-	20.95	8.96	-	-
3	25.08	9.66	26.08	9.62	25.52	10.75	22.43	-	20.77	8.89	-	-
4	25.03	9.61	25.70	9.29	25.31	10.42	22.32	-	20.67	8.91	-	-

APPENDIX C. (Continued)

Chemical and Biological Tests: pH and chlorophyll-*a* concentration (ppb) at sites 1-4 (Figure II.D.1.1). Data collected using a YSI Sonde.

	6-Jun-06		15-Jun-06		22-Jun-06		27-Jun-06		5-Jul-06		11-Jul-06		18-Jul-06	
Depth (m)	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**
Site 1														
0	7.44	2.8	7.36	2.4	7.25	3.7	7.38	3.7	7.19	2.2	7.43	3.7	7.37	2.7
1	7.44	1.9	7.19	2.4	7.24	1.5	7.25	3.4	7.15	2.6	7.31	2.1	7.355	2.7
2	7.44	3.1	7.15	3.3	7.24	1.8	7.23	3.5	7.14	2.5	7.29	2.9	7.34	2.7
3	7.42	3.5	7.12	3.5	7.23	2.7	7.21	3.4	7.13	3.6	7.29	3.2	7.35	3.1
4	7.40	3.4	7.10	4.4	7.20	2.3	7.20	3.9	7.12	3.8	7.27	3.5	7.34	3.4
5	7.38	3.3	7.095	4.1	7.18	2.7	7.15	3.1	7.06	3.7	7.26	4.3	7.32	4.0
6	7.35	2.8	7.09	2.6	7.15	2.8	7.00	2.1	7.04	3.6	7.22	4.6	7.24	3.8
7	7.30	2.5	7.08	3.1	7.08	2.4	6.97	1.9	6.88	2.7	7.12	3.7	7.03	2.7
8	7.26	2.2	7.05	3.1	7.05	1.6	6.92	1.6	6.79	2.6	6.96	4.3	6.94	1.6
9	7.20	1.7	6.97	2.2	7.02	1.7	6.80	1.6	6.49	1.6	6.85	2.7	6.84	2.1
10	7.15	1.9	6.87	1.9	6.92	0.9	6.74	1.6	6.47	1.7	6.72	2.3	6.75	1.9
11	7.08	2.4	6.81	1.1	6.85	1.0	6.69	0.7	6.41	1.8	6.66	2.1	6.69	1.9
12	7.01	1.6	6.71	1.3	6.80	0.8	6.63	0.6	6.37	1.8	6.59	2.1	6.63	2.1
13	6.98	2.4	6.67	1.4	6.75	0.8	6.59	1.8	6.32	1.3	6.54	2.3	6.57	2.1
14	6.87	1.6	6.64	1.5	6.70	0.8	6.57	1.3	6.30	1.7	6.46	2.0	6.53	2.2
15	6.81	1.83	6.61	1.5	6.66	0.5	6.54	1.4	6.28	2.0	6.42	1.8	6.49	1.9
16	-	-	6.57	0.7	6.63	0.3	6.51	0.7	6.24	2.0	6.39	1.7	6.46	2.1
17	-	-	6.53	0.7	6.60	0.2	6.48	1.1	6.23	2.0	6.37	1.9	6.43	1.8
18	-	-	6.51	0.5	6.57	-	6.45	-	6.20	-	6.35	-	6.40	1.0

APPENDIX C. (Continued)

	6-Jun-06		15-Jun-06		22-Jun-06		27-Jun-06		5-Jul-06		11-Jul-06		18-Jul-06	
Depth (m)	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**
Site 2														
0	-	-	-	-	7.24	1.0	7.47	3.7	7.30	3.7	7.33	3.7	7.44	3.7
1	-	-	-	-	7.21	1.0	7.30	3.9	7.24	3.2	7.29	3.1	7.42	2.5
2	-	-	-	-	7.20	1.1	7.21	4.6	7.22	4.0	7.28	3.3	7.42	2.5
3	-	-	-	-	7.20	2.5	7.15	4.0	7.21	4.1	7.27	4.0	7.41	3.1
4	-	-	-	-	7.16	2.8	7.10	3.9	7.18	5.1	7.24	4.3	7.40	4.1
5	-	-	-	-	7.13	2.8	7.04	2.8	7.15	5.2	7.24	4.4	7.38	4.4
6	-	-	-	-	7.11	1.8	7.00	2.5	7.10	3.7	7.19	4.3	7.27	3.8
7	-	-	-	-	7.04	2.4	6.93	2.9	7.04	3.5	7.10	3.7	7.12	3.0
8	-	-	-	-	6.96	1.1	6.87	2.9	6.90	3.0	7.01	3.8	6.98	2.7
9	-	-	-	-	6.87	-	6.78	2.2	6.80	3.2	6.94	-	6.88	2.3
Site 3														
0	-	-	-	-	7.27	3.7	7.37	3.7	7.23	2.5	7.46	1.9	7.54	3.7
1	-	-	-	-	7.25	3.4	7.31	3.5	7.20	1.9	7.34	2.5	7.47	2.7
2	-	-	-	-	7.24	3.6	7.29	3.9	7.19	3.1	7.32	2.6	7.44	2.2
3	-	-	-	-	7.23	3.5	7.29	4.6	7.18	4.0	7.31	2.8	7.42	2.2
4	-	-	-	-	7.23	6.3	7.30	4.7	7.17	3.4	7.29	3.2	7.41	3.1
5	-	-	-	-	7.22	4.8	7.29	4.8	7.11	3.2	7.25	3.5	7.34	4.7
6	-	-	-	-	7.21	4.2	7.29	4.9	7.04	3.0	7.15	2.9	7.24	4.1
7	-	-	-	-	7.15	3.0	7.28	4.7	7.01	2.8	7.08	3.0	7.10	3.4
8	-	-	-	-	7.06	2.8	7.28	4.7	6.90	3.0	7.00	2.7	6.97	2.9
Site 4														
0	-	-	-	-	7.24	3.7	7.66	3.7	7.32	2.4	7.74	5.6	7.59	2.4
1	-	-	-	-	7.21	2.7	7.49	3.7	7.28	2.8	7.37	5.7	7.47	1.9
2	-	-	-	-	7.20	3.4	7.45	4.2	7.26	2.9	7.32	5.7	7.41	2.0
3	-	-	-	-	7.18	4.6	7.4	5.7	7.21	4.3	7.28	6.6	7.37	2.4
4	-	-	-	-	7.16	3.3	7.35	3.7	7.18	3.9	7.20	6.3	7.34	2.4

APPENDIX C. (Continued)

Depth (m)	25-Jul-06 pH	Chloro.	1-Aug-06 pH	Chloro.	8-Aug-06 pH	Chloro.	14-Aug-06 pH	Chloro.	30-Aug-06 pH	Chloro.	2-Oct-06 pH	Chloro.
Site 1												
0	7.32	2.7	7.32	1.7	7.74	4.1	7.49	1.2	7.72	3.6	7.42	2.1
1	7.32	2.7	7.17	2.3	7.345	4.1	7.14	2.8	7.42	1.8	7.19	4.1
2	7.32	3.5	7.16	2.7	7.27	4.0	7.08	3.4	7.31	3.6	7.14	4.7
3	7.32	4.1	7.15	3.0	7.25	4.0	7.05	4.1	7.25	3.6	7.07	4.5
4	7.32	3.7	7.13	3.9	7.23	4.2	7.03	4.2	7.18	3.5	7.01	4.2
5	7.29	3.7	7.07	4.2	7.20	4.2	7.01	4.1	7.11	2.8	6.98	4.2
6	7.18	4.1	7.02	4.5	7.18	4.2	7.00	3.9	7.04	2.8	6.96	3.8
7	6.95	3.7	6.85	4.4	6.99	4.4	6.99	4.7	7.01	2.5	6.94	4.1
8	6.81	3.0	6.65	3.2	6.79	3.8	6.78	3.0	6.74	2.0	6.93	4.6
9	6.70	2.2	6.45	3.2	6.63	2.8	6.55	2.5	6.45	2.1	6.93	4.2
10	6.63	2.3	6.28	2.7	6.52	2.8	6.46	2.1	6.26	1.6	6.91	3.8
11	6.57	1.4	6.24	2.2	6.47	1.8	6.34	2.1	6.13	1.3	6.9	4.1
12	6.52	1.7	6.19	1.9	6.41	1.4	6.3	1.7	6.10	2.2	6.86	3.8
13	6.48	2.0	6.16	2.4	6.37	1.8	6.25	2.5	6.08	2.1	6.68	3.1
14	6.45	1.3	6.13	2.5	6.33	1.8	6.22	1.5	6.06	1.5	6.57	2.2
15	6.41	1.8	6.11	1.9	6.29	1.7	6.19	1.3	6.10	1.9	6.49	2.7
16	6.39	1.8	6.09	1.9	6.24	1.8	6.17	1.5	6.15	2.3	6.49	2.5
17	6.35	2.9	6.07	1.9	6.15	2.4	6.16	1.5	6.15	1.6	6.49	2.8
18	-	-	6.05	2.3	6.15	2.1	6.15	1.6	6.16	1.8	6.50	2.4
19	-	-	6.03	2.2	6.13	1.8	-	-	6.19	2.2	-	-
20	-	-	-	2.3	6.11	-	-	-	-	-	-	-

APPENDIX C. (Continued)

	25-Jul-06		1-Aug-06		8-Aug-06		14-Aug-06		30-Aug-06		2-Oct-06	
Depth (m)	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**	**pH**	**Chloro.**
Site 2												
0	7.44	3.7	7.03	3.7	7.12	3.7	6.99	3.7	6.94	3.7	7.60	3.7
1	7.39	2.5	7.03	3.0	7.05	5.0	6.98	3.3	6.85	2.9	7.10	4.0
2	7.38	2.9	7.05	3.2	7.04	4.7	6.98	4.4	6.84	3.5	7.04	4.5
3	7.37	4.1	7.05	3.9	7.03	4.6	6.98	4.6	6.84	4.5	7.00	3.8
4	7.34	4.0	7.05	4.0	7.03	4.1	6.97	4.4	6.84	4.4	6.97	3.8
5	7.29	3.8	7.01	4.1	7.03	4.8	6.96	4.7	6.84	4.2	6.95	4.5
6	7.12	3.7	6.89	4.2	7.03	4.2	6.96	4.0	6.84	4.2	6.94	4.0
7	6.96	3.2	6.71	4.0	7.03	4.6	6.92	3.7	6.82	4.3	6.93	4.1
8	6.80	2.3	6.52	3.3	7.03	4.5	6.73	3.0	6.80	3.7	6.91	-
9	6.74	2.3	6.43	3.3	7.03	-	6.52	2.2	6.79	3.7	6.91	-
Site 3												
0	7.45	3.7	6.98	3.0	7.61	3.7	7.12	2.9	7.36	1.7	-	-
1	7.38	2.9	6.99	2.7	7.43	3.2	7.07	3.5	7.06	2.6	-	-
2	7.37	3.2	6.98	3.0	7.39	4.4	7.04	4.0	7.01	2.8	-	-
3	7.36	4.2	6.98	3.2	7.36	5.0	7.02	3.8	6.97	3.6	-	-
4	7.35	4.1	6.99	3.0	7.29	5.2	7.01	3.9	6.94	3.6	-	-
5	7.34	3.5	6.98	3.9	7.21	4.8	6.96	3.9	6.91	3.8	-	-
6	7.33	3.8	6.90	4.5	6.99	4.4	6.95	4.1	6.90	4.5	-	-
7	7.31	3.6	6.66	4.3	6.79	3.4	6.93	3.6	6.90	3.0	-	-
8	7.20	3.6	6.49	3.5	6.61	3.5	6.90	5.1	6.90	-	-	-
Site 4												
0	7.52	3.7	6.82	1.4	8.06	0.9	7.14	3.3	7.27	1.8	-	-
1	7.37	2	6.84	2.4	7.53	3.3	7.06	3.0	7.02	2.1	-	-
2	7.32	2.8	6.85	2.3	7.41	3.8	7.02	3.3	6.97	3.8	-	-
3	7.30	3.6	6.84	2.8	7.33	4.2	6.99	3.5	6.93	4.6	-	-
4	7.27	3.3	6.80	3.4	7.21	3.5	6.98	3.2	6.91	3.5	-	-

APPENDIX C. (Continued)
Chemical Tests: Total Phosphorus (ppb) (see Figure 28 for site locations)

	6-Jun-06	13-Jun-06	22-Jun-06	27-Jun-06	5-Jul-06	11-Jul-06	18-Jul-06	25-Jul-06	1-Aug-06	8-Aug-06	14-Aug-06	30-Aug-06
Site 1												
Surface	5.0	3.8	2.0	27.5	7.1	3.7	4.6	1.9	1.4	7.7	9.2	5.2
Middle	21.4	5.2	8.6	24.7	9.8	6.4	5.3	4.5	5.1	5.8	7.2	9.8
Bottom	7.2	5.2	7.5	26.7	9.8	10.7	10.1	9.6	12.5	14.4	15.6	23.8
Epicore	9.0	5.6	6.2	23.9	8.4	9.5	4.4	2.5	3.6	4.7	7.1	6.8
Site 2												
Surface	--	7.0	2.9	30.5	8.3	--	4.0	3.7	3.1	8.4	9.6	2.4
Middle	--	12.4	2.1	8.2	8.8	--	8.3	3.5	7.7	7.2	7.9	6.4
Bottom	--	5.5	0.2	8.3	7.4	--	5.0	6.1	7.8	7.9	7.5	5.3
Epicore	--	6.1	6.4	7.2	--	--	--	--	--	--	--	--
Site 3												
Surface	--	5.7	7.2	7.9	7.1	--	6.8	4.7	5.9	7.7	7.1	6.0
Middle	--	7.5	8.2	10.9	7.1	--	7.4	4.2	3.1	6.3	6.0	--
Bottom	--	11.0	9.3	9.1	6.6	--	4.2	7.1	5.5	5.3	6.1	5.0
Epicore	--	5.3	--	--	--	--	--	--	--	--	--	--
Site 4												
Surface	--	--	4.7	10.2	--	--	3.0	3.2	3.1	10.1	7.5	4.8
Middle	--	--	8.6	12.6	--	--	--	--	--	--	--	--
Bottom	--	--	--	--	--	--	--	--	3.4	3.3	7.2	5.2

APPENDIX C. (Continued)

Sampling conditions and physical parameters: Secchi disk (m) and turbidity (NTU) (see Figure 28 for site locations)

	6-Jun-06	13-Jun-06	22-Jun-06	27-Jun-06	5 & 6-Jul-06	11&12-Jul-06
Cloud Cover		45-70%	35-90%	30-60%	25-60%	10-90%
Wind Speed		5-8 mph	5-11 mph	9-15 mph	5-10 mph	7 mph
Wind Direction		From N	From S	From S	From W	From S
Previous Weather	Rain	Heavy Rain, Sun	Night T-storms, sun	Rain	Sun	Rain, before & after T-storms
Site 1						
Sample Depths (m)						
Epicore	7.0	7.0	8.0	8.0	8.0	8.0
Middle	7.0	7.5	9.0	8.5	9.0	9.0
Bottom	13.5	16.0	17.0	16.5	18.0	17.0
Secchi Disk (m)	4.79	4.37	4.50	4.80	5.60	4.40
Turbidity						
Surface	0.55	0.61	0.87	2.01	0.92	0.84
Middle	0.67	0.66	1.65	2.34	0.82	0.68
Bottom	0.60	0.49	2.09	1.57	1.98	0.88
Site 2						
Sample Depths (m)						
Epicore	-	7.0	8.0	8.0	-	-
Middle	-	4.5	4.5	4.5	4.0	4.0
Bottom	-	8.0	8.0	8.0	8.0	8.0
Secchi Disk (m)	-	4.58	4.95	5.00	3.85	4.28
Turbidity						
Surface	-	0.69	0.73	2.08	1.14	0.92
Middle	-	0.66	0.71	2.59	1.11	1.01
Bottom	-	0.25	1.28	2.73	1.93	3.32
Site 3						
Sample Depths (m)						
Epicore	-	7.0	-	-	-	8.0
Middle	-	7.0	4.5	3.8	4.0	3.5
Bottom	-	4.0	7.0	7.5	7.0	7.5
Secchi Disk (m)	-	4.08	4.65	4.60	3.90	5.50
Turbidity						
Surface	-	0.56	1.03	1.59	1.76	0.92
Middle	-	0.88	1.24	1.90	0.98	1.08
Bottom	-	0.85	0.84	4.63	1.14	1.08
Site 4						
Sample Depths (m)						
Epicore	-	-	-	-	-	-
Middle	-	-	2.0	2.5	-	-
Bottom	-	-	-	-	-	-
Secchi Disk (m)	-	-	4.10	3.90	-	-
Turbidity						
Surface	-	-	1.14	1.70	1.37	1.55
Middle	-	-	1.48	2.07	-	-
Bottom	-	-	-	-	-	-

APPENDIX C. (Continued)
Sampling conditions and physical parameters: Secchi disk (m) and turbidity (NTU)

	18-Jul-06	25-Jul-06	1-Aug-06	8-Aug-06	14-Aug-06	30-Aug-06	2-Oct-06
Cloud Cover	15%	5-10%	50-70%	25-80%	30-90%	5-20%	98-100%
Wind Speed	8-11 mph	8-13 mph	5-11 mph	9-13mph	5-10 mph	5-10 mph	8-13 mph
Wind Direction	From SW	From SE	From S	From N	From S	From N	From N
Previous Weather	Sun	Sun, Sun showers	Sun, Some clouds	Rain previous night	Sun	Previous rain	Previous rain
Site 1							
Sample Depths (m)							
Epicore	9.0	9.0	9.0	-	9.0	10.0	-
Middle	9.0	9.5	9.5	10.0	9.0	10.0	-
Bottom	17.0	18.0	19.0	19.5	18.0	19.0	-
Secchi Disk (m)	4.60	-	4.43	4.51	4.00	6.20	3.65
Turbidity							
Surface	0.80	0.91	0.74	0.73	0.97	0.69	-
Middle	1.13	0.65	0.89	0.61	1.22	1.15	-
Bottom	0.82	0.87	1.28	1.43	2.21	0.86	-
Site 2							
Sample Depths (m)							
Epicore	-	-	-	-	-	-	-
Middle	4.0	4.5	4.5	4.0	4.5	4.3	-
Bottom	8.0	8.0	8.5	8.0	8.5	8.0	-
Secchi Disk	4.40	-	3.90	4.50	3.90	-	4.10
Turbidity							
Surface	0.75	0.89	0.73	0.77	0.78	0.51	-
Middle	1.04	0.96	1.10	0.85	0.89	0.82	-
Bottom	1.60	1.28	0.97	0.69	1.49	0.68	-
Site 3							
Sample Depths (m)							
Epicore	-	-	-	-	-	-	-
Middle	3.5	4.0	4.0	4.0	4.0	4.0	-
Bottom	7.0	7.5	7.0	7.5	7.0	7.3	-
Secchi Disk	5.10	-	4.91	4.20	-	-	-
Turbidity							
Surface	0.75	0.97	1.11	0.83	0.95	-	-
Middle	0.87	0.91	0.72	0.79	0.75	0.66	-
Bottom	0.90	1.00	0.94	0.87	0.95	0.70	-
Site 4							
Sample Depths (m)							
Epicore	-	-	-	-	-	-	-
Middle	-	-	-	-	-	-	-
Bottom	-	-	3.5	3.5	3.5	4.0	-
Secchi Disk	-	-	-	-	-	-	-
Turbidity							
Surface	0.93	1.30	1.30	0.88	0.87	0.64	-
Middle	-	-	-	-	-	-	-
Bottom	-	-	0.92	1.20	0.99	0.76	-

APPENDIX D. WATER BUDGET VALUES AND CALCULATION

1. Physical Parameters of Long Pond North Used in the Water Budget

Physical Parameter	Value	Units
Runoff Coefficient	0.622	meters/year
10 Year Mean Precipitation	1.057	meters/year
Evaporation Coefficient	0.560	meters/year
Watershed Area	2.316×10^7	$meters^2$
Lake Area	5.160×10^6	$meters^2$
Lake Volume	3.492×10^7	$meters^3$

2. Calculating Net Input (m^3/year) of Long Pond North

I_{net} = (runoff * watershed area) + (precipitation * lake area) – (evaporation * lake area)
$I_{net} = (0.622 * 2.316 \times 10^7) + (1.057 * 5.160 \times 10^6) – (0.560 * 5.160 \times 10^6)$

The net input to Long Pond North is 1.697×10^7 cubic meters per year.

3. Input of Lakes Draining into Long Pond North

Lake	Net Input (m^3/year)
Beaver Pond	2.398×10^6
Great Pond	1.034×10^8
Kidder and McIntire Ponds	9.072×10^5
Round Pond	2.257×10^6
Whittier and Watson Ponds	6.208×10^6

4. Flushing Rate (flushes/year)

Flushing Rate = [(I_{net} Long Pond) + (I_{net} $Input_1$) + … (I_{net} $Input_n$)] / (Volume of Lake)
Flushing Rate = $(1.324 \times 10^8)/(3.492 \times 10^7)$

The flushing rate of Long Pond North is 3.79 flushes per year.

5. Total Input (Q) to Long Pond North for Use in Phosphorus Budget

Q (Total) = (I_{net} Long Pond) + (I_{net} $Input_1$) + … (I_{net} $Input_n$)
Q (Total) = 1.324×10^8 cubic meters per year

APPENDIX E. PHOSPHORUS MODEL EQUATION

$$W = (Ec_a \times Area_s) + (Ec_{ag} \times Area_{ag}) + (Ec_{cf} \times Area_{cf}) + (Ec_{df} \times Area_{df}) + (Ec_{gc} \times Area_{gc}) + (Ec_w \times Area_w) + (Ec_{cc} \times Area_{cc}) + (Ec_{cm} \times Area_{cm}) + (Ec_{rl} \times Area_{rl}) + (Ec_{mf} \times Area_{mf}) + (Ec_{pk} \times Area_{pk}) + (Ec_{cr} \times Area_{cr}) + (Ec_{sr} \times Area_{sr}) + (Ec_s \times Area_s) + (Ec_n \times Area_n) + [(Ec_{ss} \times \#\ capita\ years \times (1\text{-}SR_1)) + (Ec_{ns} \times \#\ capita\ years_n \times (1\text{-}SR_2))] + (Sd_{cs} \times Area_{cs}) + PSI_{gp} + PSI_{bp} + PSI_{wp}$$

Ec_a = export coefficient for atmospheric input (kg/ha/yr)

Estimated Range = 0.11 – 0.21 Best Estimate = 0.16

Reckhow and Chapra (1983) derived an estimated atmospheric export coefficient range of 0.15 - 0.6. This study uses a lower range and best estimate based on a recent study of Togus Pond, which is located in the same county as Long Pond North (MDEP & MACD 2005). Air particulate content is most likely low for Long Pond North because it is far from any large city and has relatively little industry or agriculture.

Ec_{ag} = export coefficient for agricultural land (kg/ha/yr)

Estimated Range = 0. 2 – 1.3 Best Estimate = 0.5

This coefficient is based on Reckhow and Chapra’s study of Higgins Lake in Michigan (1983). Like Higgins Lake, Long Pond North’s agricultural land consists mostly of pasture. The best estimate is adapted from the grassland export coefficient from a past report on China Lake (CEAT 2005).

Ec_{cf} = export coefficient for coniferous forest (kg/ha/yr)

Estimated Range = 0.01 – 0.07 Best Estimate = 0.04

Coniferous forests contribute less phosphorus to lakes than deciduous forests because coniferous trees produce less leaf litter. The estimated range and best estimate are similar to those from a recent study of Togus Pond (MDEP & MACD 2005).

Ec_{df} = export coefficient for deciduous forest (kg/ha/yr)

Estimated Range = 0.02 – 0.09 Best Estimate = 0.06

This range is derived from a past study on Togus Pond, but is adapted to be slightly higher than the coniferous forest coefficient range because deciduous trees contribute more phosphorus to a lake (MDEP & MACD 2005). The best estimate is also higher than that of the coniferous forest for this same reason.

Ec_{gc} = export coefficient for golf course (kg/ha/yr)

Estimated Range = 0.3 – 1.00 Best Estimate = 0.50

For this study, the estimated range is adapted from Reckhow and Chapra’s (1983) agricultural export coefficient range of 0.2 - 1.30. The lower end is greater than that of Reckhow and Chapra’s because golf courses tend to be large and heavily fertilized. There is virtually no canopy to slow rain before ground impact, resulting in higher erosion rates. A similar range of 0.4 - 1.00 is used in a past report on Great Pond for industrial and municipal land, which mainly took into account the golf course’s phosphorus contribution (CEAT 1999).

Ec_w = export coefficient for wetlands (kg/ha/yr)

Estimated Range = 0.02 – 0.05 Best Estimate = 0.01

These low values are based upon a past study on Togus Pond, which yielded a range of 0 - 0.05 (MDEP & MACD 2005). Wetlands act as a sink for phosphorus, especially during the summer growing season, and therefore contribute very little phosphorus to the lake.

Ec_c = export coefficient for cleared land (kg/ha/yr)

Estimated Range = 0.10 – 1.00 Best Estimate = 0.40

A past Long Pond North report gives cleared land coefficients of 0.10 - 1.00 because at the time, there were no active farms within the watershed (CEAT 1995). The best estimate for this study is on the higher end because the horse farm reopened. Cleared land has higher rates of erosion and phosphorus runoff than forested lands.

Ec_{cm} = export coefficient for commercial land (kg/ha/yr)

Estimated Range = 0.40 – 1.00 Best Estimate = 0.40

The main component of Long Pond North's commercial land is the town of Belgrade Lakes, which sits between Long Pond and Great Pond. The export coefficients are similar to those from a past Great Pond study (CEAT 1999), with a higher best estimate since the town sits near the mouth of one of Long Pond North's main water inputs.

Ec_{cr} = export coefficient for camp roads (kg/ha/yr)

Estimated Range = 0.45 – 6.00 Best Estimate = 2.50

Ec_{sr} = export coefficient for state roads (kg/ha/yr)

Estimated Range = 0.25 – 4.00 Best Estimate = 1.00

These coefficients are adapted from a past study on Togus Pond (MDEP & MACD 2005). Camp roads have a higher best estimate because they are closer to the lake, mostly unpaved, and in poorer condition than the impervious, well-maintained state roads. Many Long Pond North camp roads are lacking proper drainage and crownage (see Watershed Development Patterns: Roads).

Ec_{mf} = export coefficient for mixed forest (kg/ha/yr)

Estimated Range = 0.02 – 0.08 Best Estimate = 0.05

Reckhow and Chapra report a general forest export coefficient of 0.02 - 0.45 in their study of Lake Higgins (1983). This study uses a lower upper limit and best estimate derived from a past Togus Pond study (MDEP & MACD 2005). Being comprised of both deciduous and coniferous trees, mixed forests contribute an intermediate amount of phosphorus to the lake.

Ec_s = export coefficient for shoreline development (kg/ha/yr)

Estimated Range = 0.50 – 1.3 Best Estimate = 2.00

Reckhow and Chapra assigned Higgins Lake a coeffient range of 0.35 - 2.7 (1983). Like Higgins Lake, Long Pond North is mostly a residential/recreational lake. The bottom limit for this study is higher than the 1983 Higgins Lake study to take increased development into account. A past study on Long Pond North reports an estimated range of 0.80 - 3.00 (CEAT 1995). The coefficient range and best estimate for this study are smaller than the 1995 range because although there has been more development, many of the new houses are built to code with proper septic and buffer requirements.

Ec_n = export coefficient for non-shoreline development (kg/ha/yr)

Estimated Range = 0.35 – 1.00 Best Estimate = 0.35

Non-shoreline homes are farther away from the lake and contribute less phosphorus than shoreline homes. Their coefficient range is therefore much less. The export coefficient is derived from a past study on Great Pond because of its similarity to Long Pond North (CEAT 1999).

Ec_{rl} = export coefficient for regenerating land (kg/ha/yr)

Estimated Range = 0.2 – 0.8 Best Estimate = 0.35

Regenerating land is defined as land that was cleared, but is currently undergoing early to mid-successional stages of growth. The estimated range was based on the reverting land coefficient from a study of Threemile Pond because of the lack of a full canopy (CEAT 2004). The best estimate was chosen to fall between that of forested and cleared land.

Ec_{pk} = export coefficient for park (kg/ha/yr)

Estimated Range = 0.20 – 0.80 Best Estimate = 0.30

Parkland is defined as open, grassy areas used mainly for recreation. The best estimate is less than that of the golf course because of the lack of fertilizer, and less than that of cleared land because parklands tend to be managed and contain very few trees. The estimated range is similar to the export coefficient for reverting land from a past China Lake report because reverting land characteristics are similar to those of parkland (mostly grasses and shrubs with less than 50 percent canopy cover) (CEAT 2005).

Ec_{ss} = export coefficient for shoreline septic tank systems (kg/ha/yr)

Estimated Range = 0.40 – 1.20 Best Estimate = 0.50

A study of Great Pond reported a conservative coefficient range of 0.5 - 1.30 because many areas around the lake have soils with poor septic suitability (CEAT 1999). The range for this study has been lowered because many of the septic systems around the lake have been brought up to date due to new construction or conversion from seasonal to year-round residency. Also, the soil around the lakeshore is mostly suitable for septic systems (see Watershed Development Patterns: Residential Survey: Septic Suitability Model). The best estimate is also on the lower end for these same reasons.

Ec_{ns} = export coefficient for non-shoreline septic tank systems (kg/ha/yr)

Estimated Range = 0.30 – 0.90 Best Estimate = 0.40

Non-shoreline septic tank systems should have a lesser effect on phosphorus runoff because of their distance from the shore. This range is based on a past study of nearby Great Pond (CEAT 1999).

SR_1 = soil retention coefficient for shoreline development

Estimated Range = 0.65 – 0.35 Best Estimate = 0.45

SR_2 = soil retention coefficient for non-shoreline development

Estimated Range = 0.90 – 0.75 Best Estimate = 0.80

Soil retention is a measurement of how well the soil can retain nutrients such as phosphorus. This coefficient ranges from 0 to 1 with greater values representing a greater capacity to hold phosphorus. Soils with larger particles tend to retain less and have higher coefficients than those with smaller particles. The soil around the shore consists mostly of Berkshire stony, which has a moderately coarse texture and drains well. This increases the likelihood of septic leakage percolating into the soil and traveling towards this lake. A lower coefficient range similar to Togus Pond is used because its soil is also of moderate permeability and excessively drained (CEAT 2005). The soil retention farther away from the shoreline affects phosphorus runoff less, so a higher coefficient range and estimate are granted to non-shoreline development.

PSI_{gp} = point-source input from Great Pond (kg/yr)

Best Estimate = 898.72

Great Pond flows directly into Long Pond North via a dam on the Long Pond North eastern shore. CEAT calculated from summer 2006 measurements of Great Pond that mean (± SE) epicore total phosphorus is approximately 8.7 ppb ± 1.3. Using the amount of water entering Long Pond North from this lake, the total mass input from this point source was calculated to be 898.72 kg/yr.

PSI_{bp} = point-source input from Beaver Pond (kg/yr)

Best Estimate = 27.6

McIntire Pond empties into Kidder Pond, which flows into Round Pond, which empties into Beaver Pond and eventually flows into Long Pond North via Beaver Brook in the northwest. The surface total phosphorus concentration of Beaver Pond was 10.0 ppb in 2004 (PEARL 2006), whereas Beaver Brook was measured by CEAT to have a surface total phosphorus concentration of 13.0 ppb in 2006. For this point-source input calculation, an average of the two values (11.5 ppb) was used. The total mass input (27.6 kg/yr) was calculated using the amount of water entering Long Pond North from Beaver Pond.

PSI_{wp} = point-source input form Whittier Pond (kg/yr)

Best Estimate = 117.8

Watson Pond empties into Whittier Pond, which flows into Long Pond North via a tributary in the northern-most region of the lake. The epicore total phosphorus of Whittier Pond in 2004 was 19 ppb (PEARL 2006). Using the amount of water entering Long Pond north from Whittier Pond, the total mass input from this point source was calculated to be 117.8 kg/yr.

Areas of Land-Use Components:

Area Symbol	**Area Term**	**Area (ha)**
A_s	Area of Long Pond North	595.00
$Area_f$	Area of mature forest	746.10
$Area_{cf}$	Area of coniferous forest	482.52
$Area_{df}$	Area of deciduous forest	410.94
$Area_w$	Area of wetlands	35.13
$Area_c$	Area of cleared land	17.40
$Area_{rl}$	Area of regenerating land	61.83
$Area_{cm}$	Area of commercial land	3.50
$Area_{pk}$	Area of park land	0.24
$Area_{gc}$	Area of golf course	5.31
$Area_{cr}$	Area of camp roads	33.00
$Area_{sr}$	Area of state roads	18.00
$Area_s$	Area of shoreline residential land	52.81
$Area_n$	Area of non-shoreline residential land	85.80

APPENDIX F. PREDICTIONS FOR ANNUAL MASS RATE OF PHOSPHORUS INFLOW

The phosphorus loading model used by CEAT in this study presents the annual total phosphorus input as a loading per unit lake surface in kg/ha. This was estimated by dividing the total phosphorus inflow (W) by the surface area of Long Pond North (A_s) (Reckhow and Chapra 1983):

$L = W / A_s$

L	= areal phosphorus loading (kg/ha/yr)
W	= annual mass rate of phosphorus inflow (kg/yr)
A_s	= surface area of the lake (m^2)

Atmospheric water loading was calculated by dividing the total inflow water volume by the surface area of the lake (A_s) (Reckhow and Chapra 1983):

$q_s = Q_{total} / A_s$

q_s	= areal water loading (m/yr)
Q_{total}	= total inflow water volume (m^3/yr)

Low, best, and high estimates of total phosphorus concentration were then calculated by dividing the total atmospheric phosphorus loading by the approximation of phosphorus settling velocity in the lake (Reckhow and Chapra 1983):

$P = L / (11.6 + 1.2q_s)$

P	= total phosphorus concentration (ppb)

Constants for low, best, and high estimates for Long Pond:

A_s	= 5159746.5 m^2
Q_{total}	= 132387058.4 m^3
q_s	= 25.66 m/yr

Low Estimate:		**Without Sediment Release**	**With Sediment Release**
W	=	1303.31 kg/yr	1354.91 kg/yr
L	=	0.25 kg/ha/yr	0.26 kg/ha/yr
P	=	5.96 ppb	6.19 ppb
Best Estimate:			
W	=	1601.78 kg/yr	1911.37 kg/yr
L	=	0.31 kg/ha/yr	0.37 kg/ha/yr
P	=	7.32 ppb	8.74 ppb
High Estimate:			
W	=	2259.70 kg/yr	2793.52 kg/yr
L	=	0.44 kg/ha/yr	0.54 kg/ha/yr
P	=	10.33 ppb	12.69 ppb

APPENDIX G. ROAD INDEX FIGURES AND SURVEY FORMS

ROAD SURVEY DATA SHEET 2006

DATE:		SURVEYORS:	ROAD NAME: ROAD TYPE:	state road
GPS at start of road:				camp road
GPS at end of road:				other:
ROAD LENGTH (MILES):				
AVERAGE WIDTH (FEET, include shoulders):				
HOUSE COUNT (tally # of houses per road)		Year-Round Not Shore #:		Shoreline:
		Seasonal Not Shore #:		Shoreline:
NOTE COMMERCIAL LAND USE, GPS (gas stations, stores, etc.):				
TALLY # INACCESSABLE LAKEFRONT DRIVEWAYS:				
SLOPE: Draw road profile, label with significant slope range		0-5%, 6-10%, 11-15%, 16-20%, >20% describe any discrepancies		
DESCRIBE CROWN:				
measurment:	0-2 in	2-4 in	4-6 in	6-8 in
DESCRIBE DITCH CONDITION: shape: vegetation, stone-lined, mixed dirt/gravel, dirt: clear of debris?				
DESCRIBE ROAD SURFACE CONDITION: surface material (gravel, gravel/sand, dirt, sand/clay, clay, pavement): age of road (new or old) road use (year round or seasonal):				
BASIC SUMMARY:				
OVERALL CONDITION	good	acceptable	fair	poor

APPENDIX G. (continued)

Road Survey Data Sheet for Problem areas

Please address these issues for the following problem areas:

Crown- height, edge (berms or ridges preventing water?)

Ditch- depth and width, vegetation, sediments, shape.

Diversion- needed? where does water runoff go?

Culvert- wear (erosion/crushed), diameter, inside, covering material

Problem #					
GPS reading					
Location on road (miles)					
Problem area	crown	ditch	diversion	culvert	other
Summary (address issues above, what needs to be done):					

APPENDIX H. PERSONAL COMMUNICATIONS

Bacon, Earl	Long Pond North resident
Bouchard, Roy	Maine Department of Environmental Protection
Firmage, David	Biology Department, Colby College
Fuller, Gary	Code Enforcement Officer, Belgrade Municipal Office
Keschl, Dennis	Town Manager, Belgrade Municipal Office
Najpauer, William	Code Enforcement Officer, Rome Municipal Office

APPENDIX I. BUFFER STRIP SURVEY

Group Members				Date:		
Reference Number:						
GPS Coordinates:						
% Shoreline w/Buffer	0	1-25	26-50	51-75	Over 75	
	0	1	2	3	4	
Buffer Depth from Shore (ft)	0	1-10	11-33	34-65	Over 65	
	0	1	2	3	4	
Slope Rating		Steep	Moderately Steep	Small Incline	Flat	
		1	2	3	4	
Buffer Composition	100%	75%	50%	25%	0%	
Trees	4	3	2	1	0	
Shrubs/Herbaceous	10	8	6	4	0	
Total						
Building Type	Year Round Residence		Seasonal Residence		Commercial	
Lot Shoreline Distance (ft)	0-60	60-120	120-180	Over 180		
Noticeable Outdoor Septic	Yes		No			
Rip Rap	Exists		Needed			

APPENDIX J. RESIDENTIAL SURVEY FORM

OVERALL ROAD SURVEY DATA SHEET 2006

DATE:		SURVEYORS:	ROAD NAME:	
			ROAD TYPE:	state road
GPS at start of road:				camp road
GPS at end of road:				other:
ROAD LENGTH (MILES):				
AVERAGE WIDTH (FEET, include shoulders):				
HOUSE COUNT (tally # of houses per road)		Year-Round Not Shore #:		Shoreline:
		Seasonal Not Shore #:		Shoreline:
NOTE COMMERCIAL LAND USE, GPS (gas stations, stores, etc.):				
TALLY # INACCESSABLE LAKEFRONT DRIVEWAYS:				
SLOPE: Draw road profile, label with significant slope range			0-5%, 6-10%, 11-15%, 16-20%, >20% describe any discrepancies	
DESCRIBE CROWN:				
measurment:	0-2 in	2-4 in	4-6 in	6-8 in
DESCRIBE DITCH CONDITION: shape: vegetation, stone-lined, mixed dirt/gravel, dirt: clear of debris?				
DESCRIBE ROAD SURFACE CONDITION: surface material (gravel, gravel/sand, dirt, sand/clay, clay, pavement): age of road (new or old) road use (year round or seasonal):				
BASIC SUMMARY:				
OVERALL CONDITION	good	acceptable	fair	poor

Road Survey Data Sheet for Problem areas

Please address these issues for the following problem areas:

Crown- height, edge (berms or ridges preventing water?)

Ditch- depth and width, vegetation, sediments, shape.

Diversion- needed? where does water runoff go?

Culvert- wear (erosion/crushed), diameter, inside, covering material

Problem #					
GPS reading					
Location on road (miles)					
Problem area	crown	ditch	diversion	culvert	other
Summary (address issues above, what needs to be done):					