

# Table of Contents

<b>WATERSHED ASSESSMENT INTRODUCTION .....</b>	<b>1</b>
EXECUTIVE SUMMARY .....	1
LONG POND CHARACTERISTICS .....	35
Watershed Description.....	35
Historical Perspective .....	37
Water Quality.....	37
General Chemistry .....	37
Gloeotrichia.....	38
Regional Land-use Trends.....	38
Biological Perspective .....	40
Introduction.....	40
Native Aquatic Flora.....	40
Fish Stocking .....	40
Invasive Plants .....	42
Trophic Status .....	42
Geological and Hydrological Perspective.....	43
STUDY OBJECTIVES.....	45
Introduction .....	45
Land-Use Assessment.....	45
Water-Quality Assessment.....	45
Future Trends .....	46
<b>ANALYTICAL PROCEDURES AND RESULTS .....</b>	<b>47</b>
GIS .....	47
Introduction.....	47
WATERSHED LAND-USE PATTERNS.....	49
Introduction.....	49
Methodology .....	49
Wetlands .....	53
Forest Types.....	56
Cleared Land.....	58
Regenerating Land.....	59
Commercial and Residential.....	59
WATERSHED DEVELOPMENT PATTERNS .....	61
Roads.....	61
Introduction.....	61
Methods.....	62
Results and Discussion .....	63
Road Problems .....	64
Residential Survey .....	72
House Count.....	72
Introduction.....	72
Methods.....	72

Results and Discussion .....	73
Buffer Strips.....	74
Introduction.....	74
Methods.....	75
Results and Discussion .....	76
Subsurface Disposal Systems .....	79
Introduction.....	79
Methods.....	80
Results and Discussion .....	80
Septic Suitability Model .....	81
Introduction.....	81
Methods.....	82
Results and Discussion .....	82
Erosion Potential Model .....	85
Introduction.....	85
Methods.....	86
Soils.....	86
Slope .....	86
Land Use .....	87
Weighted Overlay .....	88
Results and Discussion .....	89
Erosion Impact Model.....	91
Introduction.....	91
Methods.....	91
Erosion Potential.....	91
Proximity Zones.....	91
Weighted Overlay .....	91
Results and Discussion .....	92
Development Potential Model .....	93
Introduction.....	93
Methods.....	93
Results.....	95
WATER QUALITY STUDY SITES.....	97
Sample Sites.....	97
Tributaries .....	97
LONG POND WATER QUALITY ASSESSMENT .....	99
Physical Measurements.....	99
Dissolved Oxygen and Temperature.....	99
Introduction.....	99
Transparency.....	106
Introduction.....	106
Methods.....	107
Results and Discussion .....	107
Turbidity .....	109
Introduction.....	109
Methods.....	109

Results and Discussion .....	110
Chemical Analyses.....	111
pH.....	111
Introduction.....	111
Total Phosphorus .....	114
Introduction.....	114
Methods.....	115
Results and Discussion .....	116
Biological Parameters .....	119
Chlorophyll-a .....	119
Introduction.....	119
Methods .....	119
Results and Discussion .....	120
WATER BUDGET .....	123
Introduction.....	123
Methods.....	123
Results and Discussion .....	124
PHOSPHORUS BUDGET .....	127
Introduction.....	127
Methods.....	127
Results and Discussion .....	128
<b>FUTURE PROJECTIONS.....</b>	<b>131</b>
POPULATION TRENDS .....	131
Historic Population Trends .....	131
Future Population and Development Trends .....	132
<b>RECOMMENDATIONS.....</b>	<b>133</b>
WATERSHED MANAGEMENT .....	133
Roads.....	133
Land Use .....	133
Boat Ramp .....	134
Community Awareness and Education.....	134
<b>ACKNOWLEDGEMENTS .....</b>	<b>136</b>
<b>LITERATURE CITED .....</b>	<b>137</b>
<b>APPENDICES.....</b>	<b>142</b>

## Tables

<b>Table 1.</b>	Characteristics of oligotrophic, eutrophic, and dystrophic lakes.....	9
<b>Table 2.</b>	Characteristics of freshwater inland wetlands .....	33
<b>Table 3.</b>	Fish species present in Long Pond.....	41
<b>Table 4.</b>	Invasive aquatic plants threatening Maine's inland waters .....	42
<b>Table 5.</b>	Percent area of land-use types .....	54
<b>Table 6.</b>	House count comparison for 1995 and 2006.....	60
<b>Table 7.</b>	House count data by category for 2006.....	73
<b>Table 8.</b>	Residential density for selected Maine lakes.....	74
<b>Table 9.</b>	Land-use erosion potential ratings .....	87
<b>Table 10.</b>	Mean surface pH of Long Pond North and nearby lakes .....	114
<b>Table 11.</b>	Flushing rate of Long Pond North and other Belgrade lakes .....	126
<b>Table 12.</b>	Percent contribution of phosphorus by land-use type.....	130

## Figures

<b>Figure 1.</b>	Lake turnover.....	7
<b>Figure 2.</b>	Phosphorus cycles within a lake.....	12
<b>Figure 3.</b>	Nitrogen cycles within a lake .....	13
<b>Figure 4.</b>	Runoff characteristics of watersheds near Augusta, Maine .....	17
<b>Figure 5.</b>	Ideally buffered home.....	20
<b>Figure 6.</b>	Layout of a typical septic system .....	23
<b>Figure 7.</b>	Components of a typical septic system treatment tank.....	24
<b>Figure 8.</b>	Political boundaries dividing the Long Pond North watershed.....	36
<b>Figure 9.</b>	Land-use map of Long Pond North watershed.....	55
<b>Figure 10.</b>	Percent land-cover comparison, 1991 and 2003.....	57
<b>Figure 11.</b>	Photo of a good culvert.....	62
<b>Figure 12.</b>	Photo of a poorly maintained culvert .....	62
<b>Figure 13.</b>	Photo of an eroded road in need of a diversion .....	63
<b>Figure 14.</b>	Percent road area of camp and state roads categorized by quality .....	64
<b>Figure 15.</b>	Road ratings map for the Long Pond North watershed .....	65
<b>Figure 16.</b>	Road problem sites within the Long Pond North watershed.....	66
<b>Figure 17.</b>	Photos of a good and poor buffer .....	75
<b>Figure 18.</b>	Percent of properties in each buffer quality category .....	77
<b>Figure 19.</b>	Composition of buffer quality categories by lot size.....	77
<b>Figure 20.</b>	Buffer quality map of Long Pond North’s shoreline.....	78
<b>Figure 21.</b>	Soil series map of the Long Pond North watershed .....	83
<b>Figure 22.</b>	Septic suitability map of the Long Pond North watershed.....	84
<b>Figure 23.</b>	Erosion potential flowchart used for GIS map .....	89
<b>Figure 24.</b>	Erosion potential map of the Long Pond North watershed .....	90
<b>Figure 25.</b>	Impact of erosion flowchart used for GIS map .....	92
<b>Figure 26.</b>	Impact of erosion map of the Long Pond North watershed.....	94
<b>Figure 27.</b>	Development potential map of the Long Pond North watershed .....	96
<b>Figure 28.</b>	Sampling locations on Long Pond North .....	98
<b>Figure 29.</b>	Dissolved oxygen profile at site 1 for summer 2006.....	101
<b>Figure 30.</b>	Projected anoxic areas in Long Pond North during summer 2006.....	102
<b>Figure 31.</b>	Historic depths of low dissolved oxygen concentration at site 1 .....	103
<b>Figure 32.</b>	Temperature profile at sites 1 and 3 for summer 2006.....	104
<b>Figure 33.</b>	Historic temperature profile for site 1 .....	105
<b>Figure 34.</b>	Temperature and dissolved oxygen profiles for two dates at site 1.....	106
<b>Figure 35.</b>	Mean Secchi depth at site 1-3 during summer 2006 .....	108
<b>Figure 36.</b>	Historic water clarity at site 1 .....	108
<b>Figure 37.</b>	Surface, mid, and bottom turbidity at site 1 for summer 2006.....	110
<b>Figure 38.</b>	Mean surface trubidity at sites 1-4 for summer 2006.....	111
<b>Figure 39.</b>	Profile of pH at site 1 for summer 2006 .....	113
<b>Figure 40.</b>	Historic pH values at site 1 .....	114
<b>Figure 41.</b>	Mean total phosphorus at sites 1-4 for summer 2006.....	116
<b>Figure 42.</b>	Mean phosphorus concentrarions at site 1 in June, July, and August 2006 .....	117
<b>Figure 43.</b>	Mean phosphorus concentrations at site 3 in June, July, and August 2006 .....	118

**Figure 44.** Historic phosphorus concentrations at site 1 ..... 119  
**Figure 45.** Chlorophyll profile at sites 1 and 2 for summer 2006..... 121  
**Figure 46.** Historic chlorophyll concentrations at site 1 ..... 122  
**Figure 47.** Long Pond North direct and indirect watershed map ..... 125  
**Figure 48.** Population trends for the towns of Belgrade and Rome ..... 131

## Appendices

<b>Appendix A.</b>	Water-Quality Measurements and Tests .....	143
<b>Appendix B.</b>	Quality Assurance.....	144
<b>Appendix C.</b>	Physical Measurements & Chemical Analyses of Long Pond Water Quality	148
<b>Appendix D.</b>	Water Budget Values and Calculation .....	159
<b>Appendix E.</b>	Phosphorus Model Equation.....	160
<b>Appendix F.</b>	Predictions for Annual Mass Rate of Phosphorus Inflow.....	164
<b>Appendix G.</b>	Road index Figures and Survey Forms .....	165
<b>Appendix H.</b>	Personal Communications.....	167
<b>Appendix I.</b>	Buffer Strip Survey.....	168
<b>Appendix J.</b>	Residential Survey Form.....	169

