

Proposal

Maranacook Lake Watershed Hydrologic Study



From:

Northstar Hydro, Inc.

8 Go Way

Winthrop, ME 04364

To:

Mr. Jeffrey Woolston

Town Manager

Winthrop Town Office

17 Highland Avenue

Winthrop, ME 04364

Northstar Hydro, Inc.

Ms. Wendy Dennis
Cobbossee Watershed District
Maranacook Outlet Dam Study Committee
167 Main Street
Winthrop, ME 04364

September 25, 2014

Re: Proposal to: Develop a Hydrologic Model for the Cobbossee Watershed in the Towns of Winthrop and Readfield

Dear Wendy;

Thank you for contacting Northstar Hydro, Inc. to assist with developing a hydrologic model which includes the outlet dam for Maranacook Lake. Thank you for the informative site visit last Thursday. The following information is offered to describe our understanding of the project and our proposal to develop a watershed model. In addition to background included in our resumes and firm background sheet, we recently completed a study for a small dam in Washington County related to fish passage/dam reconstruction and water levels. We also recently completed a detailed study for a dam removal in Pennsylvania. Northstar Hydro includes Ellen O'Brien, P.E., C.G and Nicole Buck, also a P.E. and C.G., specializing in GIS applications in hydrology. Ms. O'Brien lives in Winthrop and is very familiar with the Maranacook lake watershed. As a small, local firm, we can provide excellent cost control for this project as well as specialized hydrologic services.

Project Purpose and Scope

In recent years, the Maranacook Lake Dam located in the Town of Winthrop, ME, was replaced with a new dam. Since the dam replacement, residents along the Lake have noted higher than normal lake levels and longer lasting high water periods. The new dam was subsequently modified but high lake levels persist. Phase I of the proposed project aims to develop a hydrologic model and conduct a preliminary analysis of the Cobbossee watershed with an outlet at the Maranacook Lake Dam. The drainage basin upstream of the dam outlet is approximately 20,500 acres or 32.0 square miles. In Phase II, the model could be applied in reevaluation of the Dam design in an effort to improve its operational capacity and potentially address some downstream scour/erosion issues.

Project Approach

*8 Go Way * Winthrop, ME 04364 * 207-377-8043 * cell 207-458-2997*
www.northstarhydro.com * ekobrien@fairpoint.net

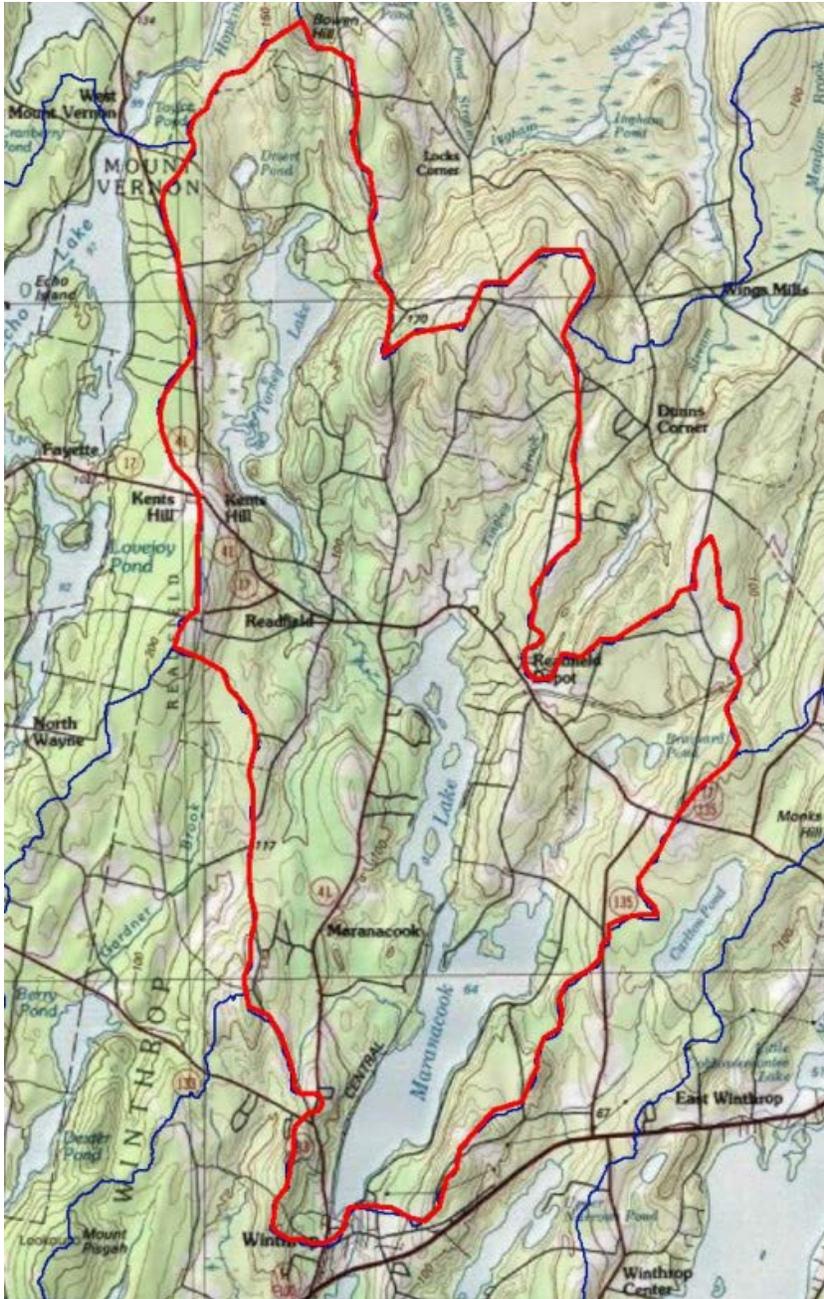


Figure 1: Maranacook Dam Watershed Map (32.0 sq. mi.)

The hydrologic model of the Cobbossee watershed will be built in the Hydraulic Engineering Center – Hydrologic Modeling System (HEC-HMS) software. The software is developed and maintained by the Army Corps of Engineers. This model is publicly available and incorporates a variety of model options. A version of the HEC-HMS software integrates with the commercial ArcGIS software developed by ESRI which will be used to convert geographic datasets into data to be used in the hydrologic model. Unless higher resolution data is available, the following nationally available geographic datasets will be used to develop the model: USGS Digital Elevation Models (DEM), National Hydrography Dataset (NHD) Drainage Network, Soil Survey Geographic Database (SSURGO), 2006 Land Cover Database, and rainfall data from the National Climatic

Data Center gage at Augusta Airport. Finally, observations of lake levels and daily rainfall by Cobbossee Watershed District Personnel will be used to calibrate model outputs. While invaluable, this data is weekday observations of rainfall and lake levels, limiting calibration quality.

The national datasets will be processed in ArcGIS to develop the set of parameters necessary for building a HEC-HMS model. The DEM will be used to develop the Cobbossee watershed boundaries as well as selected internal sub-watershed boundaries; the slope, flow direction, and

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accumulation maps; and river reaches. The stream reaches resulting from the DEM analysis will be compared with the NHD Drainage Network. The SSURGO and 2006 Land Cover Databases will be combined to develop the runoff curve number for each sub-watershed. Dam information for upstream dams will be obtained from the Maine DEP and information available through CWD. In addition to the 1, 2, 5, 10, 25, 50, and 100 year design storms, actual precipitation events from the nearest rain gage (Augusta State Airport) will be compared to design storms and a hyetograph will be developed to simulate rainfall events observed at the Lake. These rainfall events will be used to calibrate the model in conjunction with the Lake levels recorded by the CWD. For Phase II work on dam design and long term water level planning, it may be possible to set the watershed model such that the model can import NEXRAD data from NOAA and analyze real storm data on the watershed. This effort is time consuming and costly so is not included for this phase of the model.

A new rating curve for the dam and bridge will be developed using either detailed or approximate survey (see below) of the dam and bridge, run through a HECRAS hydraulic model.

Available Data:

Cobboossee Watershed District has furnished the following data related to the project:

- Photographs of existing dam and description of dam modification
- Tables and Graphs of precipitation and Lake Level for 2008, 2009, 2010, 2011, 2012 and 2013
- Rating curve for existing dam and former dam with 15" higher spillway
- USGS gage number 01049373, Mill Stream at Winthrop, ME. Record from 1977-1992, includes stream flow measurements in Mill Stream, downstream from Maranacook Lake dam.
- Photographs of the existing dam. (example below)



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Data that will be needed includes:

- Surveyed plan of existing dam and bridge at same datum (NGVD) as water level data (see survey options below).

Data gaps are likely to include, but may not be limited to:

- Water level data related to hourly rainfall
- Upstream data for Torsey Pond
- Maranacook Dam original dam configuration
- Watershed elevation data limited to approximately 10 m (33 ft) grid size resolution

Survey Options

Northstar Hydro is proposing two survey options:

1. Hire a licensed surveyor to collect seven cross sections in the area of the dam: below the dam, the dam crest, just upstream of the dam, and 4 sections at the bridge just upstream. These sections would be a critical component of the Phase II analysis of dam modifications.
2. Northstar Hydro will conduct a simplified survey of the dam area using a weighed tape and a water level measurement from the gage to estimate the bottom elevations. CWD staff would be invited to assist with this survey to contain costs.

Deliverables

At the termination of the project, a calibrated HEC-HMS model of the Cobbossee watershed will be digitally delivered along with a hardcopy write up of the process taken to develop the model, information on model calibration, results of modeled storms, recommendations for further evaluation based on modeled dam reconfigurations, and basic instructions for running the model. All intermediary GIS files will be included in the digital file.

The Phase I study goal is to develop a representative hydrologic model of the Cobbossee watershed which can be used in a Phase II study considering modification of the current dam for water level optimization. It is expected that Cobbossee Watershed will assist in setting desirable water levels as the study progresses.

Expected Cost:

We propose to provide the hydrologic model for a flat fee of \$7500.00 plus the cost of obtaining bottom elevations in the area of the dam. This fee likely does not reflect the actual time and cost of preparing the detail that will be required to arrive at a model that can accurately model the watershed, but because this is a local project, I have adjusted the fee to reflect my commitment to this community.

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Total Costs:

Survey Option 1 (Licensed Survey): $\$7,500.00 + \$2,500.00 = \$10,000.00$

Survey Option 2 (Simplified Survey): $\$7,500.00 + \$500.00 = \$8,000.00$

Personnel:

The project will be led by Ellen O'Brien, P.E., C.G. of Winthrop. Ms. O'Brien has over 30 years of experience in hydrologic and hydraulic modeling for engineering applications. She has owned Northstar Hydro, Inc. since 1994, working for many of Maine's large engineering companies on specialized hydrology/hydraulics applications for engineering.

Nicole Buck, P.E. of Hartland, Vermont will join the team as the hydrologic modeler, with specialized expertise in integration of GIS technology with hydrologic modeling. Ms. Buck has a Master's degree in hydrology and over 15 years experience using GIS in engineering and geological applications throughout the US. Previous employers include the Army Corps of Engineers as well as several regional engineering firms.

We look forward to working with you. Please do not hesitate to ask if you have questions.

Sincerely,

Ellen K. O'Brien, P.E., C.G.
President, Northstar Hydro, Inc.

NORTHSTAR HYDRO, Inc.

Northstar Hydro, Inc.’s goal is to provide *excellence in consulting engineering and scientific hydrology*. Northstar is a sole-proprietorship founded in 1994 by Ellen O’Brien, specializing in surface- and ground-water hydrology. With over 30 years of professional experience, Ms. O’Brien is licensed in engineering and geology, and has taught courses in hydrology at Bates College. Located in Winthrop, Maine, Northstar is certified as a DBE/WBE in Maine, Vermont, Massachusetts, Rhode Island, and New Hampshire. Prior to forming Northstar Hydro, Ms. O’Brien was associated with a small hydrogeologic and engineering consulting firm in Maine, and before that with DMJM Harris (now AECOM) in Boston, Mass.

Northstar Hydro has provided specialized expertise to engineers and planners in the field of hydrology and hydraulics. Northstar Hydro has provided hydrologic, hydraulic, and scour design services for bridge replacement projects in Maine, Massachusetts, Rhode Island and elsewhere. Northstar has performed many scour evaluations and inspections for existing bridges in Maine. For example, Northstar provided the hydraulic and scour analysis for the Martin’s Point Bridge between Portland and Falmouth, Maine.

Northstar has provided design services associated with stormwater management on many roadway reconstruction and realignment projects in Maine such as Route 2 in Mexico/Dixfield, Route 2 in Bethel-Gilead, Route 201 in Farmingdale, and the Route 3 bypass and bridge in Augusta, as well as several projects in Massachusetts. Northstar Hydro completed a GIS based hydrologic model of the Saco River Basin for the University of New England.

Ms. O’Brien and Northstar Hydro have managed over 100 Flood Insurance Studies in Maine, Massachusetts and Rhode Island. Northstar has also worked on a number of studies involved in dam reconstruction or other dam related issues.

Subsurface hydrologic experience includes work on water supply development, contamination investigations, quarry operations, landfills, underground tanks and other hydrogeologic issues.

Modeling capabilities include 1- and 2-dimensional flow modeling, as well as GIS based modeling support. Professional services include: hydrologic systems analysis, coastal hydrology/hydraulics, riverine hydraulics, scour evaluations, surface water hydrology, ground water hydrology, stormwater management, erosion control, roadway and railroad drainage. Computer modeling experience includes two dimensional flow analysis using SMS – RMA2, hydrology models such as HEC-HMS, TR20, TR55, Hydrocad, riverine hydraulics – HECRAS, stormwater modeling with Hydraflow and GIS applications in water resources.

Recently Northstar Hydro has teamed with Nicole Buck Engineering based in Hartland, Vermont. Ms. Buck is a geologist and licensed engineer with over 15 years of experience specializing in hydrology and hydraulics. Ms. Buck has particular expertise in advanced hydrologic GIS applications and sediment transport. Prior to forming Nicole Buck Engineering, Ms. Buck performed technical research for the Army Corps of Engineers and was associated with several engineering consulting firms in Vermont and New Hampshire.

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[email ekobrien@northstarhydro.com](mailto:ekobrien@northstarhydro.com)* www.northstarhydro.com*

ELLEN K. O'BRIEN, C.G. P.E.
PROFESSIONAL PROFILE



8 Go Way, Winthrop, ME 04364. 207-458-2997. ekobrien@fairpoint.net

Certifications

Certified Geologist - State of Maine #245

Professional Engineer - State of Maine #7945

Education

Northeastern University: M.S.C.E., Environmental Engineering/Water Resources, 1984

University of New Hampshire: B.S., Hydrology, summa cum laude, 1976

Employment History

1994- Present. President, CEO, Northstar Hydro, Inc., Winthrop, Maine. Private Consultant specializing in engineering applications for surface-and ground-water hydrology and hydraulics of inland and coastal waters: analysis and modelling - rivers, bridges, dams, stormwater, flooding. Responsible for all business operations, including marketing, book keeping, financial records, office management, client contact, registrations, etc. as well as professional services.

1987-1994. Project Manager/ Senior Hydrologist. Acheron Engineering Services, Winthrop, Maine. Responsible for surface- and ground-water hydrologic and hydraulic

investigations for various projects, including project oversight. Management of eleven coastal flood insurance studies in northern Maine involving hydrology and hydraulics of tidal systems. Other projects include dam investigations and hydrogeologic and contaminant investigations.

1982 -1986. Private Consultant, Hydrology, Mechanic Falls, Maine. As private consultant, conducted Flood Insurance Studies for inland and coastal systems, tidal flooding analyses for several proposed coastal developments, design review of stormwater management systems for several proposed coastal developments and numerous subdivisions and developments, dam investigations, water system evaluations, and hydrogeologic studies.

1979-1983. Hydrologist, Project Manager/Project Engineer, PRC Engineering/Frederic R. Harris, Boston, MA. Management of various water resources projects involving hydrology and hydraulics of freshwater and tidal systems, and their response to transient conditions, including the application of computer modeling techniques and all hydrologic/hydraulic analyses for water resources department.

Teaching Experience

1987-1992. Bates College, Lewiston, Maine, Lecturer, Geology Department - Courses included Surface Water Hydrology and Ground Water Hydrology.

Computer Modeling Experience

Arview GIS, HECRAS, HECHMS, TR55, TR20, Hydrocad, RMA2, BOSS SMS, 2-d coastal models on Stormsurge and Northeaster/Hurricanes

Affiliations

American Society of Civil Engineers, and Maine ASCE Board of Directors (2008-present), President Elect
Geological Society of Maine
American Institute of Hydrology

Public Service

Theater at Monmouth, Board of Directors, 2006 to present
Board of Education, 1996-2006, Chair 2001, 2002, 2005, 2006, Winthrop, Maine
Lower Ninth Ward, New Orleans, 2007, Coordinated group of 26 volunteers from central Maine to work on recovery efforts
Saint Bernard Project, October 2006, St. Bernard Parish, New Orleans, LA, gutting houses
American Lung Association, Trek Across Maine, 180 mile, 3-day bike ride, 18 year vet

PO Box 377, Hartland, VT 05048
(802) 436-1060
nbuckengineering@gmail.com

Certifications

Professional Engineer - State of Vermont #88850

Education

Dartmouth College: M.S. Earth Sciences, specializing in Hydrology and Geomorphology, 2008.

Bucknell University: B.S. Civil Engineering, cum laude, 1998.

Bucknell University: B.A. Environmental Geology, cum laude, 1998.

Employment History

2014 – Present: Nicole Buck Engineering, PLC, Sole Proprietor, Hartland, Vermont. Private consultant specializing hydrologic and hydraulic studies for engineering applications. Services include hydrologic GIS analysis; model development of river channels, dams, and bridges; and drainage analysis. Responsible for all business management activities.

2012 – Present: Dartmouth College, Emergency Management Coordinator (part-time), Hanover, New Hampshire. Coordinate emergency response planning and preparedness for the College.

2009 – 2012: US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire. Research Engineer studying the effects of moisture and biopolymers on the entrainment of poorly graded sands and silts and worked toward the development of a fundamental eolian sediment transport equation; the impact of high-speed vehicle maneuvers on loose-surfaces and the dynamic relationship between surface conditions, particle motion, and vehicle mobility; and the effectiveness of a GIS-based geomorphic decision tree model in predicting near-surface geologic materials.

2006 – 2008: Dartmouth College, Research Assistant, Hanover, New Hampshire. Researched the vertical structure of turbulent high-density silt suspensions under steady state conditions in an oval race-track flume in an effort to further the understanding of rivers, lakes, and coastal regions during episodic floods, storm surges, and spring tides.

2006: Bruno Associates, Engineer, Woodstock, Vermont. Determined the effects of site development on local drainage areas and watersheds including designing and permitting drainage systems using multiple hydrologic models.

2001 – 2005: Resource Systems Group, Inc., Project Associate, White River Junction, Vermont. Managed small and large scale transportation planning and traffic operations projects. Conducted site investigations, performed data analysis, recommended transportation improvements to private and public clients, and developed mathematical models of regional (county based) traffic flow.

2000 – 2001: Pathways Consulting/T&M Associates, Engineer, Lebanon, New Hampshire. Designed site plans, drainage, sewer, water, and remedial systems and performed hydrologic and environmental analysis for design purposes.

1998 – 2000: Environmental Strategies Corporation, Engineer/Geologist, Reston, Virginia. Designed and oversaw soil and groundwater remediation projects including dual and soil vapor extraction, bio-venting systems, barrier walls, and wastewater treatment systems.

Computer Modeling Experience

ArcGIS, Quantum GIS, HEC-RAS, HEC-HMS, TR-55, TR-20, PondPack, AutoCAD, Matlab, and TransCAD.

Publications

Haehnel, R., Buck, N., Song, A. (2013) *Moisture effects on eolian particle entrainment*. Journal of Environmental Fluid Mechanics.

Buck, N., Shoop, S. and Cary, T. (2012) *Initial Effects of Heavy Vehicle Trafficking on Vegetated Soils*. USA ERDC-CRREL Report (TR-12-6).

Buck, N., Shoop, S. and Coutermarsh, B. (2010) *Loose surface vehicle-terrain dynamics during high-speed maneuvers*. USA ERDC-CRREL Report (TR-16149).

Shoop, S., Cary, T., Barna, L., Buck, N., Howard, H. (2010) *Experimental Program for the assessment of vegetation effects on soil strength and trafficability*. Conference Paper: ISTVS Sapporo, Japan Sept. 27-30, 2010.

Lawe, Stephen and Buck, Nicole, 2005; *Modeling Future Conditions Where Demand Far Exceeds Supply*, 10th TRB Transportation Planning Applications Conference Proceedings.

Affiliations

American Geophysical Union

Community Service

2001 – Present: Hartland Volunteer Fire Department, Lieutenant (former), Fire Prevention Officer, Safety Officer, Hazard Mitigation Coordinator, Hartland, Vermont.

2006-2007: Hartland Zoning Working Group, committee member, Hartland, Vermont.

2006: Ford Sayre Cross Country Ski Team, 2nd and 3rd grade coach, Hanover, New Hampshire.