

Messer Pond Watershed-based Implementation Plan

A Final Report to

The New Hampshire Department of Environmental Services

Submitted by

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Executive Summary

Messer Pond is listed as impaired for chlorophyll-a, total phosphorous and pH under the 'Aquatic Life' designated use. Those same parameters are classified as "bad" or "slightly bad" by the NH Department of Environmental Services in the 2015 Annual VLAP Lake Report for Messer Pond (Appendix A).

The goal of this effort was to develop a Watershed-Based Implementation Plan for Messer Pond that will conform to the US EPA's guidelines for watershed based plans, and address the nine required key elements.

The plan submitted with this final report identifies the existing pollutant sources to the pond and provides a systematic approach to address these sources of pollution by designing structural and non-structural BMP's that would mitigate their impact, such that water quality standards will be met.

The total project cost was \$3,828.60. Approximately fifty percent of the cost was funded by a \$2,000 NHDES Watershed Assistance Grant awarded to the Messer Pond Protective Association (MPPA). The remaining project cost (\$1,828.60) was funded by a grant from the New Hampshire Conservation Committee (\$1,600) and in-kind volunteer hours. The project completion date is March 31, 2016.

Upon submittal and NHDES approval of this final report all performance targets required under the grant agreement will have been met.

Introduction

Messer Pond (HUC: 010700030303) is 67 acres in size with a mean depth of 8.5 feet and a maximum depth of 25 feet. Its watershed covers 1,408 acres and is made up of a mixture of forest, pasture/hay fields and residential development. Both the pond and its watershed are situated entirely in the town of New London, New Hampshire.

Following initial concerns regarding water quality and pond health, in 2008 the Messer Pond Protective Association (MPPA) contracted CLD Engineering (CLD) to conduct a watershed study and to develop a best management practices (BMP) manual to be used by watershed residents to assist them in addressing erosion and storm water management issues. CLD provided this information in a reported titled 'The Messer Pond Watershed Study'. In early 2013, following discussions with New Hampshire Department of Environmental Services (NHDES) representatives regarding continued degrading pond water quality related to phosphorus and sediment, the MPPA decided to initiate further studies aimed at developing a Watershed-Based Implementation Plan (Plan). Subsequently, the MPPA contracted Base Flow, LLC to develop the Plan in coordination with MPPA management and volunteers. The goals of this Plan are:

- Identify and quantify pollutants being conveyed to the pond (i.e. nutrients and sediment);
- Develop a systematic approach for addressing existing pollutant sources to the pond as well as limiting future sources, such that water quality standards are met and maintained.

To achieve the goals listed above, the Plan will:

- explain the in-lake phosphorous concentrations and load reduction calculations
- provide a description of the watershed modeling, including a summary of the field work performed to support and calibrate the design of the model
- develop a prioritized list of implementation projects, including conceptual designs, with estimated engineering and construction costs

In addition, this Plan was developed to address the following nine required elements, as specified by the US EPA's guidelines for watershed based plans:

1. Identify Pollutant Sources
2. Pollutant Load Reduction Estimates
3. Describe Nonpoint Source Pollution Management Measures
4. Estimate Technical and Financial Assistance
5. Public Information and Education
6. Implementation Schedule
7. Interim Milestones
8. Evaluation Criteria
9. Monitoring

The MPPA applied and was awarded a Watershed Assistance Grant to help fund the final phases of this effort. Specifically, the grant monies covered the following three areas of the Plan:

- Design of BMP's to reduce impact of pollution into the pond
- Public outreach efforts that would promote an understanding of the project
- Complete the Watershed-Based Implementation Plan and a Final Report

Watershed Map

In order to successfully achieve the project goals, the MPPA and Base Flow agreed that a solid foundation of watershed flows, pollutant source identification and quantification was imperative. This foundation consisted of a comprehensive water budget and pollution budget, and watershed surveys that would facilitate pollution budget development via modeling, and ultimately lead to successful BMP/LID designs.

A water budget is a summation of water inputs, outputs, and net changes to a particular water resource system; in this case the sub-watersheds. A pollution budget is similar – a summation of pollutant inputs, outputs and net changes within a particular system; and for this Plan we focus on the export of pollutants to the pond from each sub-watershed, in addition to internal loading of pollutants from the pond bottom sediments.

To simplify the analysis and modeling efforts, as well as facilitate the development of the water and pollution budgets, the Messer Pond watershed was divided into 11 sub-watersheds as shown on the following figure:

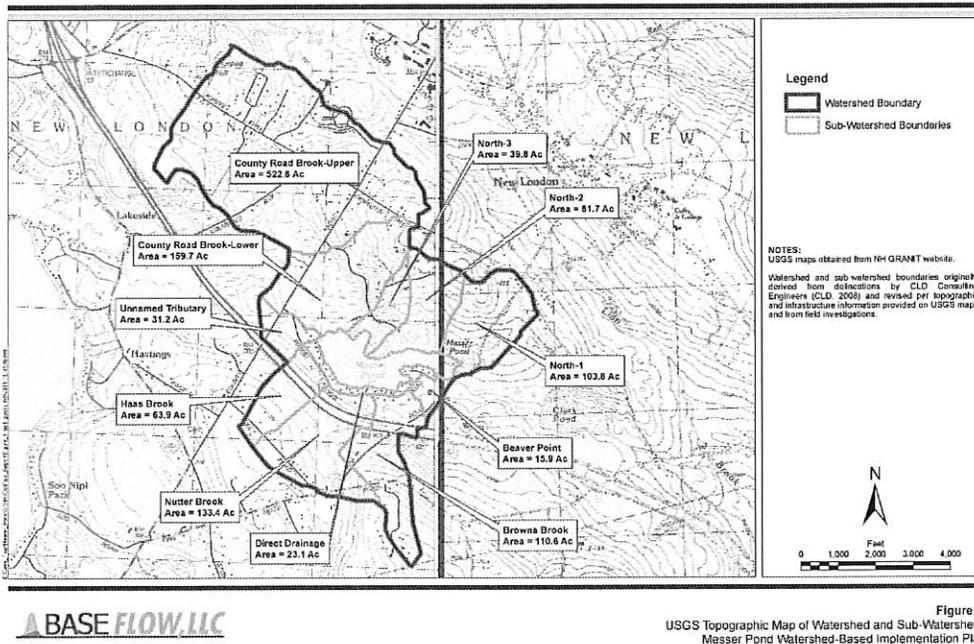


Figure 1 USGS Topographic Map of Watershed and Sub-Watersheds, Messer Pond Watershed

In addition, Base Flow conducted continuous flow monitoring at four sampling stations in the watershed. This data (along with field surveys) was used to calibrate the watershed model. The four sampling stations are indicated by the green dots on the following figure and are:

- Nutter Brook at Forest Acres Road
- Browns Brook at Forest Acres Road
- County Road Brook at County Road
- Pond Outlet at Bog Road

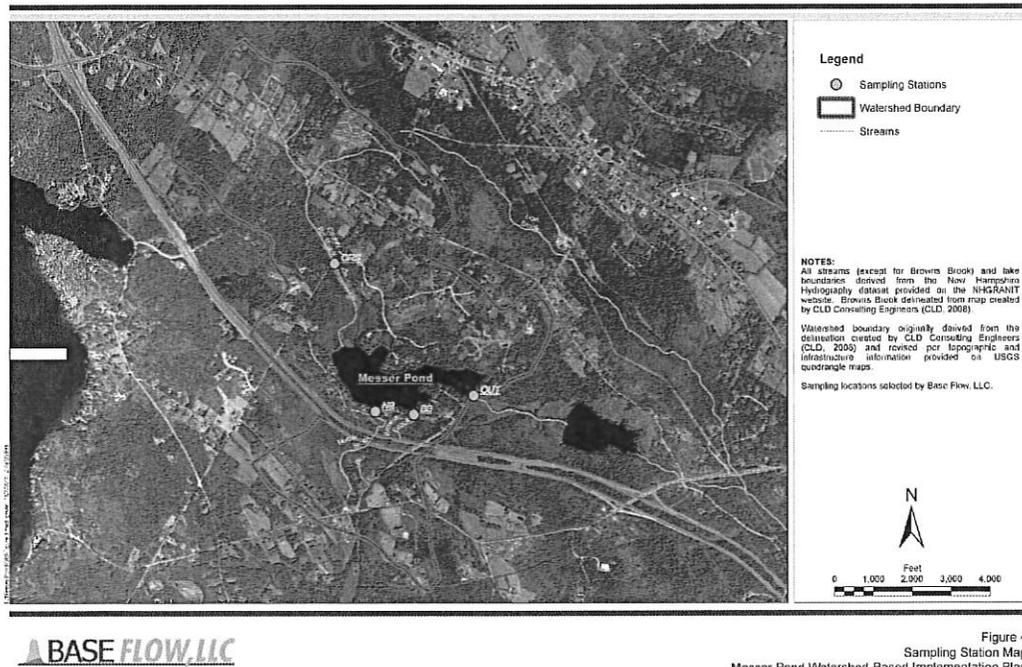


Figure 2 Sampling Station Map for the Messer Pond Watershed

Project Goals and Objectives

As previously explained, the MPPA applied and was awarded a Watershed Assistance Grant to help fund the final phases of its Watershed-Based Implementation Plan. Specifically, the grant was targeted to help complete the following three objectives in the Plan:

1. Design of BMP's to reduce impact of pollution into the pond
Task Description:
 A development of implementation projects following watershed surveys and pollutant budget modeling. Projects will be developed in sub-watersheds until the required reductions have been met. Projects will consist of structural BMPs and nonstructural BMPs (ordinance review/revisions, regulations, etc.).
2. Public outreach efforts that would promote an understanding of the project
Task Description:
 - Information session with residents and stakeholders designed to teach and promote an understanding of the project and how residents can improve and maintain the condition of natural resources linked to the pond.
 - Present initial findings to the Town of New London Administrator, Planner and DPW head. Attempt to get initial buy in to the plan and proposed direction
 - Present initial findings to faculty in Environmental Science department at Colby Sawyer College in New London. Attempt to get buy in to the possibility that some of the smaller BMP's might be potential junior/senior design projects.
3. Complete Watershed-based Implementation Plan and Final Report
Task Description:
 - A report summarizing the study, with the primary deliverable being a list of implementation projects,

- prioritized based on costs and cost per unit of pollutant removed.
- Submit all invoicing paperwork along with a final report summarizing project results, challenges and successes

Project Deliverables and Results

As stated, the Watershed Assistance Grant was awarded to help fund three goals. These objectives, the desired outcome and the results of that work are presented below.

1. Design of BMP's to reduce impact of pollution into the pond

Desired Outcome:

List of BMP's that can be cost effectively implemented to reduce pollution entering the pond

Results:

The development of the estimate of the annual phosphorus loading to Messer Pond is a combination of all external loadings. The phosphorus loadings from septic systems and atmospheric sources were derived from calculations. The loading from the watershed was derived from watershed modeling and the survey of the watershed. The estimated total annual external load is **113 lb/year**. The following figure shows the breakdown.

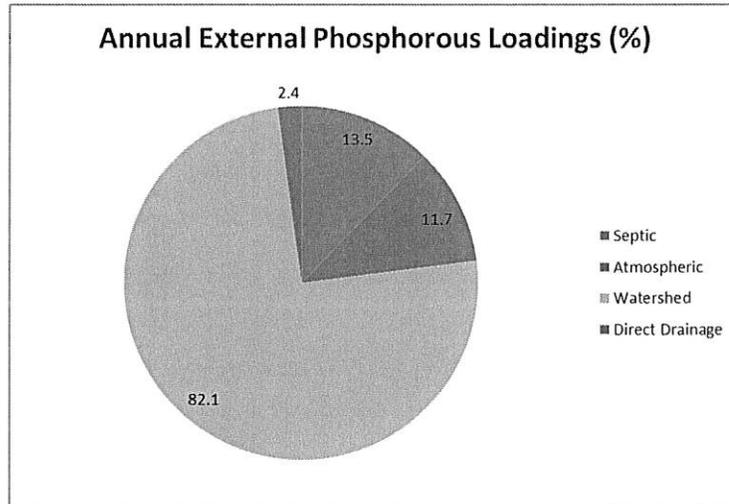


Figure 3 External Sources of Phosphorus to Messer Pond, Totaling 113 lb/year

The annual loading generated from each sub-watershed as provided by the watershed model is shown in the following table.

Sub-Watershed	Size (ac)	Estimated Annual P Load		% of Watershed
		Total (lbs)	Per Acre (lbs)	Total P Load
CRB_Upper	522.8	35.7	0.07	42.2
CRB_Lower	159.7	5.5	0.03	6.5
Unnamed_Trib	31.2	3.3	0.10	3.9
Haas_Brook	63.9	6.3	0.10	7.5
Nutter_Brook	133.4	9.2	0.07	10.9
Browns_Brook	110.6	11.0	0.10	13.0
Beaver_Point	15.9	1.4	0.09	1.7
North_1	103.8	4.9	0.05	5.8
North_2	81.7	3.0	0.04	3.5
North_3	39.8	1.7	0.04	2.1
Direct_Drainage	23.1	2.4	0.11	2.9
Messer Pond Watershed (total)	1285.9	84.50	0.07	100.00

Table 1 Watershed Modeling Estimated Annual P Load by Sub-Watershed for Surface Water Run-off, Messer Pond Watershed

To improve water quality conditions at Messer Pond and match the median phosphorus concentration for similar New Hampshire lakes, it is recommended that the MPPA target an in-pond total phosphorus concentration reduction of 2.0 µg/L. This would reduce the current concentration from 12 µg/L to 10 µg/L.

The analysis predicts that the lake’s phosphorus load must be reduced by 21.5 lb P/yr in order to achieve the recommended target in-lake phosphorus concentration of 10 µg/L. The recommended P load reduction represents approximately 19% of the estimated annual phosphorus load for the pond. The following table provides a summary of the recommendations to achieve this recommended phosphorus load reduction from the Watershed-Based Implementation Plan.

BMP Type	Site #	Proposed Action	Estimated Cost (low)	Estimated Cost (high)	Estimated P Load Reduction	Cost Per Lb. of P Reduced (x \$1,000)	Priority
Stormwater BMP	1	Upper County Road Brook Stream Buffers	\$1,500	\$2,500	0.25	8.0	Medium
	2	Forest Acres Road Runoff BMP Maintenance	\$1,500	\$2,500	1.5	1.3	High
	3	Forest Acres Road Culverts	\$20,000	\$30,000	4	6.3	High
	4	Browns Brook Wetland	\$100,000	\$150,000	6	20.8	High
	5	Shorefront Buffers	\$3,000	\$4,000	0.1	35.0	Low
	6	Residential Property on Burpee Hill Road	\$5,000	\$8,000	1	6.5	Medium
	7	Browns Brook and Forest Acres Road BMPs	\$3,000	\$4,000	0.1	35.0	Medium
	8	County Road Brook and County Road BMPs	\$6,000	\$8,000	0.2	35.0	Medium
	9	Septic Tank Upgrades	\$120,000	\$140,000	2.2	59.1	Low
	10	Rain Gardens - Assume 1 10'x20' Garden	\$1,000	\$3,000	0.3	6.7	Medium
Fertilizer Reduction	Entire Watershed	Fertilizer Reduction Program - Credit	NA	NA	4.3	-	NA
Totals:			\$261,000	\$352,000	20.0		

Table 2 Summary of BMP Projects to Reduce Phosphorus Loadings

The BMPs proposed in Table 2 are estimated to reduce the annual phosphorus load to Messer Pond by 20.0 lb/year. This load reduction represents about 93% of the targeted phosphorus load reduction (21.5 lb/year) for Messer Pond

The Watershed-Based Implementation Plan addresses this deficit in two ways:

- A detail list of future investigations are provided. These items of interest were found during the

watershed survey and were beyond the scope of the initial contracted work.

- Due to the relative ease of design and implementation, the MPPA will continue to look for opportunities to install rain gardens and other storm water runoff reduction projects throughout the watershed.

2. Public outreach efforts that would promote an understanding of the project

Desired Outcome:

Series of public outreach sessions that will maintain MPPA membership commitment and involvement; active participation of Town and College to achieve project goals

Results:

Over the course of this project, the commitment and involvement of the membership of the MPPA was maintained by:

- A project kickoff meeting; attendees included the town administrator, town planner, a board member of the Lake Sunapee Protective Association, MPPA members and town residents
- Project update presentations at the 2014 and 2015 MPPA annual meetings
- Several newsletters were sent to the membership stressing the importance of culvert cleaning, septic maintenance and trash and waste pickup
- Two volunteer training sessions where guidelines for proper sampling and data collection were provided

In addition, to more broadly convey an understanding of the project and the issues being raised to the Town Of New London and surrounding towns, we:

- Co-sponsored a presentation with other lake associations stressing the importance of proper lawn maintenance and use of BMPs like buffer plantings, to install near shorefronts
- Gave a project presentation to the New London Garden Club on 10/13/2016
- Provided a project presentation at the 2015 Annual VLAP Workshop on 6/6/2015
- Delivered a project presentation at the 2015 New Hampshire Water and Watershed Conference, held in Bartlett, NH on 3/18/2015

Going forward, once the plan is finalized, we plan to bring the MPPA membership together to review the analysis and recommendations in the Plan, as well as get buy-in to a proposed short and medium term direction. The Board of the MPPA will continue to provide quarterly and annual updates to the membership. Finally, the Board will look for opportunities to reach out to other groups in New London and neighboring towns to raise awareness on the issues that affect the condition of natural resources linked to the pond.

In order to get initial buy in and support from the town, we formally engaged several times throughout the course of the project by:

- The Town Administrator and Planner attending the project kickoff meeting
- Meetings with Town of New London Administrator and Town Planner on 4/9/2015 to solicit feedback and comments on the some initial findings and recommendations
- Meetings with Town of New London Administrator, Town Planner and DPW Director on 6/24/2015 to solicit feedback and comments on specific recommendations related to storm water runoff from the roads adjacent to the pond and from I-89.

There were also several informal conversations with officials at town planning and zoning meetings. Once the Plan is finalized, we have been invited to review our findings and recommendations at the town

planning board and the conservation committee. The goal of these discussions will be to review current watershed district ordinances and regulations and solicit support for proposed changes.

Our attempts to connect and maintain a conversation about our efforts with Colby Sawyer College has not been effective. While there was some phone and email communication at the start of the project, all attempts to reengage have been unsuccessful. We have offered to host a seminar of the work and methodology, and potentially structure some volunteer tasks for the environmental students to gain field work experience with a practicing environmental engineer.

Going forward, once the Plan is finalized, we will attempt to re-engage and offer:

- To develop a seminar on the work, methodology, findings
- A research opportunity on the impact of I-89 on the adjacent watersheds
- The opportunity to do the detail design on the recommended BMP's as a junior/senior project.

3. Complete Watershed-based Implementation Plan and Final Report

Desired Outcome:

Development of a systematic approach for addressing existing pollutant sources to the pond such that water quality standards are met

Results:

Both documents are written and will be submitted to NH DES for review and approval.

Conclusions and Recommendations

As stated in the Full Proposal of the Watershed Assistance Grant, the desired environmental outcome of this project was:

The development of a systematic approach for addressing existing pollutant sources to the pond as well as limiting future sources, such that water quality standards are met.

Overall, the project was successful in that it met the environmental objective of developing a plan that offered a set of structural and non-structural BMP's that should mitigate the nutrient loading into Messer Pond.

That said, there are two areas of concern that could limit the success of any implementation efforts for these recommendations and the ability to achieve the long term water quality goals. They are:

1. The MPPA is a small protective group, especially compared to other organizations that have undertaken efforts like this. The Board and all tasks are staffed on a volunteer basis. The ability to provide the resources (manpower and seed funds) will be a challenge and will likely affect the schedule that is proposed and the scope of any activity.
2. While the Town of New London officers and directors have been very receptive to the issues and concerns that we have raised and the recommendations we are developing, this phase of discussion has been conceptual. Once the Plan is finalized, the conversations will require a broader level of discussions that will require commitments from other Town Boards and at a Town Meeting.

Appendix A - 2015 Annual VLAP Lake Report for Messer Pond



Volunteer Lake Assessment Program Individual Lake Reports MESSER POND, NEW LONDON, NH

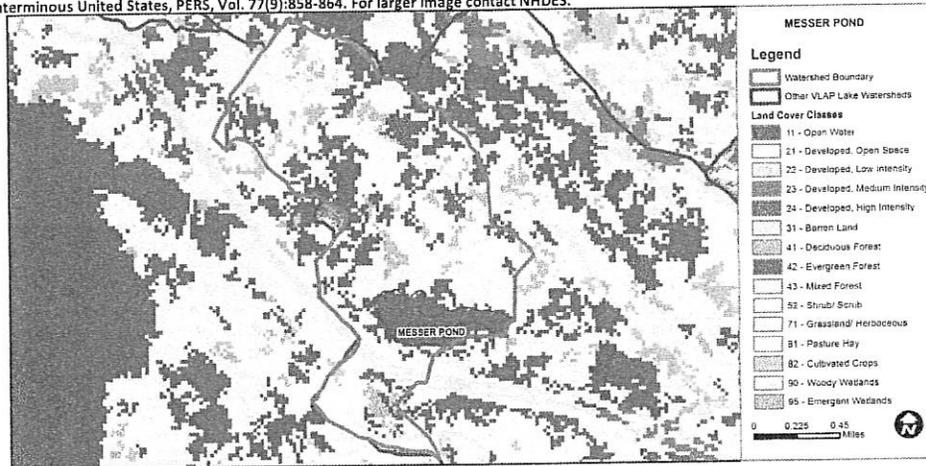
MORPHOMETRIC DATA					TROPIC CLASSIFICATION		KNOWN EXOTIC SPECIES
Watershed Area (Ac.):	1,408	Max. Depth (m):	7.6	Flushing Rate (yr ⁻¹):	4.7	Year	Trophic class
Surface Area (Ac.):	67	Mean Depth (m):	2.6	P Retention Coef:	0.53	1981	MESOTROPHIC
Shore Length (m):	3,200	Volume (m ³):	704,000	Elevation (ft):	1105	1996	MESOTROPHIC

The Waterbody Report Card tables are generated from the DRAFT 2014 305(b) report on the status of N.H. waters, and are based on data collected from 2004-2013. Detailed waterbody assessment and report card information can be found at www.des.nh.gov/organizations/divisions/water/wmb/swqa/index.htm

Designated Use	Parameter	Category	Comments
Aquatic Life	Phosphorus (Total)	Slightly Bad	The calculated median is from 5 or more samples and is > indicator and the chlorophyll a indicator is exceeded.
	pH	Bad	>10%, with a minimum of 2, samples exceed criteria, with 1 or more by a large margin.
	Oxygen, Dissolved	Encouraging	There are < 10 samples with 0 exceedances of criteria. More data needed.
	Dissolved oxygen satura	Cautionary	There are < 10 samples with 1 exceedance of criteria. More data needed.
	Chlorophyll-a	Slightly Bad	The calculated median is from 5 or more samples and is > indicator.
Primary Contact Recreation	Escherichia coli	Very Good	Where there are no geometric means, all bacteria samples are < 75% of the geometric mean. Where there are geometric means all single bacteria samples are < the SSMC and all geometric means are < geometric mean criteria.
	Chlorophyll-a	Very Good	There are a total of at least 10 samples with 0 exceedances of indicator.

WATERSHED LAND USE SUMMARY

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PERS, Vol. 77(9):858-864. For larger image contact NHDES.



Land Cover Category	% Cover	Land Cover Category	% Cover	Land Cover Category	% Cover
Open Water	6.45	Barren Land	0.1	Grassland/Herbaceous	1.45
Developed-Open Space	6.29	Deciduous Forest	5.19	Pasture Hay	13.19
Developed-Low Intensity	5.96	Evergreen Forest	23.27	Cultivated Crops	0
Developed-Medium Intensity	0	Mixed Forest	23.73	Woody Wetlands	6.57
Developed-High Intensity	0	Shrub-Scrub	5.23	Emergent Wetlands	2.16



VOLUNTEER LAKE ASSESSMENT PROGRAM INDIVIDUAL LAKE REPORTS

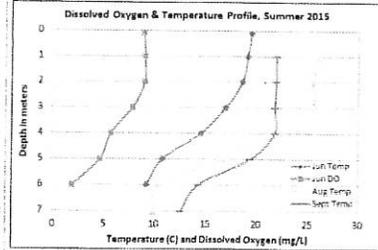
MESSER POND, NEW LONDON

2015 DATA SUMMARY

RECOMMENDED ACTIONS: Conductivity and chloride levels were greatly elevated in Haas Bk. Continue to monitor Haas Bk. in upcoming years to assess water quality. Continue development and implementation of the Watershed Management Plan to identify and quantify pollutant loads in the watershed. Continue discussions with the NH DOT in regards to addressing the nutrient load coming from the Brown Inlet sub-watershed. Keep up the great work!

OBSERVATIONS (Refer to Table 1 and Historical Deep Spot Data Graphics)

- ◆ **CHLOROPHYLL-A:** Chlorophyll levels increased slightly from June to August, then decreased from August to September, and remained within a low range in 2015. Average chlorophyll levels were less than the state median and the lowest measured since 1997! Historical trend analysis indicates relatively stable chlorophyll levels with moderate variability between years.
- ◆ **CONDUCTIVITY/CHLORIDE:** Deep spot, County Rd. 2, County Rd. Inlet, and Outlet conductivity and chloride levels remained slightly elevated and greater than the state medians. Historical trend analysis indicates highly variable epilimnetic (upper water layer) conductivity since monitoring began. Brown and Nutter Inlets continued to experience elevated conductivity and chloride levels. Haas Bk., a new monitoring site, also experienced elevated conductivity and chloride levels approaching the state chronic chloride standard of 230 mg/L.
- ◆ **TOTAL PHOSPHORUS:** Epilimnetic and metalimnetic (middle water layer) phosphorus levels were stable and low in June and August and increased slightly in September but remained within an average level. Average epilimnetic phosphorus decreased from 2014 and was less than the state median. Historical trend analysis indicates stable epilimnetic phosphorus since monitoring began. Hypolimnetic (lower water layer) phosphorus levels were low in June and average in August and September. Brown Inlet phosphorus levels were average in June and elevated in September during low flow and the turbidity was also elevated. County Rd. Inlet, Nutter Inlet and Outlet phosphorus levels were within average ranges for the stations. County Rd. 2 phosphorus levels were low in June and then elevated in August and September during low flows.
- ◆ **TRANSPARENCY:** Transparency was low (poor) in June, increased (improved) in August, and then decreased to poor levels in September likely due to wave conditions. Average transparency improved slightly from 2014 but was less than the state median and historical trend analysis indicates significantly decreasing (worsening) transparency since monitoring began. Transparency measured with the viewscope (VS) was much better than that measured without (NVS) and likely a better representation of actual conditions.
- ◆ **TURBIDITY:** Deep spot, County Rd. Inlet, Haas Bk., and Nutter Inlet turbidities were within low to average ranges. Brown Inlet turbidity was elevated in September potentially due to highly colored water during low flow conditions. County Rd. 2 turbidity was elevated in August and high amounts of sediment and organic matter were noted in the sample. Outlet turbidity was elevated in September and moderate amounts of organic matter were noted in the sample.
- ◆ **pH:** Epilimnetic and metalimnetic pH levels were within the desirable range 6.5-8.0 units however hypolimnetic pH fluctuated below the desirable range. Historical trend analysis indicates significantly increasing (improving) epilimnetic pH since monitoring began. Tributary pH tends to fluctuate below the desirable range at all stations, except for Haas Bk. where pH was within the desirable range.



NH Median Values: Median values for specific parameters generated from historic lake monitoring data.

Alkalinity: 4.9 mg/L
 Chlorophyll-a: 4.58 mg/m³
 Conductivity: 40.0 uS/cm
 Chloride: 4 mg/L
 Total Phosphorus: 12 ug/L
 Transparency: 3.2 m
 pH: 6.6

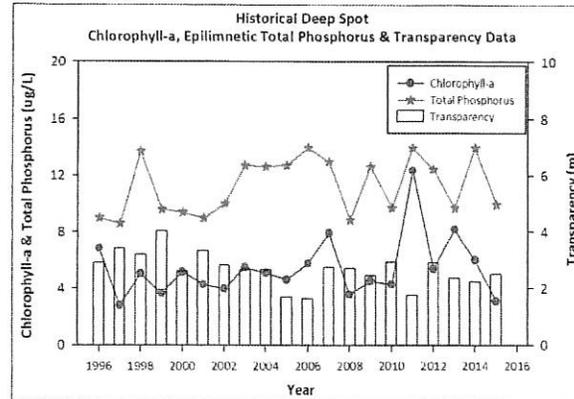
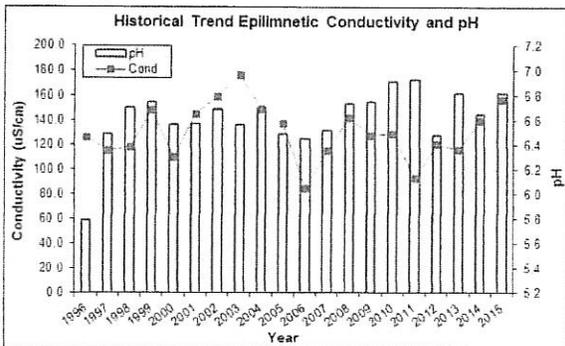
NH Water Quality Standards: Numeric criteria for specific parameters. Results exceeding criteria are considered a water quality violation.

Chloride: > 230 mg/L (chronic)
 E. coli: > 88 cts/100 mL – public beach
 E. coli: > 406 cts/100 mL – surface waters
 Turbidity: > 10 NTU above natural level
 pH: between 6.5-8.0 (unless naturally occurring)

Station Name	Table 1. 2015 Average Water Quality Data for MESSER POND								
	Alk. mg/l	Chlor-a ug/l	Chloride mg/l	Cond. uS/cm	Total P ug/l	Trans. m		Turb. ntu	pH
						NVS	VS		
Epilimnion	8.4	3.10	34	157.0	10	2.50	3.50	0.73	6.82
Metalimnion				156.1	10			0.85	6.82
Hypolimnion				156.4	13			1.19	6.47
Brown Inlet			120	418.0	51			7.40	6.29
County Rd. 2			17	130.1	46			5.85	6.64
County Rd. Inlet			21	142.0	13			0.86	6.53
Haas Bk.			210	804.0	9			0.80	7.24
Nutter Inlet			94	373.7	22			0.91	6.49
Outlet at Bog Rd.				150.0	10			22.31	6.69

HISTORICAL WATER QUALITY TREND ANALYSIS

Parameter	Trend	Explanation	Parameter	Trend	Explanation
Conductivity	Stable	Trend not significant; data highly variable.	Chlorophyll-a	Stable	Trend not significant; data moderately variable.
pH (epilimnion)	Improving	Data significantly increasing.	Transparency	Worsening	Data significantly decreasing.
			Phosphorus (epilimnion)	Stable	Trend not significant; data show low variability.



This report was generated by the NH DES Volunteer Lake Assessment Program (VLAP). For more information contact VLAP at (603) 271-2658 or sara.steiner@des.nh.gov