Tug Lake

Sediment Assessment Report



Cason & ASSOCIATES, LLC
LAND & WATER MANAGERS

Prepared for: *Tug Lake*
327 N 17th Ave
PO Box 777
Wausau, WI 54402-0777

Prepared by: *Cason & Associates, LLC*
PO Box 230
Berlin, WI 54923
877-309-8408

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INTRODUCTION

Cason & Associates was contracted by the Tug Lake Task Force to collect sediment samples with in Tug Lake. Sediment samples were collected to determine the relative phosphorus sorption capacity (PSC) and to determine if restoring deep water oxygen would improve the water quality within Tug Lake through phosphorus binding.

METHODS

Cason & Associates collected sediment samples from five sample sites surrounding the deep hole in Tug Lake. One sample was collected from each of the five sites for a total of five sediment samples. Samples were collected using a Wildco Sediment Core Sampler on February 6, 2020. The locations and the geographical coordinates of each of these five samples are indicated on Figure 1. Once the sediment samples were collected, the samples were frozen and shipped to the laboratory for iron and total phosphorus analysis.

Figure 1. The location of five sediment samples collected on February 6, 2020 from Tug Lake, in Merrill, Wisconsin by Cason & Associates.

Samples were collected around the deep hole and analyzed for iron and total phosphorus.

Hole 1: 45°18.155'N, 89°42.051'W
Hole 2: 45°18.085'N, 89°42.026'W
Hole 3: 45°18.109'N, 89°41.919'W
Hole 4: 45°18.160'N, 89°41.906'W
Hole 5: 45°18.189'N, 89°41.977'W



RESULTS

The results of the sediment analysis for Tug Lake indicate a moderate phosphorus binding capacity is available within Tug Lake as the average iron to phosphorus ratio is 12.7, with ranges from 9.1 to 21.0 (Table 1).

Table 1. Results of the iron (Fe) and total phosphorus (TP) analysis conducted on five sediment samples from Tug Lake in Merrill, Wisconsin.

Parameter	Hole 1	Hole 2	Hole 3	Hole 4	Hole 5	Average
TP (mg/kg)	756	665	97	584	571	535
Fe (mg/kg)	6850	7180	2040	6220	6960	5850
Fe/TP ratio	9.1	10.8	21.0	10.7	12.2	12.7
Predicted Phosphorus Sorption Capacity (PSC); mg P g DW-1	4.9	5.0	2.3	4.7	4.9	4.4
Predicted Mean P from Model	34.4	36.0	10.2	31.2	34.9	29.4

RECOMMENDATIONS

Adding an aeration system to Tug Lake that would maintain deep water oxygen (> 2 mg/L) would reduce the amount of available P internally re-cycled from the sediments (Figure 2). To provide increased habitat and mixing benefits, maintaining deep water oxygen at or greater than 5-6 mg/L would be required (Figure 3). Increasing oxygen concentration would provide greater oxygen penetration into the sediment, therefore increasing phosphorus binding. However, maintaining 2 mg/L dissolved oxygen is all that is needed to reduce the majority of the iron-bound phosphorus from being released and re-cycled within Tug Lake.

Figure 2. Aeration system designed to provide 2 mg/L deep water dissolved oxygen within Tug Lake in Merrill, Wisconsin.

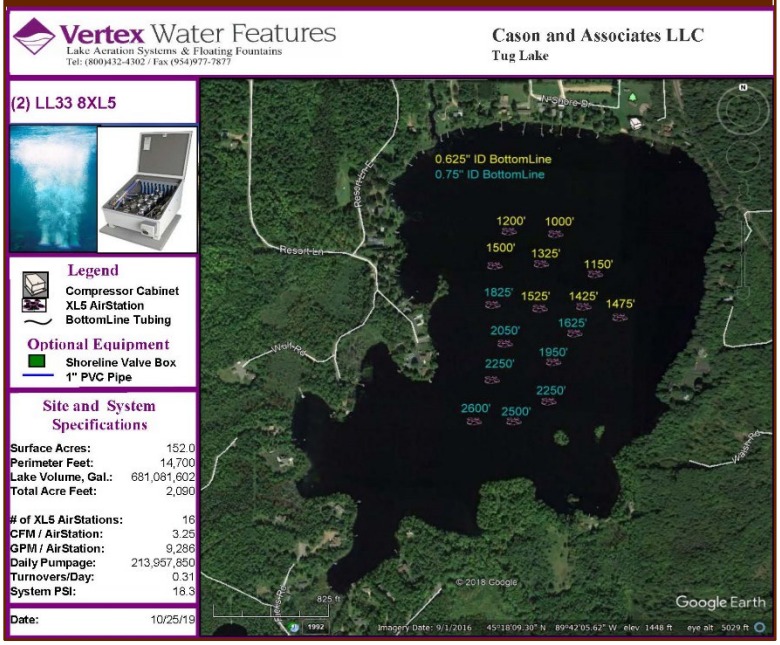
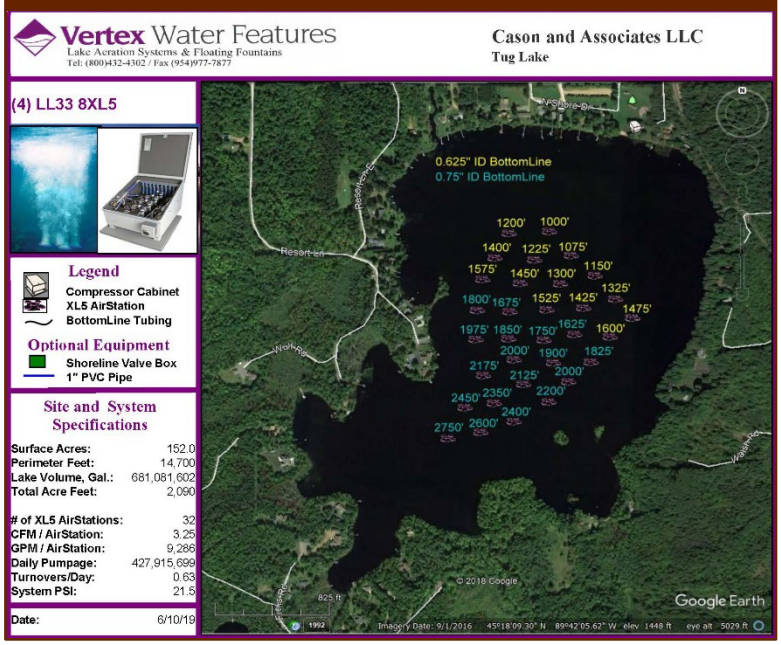


Figure 3. Aeration system designed to provide 5-6 mg/L deep water dissolved oxygen within Tug Lake in Merrill, Wisconsin.



As a result of reducing available phosphorus, phosphorus would no longer be a driving nutrient in contributing to algal blooms. As a first aeration step for Tug Lake, we recommend the 2 mg/L aeration system. Following installation, we recommend routine dissolved oxygen and temperature profiles be conducted to ensure the system is properly aerating Tug Lake. Should the deep water dissolved oxygen levels read below target levels, increasing the aeration system size may be required to properly oxygenate and reduce phosphorus in Tug Lake. Additionally, should the goals of Tug Lake change from binding phosphorus to enhancing habitat and total water quality, a larger system would be required.