Summary of Big Eagle Lake Water Quality and Load Assessment Study by WSB

Big Eagle Lake for a number of years has experienced algae blooms and other water quality issues. Your board has contracted with WSB Engineering to study this issue and offer possible solutions. This study has been completed. Throughout 2019 and early 2020, the Big Eagle Lake Improvement Association (BELIA), Sherburne Soil and Water Conservation District (SWCD), and WSB Engineering worked together to collect and assess water quality data for Big Eagle Lake and its tributaries to determine if Big Eagle Lake is impaired by nutrients (in this case phosphorous), assess the source of the nutrients, and identify potential best management practices (BMP) to increase the water quality of Big Eagle Lake. This study is very detailed and very scientific with the target audience of Minnesota Pollution Control Agency (MPCA) so we can secure future grant dollars to fund the BMP outlined in this study. This document is written to summarize the technical report in a way to make it easier to understand.

Based on data collected in 2019 by BELIA and SWCD, Big Eagle Lake is impaired for nutrients for the summer growing season for average total phosphorous which is above State Standards. The secchi depth (measure of water clarity) does not meet State standards. Chlorophyll-a concentration (measure of green in the water from algae) is higher than the State standards. More phosphorous in the lake increases the algae growth measured through chlorophyll-a parameter, and as algae increases the water clarity decreases. The MPCA will utilize this study, along with their own studies which will be completed this year, to classify our lake as impaired or not. Big Eagle Lake will need to be classified as impaired for State grants to fund the BMP's. From a historical perspective, the data outlined in this study would classify Big Eagle Lake as impaired many years ago but the MPCA has not previously completed a 2 year study to make such a classification.

To determine the source of excess nutrients in this case total phosphorous, this study addressed all of the elements contained in the following table. The watershed analysis and conclusions were a result of considering land use, soil types and computer modeling supplemented with field measure. Atmospheric contributions were derived from other studies and published data. Septic system contributions were from data supplied by Sherburne County Planning and Zoning and other studies and publications. The sediment analysis is from the three (3) core samples taken of the lake bed and analyzed by the University of Minnesota. The carp contribution is from the rough fish survey completed on two (2) occasions.

From the table below, in order to meet water quality standards, the overall phosphorous load will need to be reduced by 1172 pounds/year. The three areas that produce the most phosphorous are the northeast subwatershed, sediment at the lake bottom, and carp. These three are the most cost effective while the first two are also the most expensive. Section 7 of the final report goes into great detail on proposed BMP's.

Addressing the watershed BMP's provide the greatest challenge to reducing the phosphorous because we do not control the land, the cost / benefit is high, and the results are variable. The Northeast watershed is slightly easier to address for the effected land is in MN DNR control. More investigation is needed to fully solve this watershed.

The sediment release issue is the easiest to solve with alum treatment but it is the most expensive. Alum is aluminum sulfate. Anoxic condition is with low oxygen conditions in the water, phosphorous is released. In this case, water depths below 12' become oxygen deprived and phosphorous is released. Alum treatment in areas deeper than 12' will sequester the phosphorous and make it unavailable as a nutrient source. As a side note, there probably are not a lot of fish below 12' in the summer due to low oxygen levels. If we desire to extend the life of the alum treatment estimated to be in the 11-year range we will need to address the northeast watershed issue.

The table below is a simplified version on a number of tables in the full report.

	Summary of Study Results				
Load Source	Existing Load pounds /year Phosphorous	Range of Load Reductions in Pounds from BMP's	BPM from Study	Mid Range of Costs	Cost per Pounds Removed
Central Subwatershed	144.4	25.3	1& 2 Infiltration Basin	$ 143,750	$ 12,254
West Subwatershed	68.2	17.2	3 Wetland Restoration	$ 160,000	$ 4,923
South (Direct) Watershed	24.8	21.9	4 Rain Gardens	$ 101,000	$ 9,100
Northwest Subwatershed	25.6	12.5 to 25	5 Ag Filter Strips	$ 10,000	$ 8,333
Northeast Subwatershed	1168.9	62 to 124	9 Wetland Restoration	$ 362,000	$ 2,923
Atmospheric	123.4	0			
Septic Systems	18.8	0			
Sediment Release	1140	912 to 969	Alum Treatment	$ 800,000	$ 826
Carp	362	259	Carp Management	$ 60,000	$ 232
Total Phosorous Load	3076.1				
Possible Load Reductions		1309 to 1457			

From previous studies as well as this study, carp continue to be an issue for Big Eagle Lake by rooting up the bottom of the lake thereby releasing phosphorous. The carp survey indicates an abundance of large carp but not smaller carp. Because of the lack of small carp, one could conclude that the carp are not reproducing and the population should decrease over time. The BMP is to continue to bowfish the carp and do another survey in a couple of years. The gate on the fish trap was previously opened during the spring. We are now leaving this gate closed all year long to prevent fish from entering the lake from the downstream river.

We all need to be mindful of another complication. As we move forward with improving the water quality and particularly clarity of Big Eagle Lake where the sunlight penetrates deeper, the opportunity of increased weed growth will result.

The next steps are as follows:

1. Distribute report to BELIA members and partner agencies for further input
2. Complete 2020 in lake water sampling by MCPA with help from SWCD and BELIA to list Big Eagle Lake as impaired.
3. Prioritize the BPM's based on public and agency inputs
4. Refine technologies and cost estimates for top priority BPM's to be implemented. For example the cost for the alum treatment is conservative. Additional analysis is needed to determine the dose and actual area to be treated.
5. Develop site specific plans for implementation
6. Determine funding sources.
7. Start applying of grants in the 2021 to 2022-time frame

Prepared by Bryan Adams, Chairman of the Big Eagle Lake Quality Committee