

Date: August 24, 2012

To: Lake Shamineau Association
Al Doree
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Subject: 2012 Trophic Status Index Mapping Flight Report

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Introduction to TSI Lake Mapping

TSI Lake Mapping provides mapped TSI values that would historically be determined by measuring the Secchi depth, total phosphorus concentration, chlorophyll *a* concentration, and placing the resulting values into the Carlson Trophic Status Index algorithms. The Carlson Trophic Status Index (TSI) is a tool used to summarize measurements of water quality into one index value. This value can be used to compare lakes in the same region or as a historical comparison of improvement/degradation over time. In many ways, the index can be viewed as a measure of the potential for algal productivity. Since most people value lakes with high clarity and low algal productivity, the lower the TSI value the healthier the lake is considered to be.

| TSI Value | Trophic Status | General Lake Characteristics |
|-----------|----------------|--|
| 0 – 30 | Oligotrophic | <i>Very clean lake; water is clear.</i> |
| 31 – 40 | Oligotrophic | <i>Clean Lake with clear water and normal algae levels.</i> |
| 41 – 50 | Mesotrophic | <i>Reduced water clarity; temporary algae/aquatic plant problems.</i> |
| 51 - 60 | Eutrophic | <i>Reduced water clarity; persistent algae/aquatic plant problems.</i> |
| 61 - 70 | Eutrophic | <i>Greatly Reduced water clarity; persistent algae/aquatic plant problems.</i> |
| 71 - 80 | Hypereutrophic | <i>Water clarity is poor; extreme algae/aquatic plant problems.</i> |
| 81 - 100 | Hypereutrophic | <i>Water clarity is poor; extreme algae/aquatic plant problems.</i> |

A.W. Research Laboratories, Inc. has developed a multispectral camera that measures the TSI values for the entire lake. The camera's capabilities are similar to combining approximately 870 manually collected samples per acre and mapping the results to one image. The resulting image provides a clear depiction of problem areas that is easily understood by lake managers and property owners alike. By pinpointing problem areas immediately, you can put your efforts and budget toward remediation of the problems.

Flight Data

On August 2, 2012 AWRL conducted a TSI Mapping Flight of Lake Shamineau (MN ID# 49-0127) in Morrison County, Minnesota.

The following conditions were recorded on the day of the flight:

Date: August 2, 2012

Time: 11:50am

Conditions: Clear

Air Temp: 78.8 °F

Dew Point: 59.0 °F

Humidity: 51%

Visibility: 10.0 miles

Wind: Calm

Lake Stats

MN ID#: 49-0127-00

Nearest Town: Motley

Primary County: Morrison

Lake Area (acres): 1428

Littoral Area (acres): 746

Max Depth (feet): 52

Water Clarity (feet): 15.5*

* Secchi reading taken by Al Doree on 8/2/2012

Visible Image



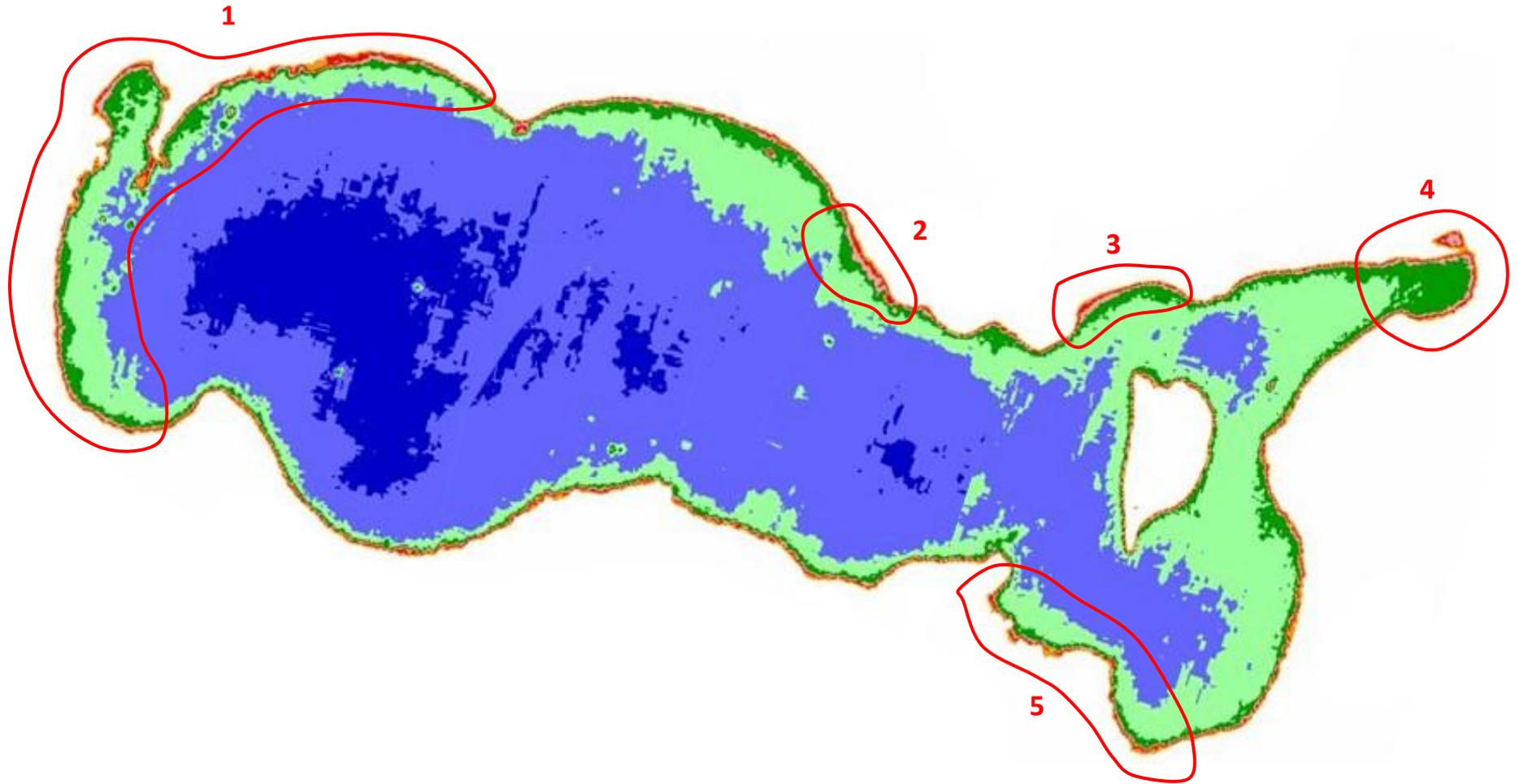
Thermal Image



Areas circled in red indicate cooler water entering the lake, potentially from groundwater springs or septic systems.

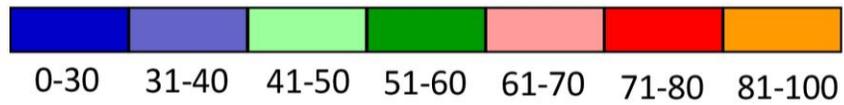
White = Warm
Dark = Cool

TSI Map



Red circled areas indicate priority areas of concern.

TSI VALUES



Conclusions and Recommendations

The TSI Map for Lake Shamineau shows TSI values ranging from 31-50 for the majority of the lake with higher TSI values (51-100) occurring near the shoreline areas. This is due to the fact that in general, the majority of nutrient loading occurs near the shoreline where runoff from roads, lawns and septic leaks from shoreline properties enter the lake.

There are a few areas where this loading is heavier that have been circled in red on the TSI Map above. These areas show a progression from Mesotrophic (light green), to Eutrophic (dark green and red), to Hypereutrophic (orange) as you move closer to the shoreline.

The large area of concern along the western shoreline, labeled #1, is likely caused by nutrient loading from leaking septic systems or springs. The thermal image shows the potential for groundwater springs in this area. Particular attention should be paid to the bright red and orange stretch on the north shore of the lake in this area.

Area of concern #2 shows some evidence of emergent vegetation and algae problems. The TSI Map indicates that there are a higher amount of nutrients in this location, which would support more vegetative growth. The sources of the higher nutrients in this location should be investigated further.

Leaking septic systems and/or springs are the most likely cause of the high TSI values at areas of concern #3, #4 and #5. The thermal image also indicates spring activity in these locations.

To further identify and correct the impact of nutrient loading on Lake Shamineau, AWRL recommends the following:

1. Groundtruthing

A volunteer committee should be formed to conduct basic groundtruthing in the areas circled in red on the TSI Map to determine what potential sources (i.e. runoff, springs, or point discharge) could be contributing to the higher TSI values in these areas. Groundtruthing is a simple process that involves visiting the property of concern and working with the property owner to locate, identify and fix any found issues. Many problems, once discovered, may be a quick fix on the part of the property owner.

2. Groundwater Intrusion Overflight (GWI)

Conduct a Groundwater Intrusion Overflight (GWI) of the areas of concern (approximately 5 miles of shoreline) in the winter of 2012-2013 to pinpoint problem septic systems and springs that are influencing the lake. The information from the flight will then be used to mitigate these nutrient sources problems and stop the nutrient loading at the source. AWRL can provide a detailed proposal if you are interested in pursuing this project.