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To: Upper South Long Lake Association  
c/o: Dan Martonik  
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Subject: 2011 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; very 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 3<sup>rd</sup>, 2011 AWRL conducted a TSI Mapping Flight of Upper South Long Lake (MN ID#18-0096) in Crow Wing County, Minnesota.

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

**Date:** August 3<sup>rd</sup>, 2011

**Time:** 2:30pm

**Conditions:** Clear

**Air Temp:** 82 °F

**Dew Point:** 57 °F

**Humidity:** 42%

**Visibility:** 10.0 miles

**Wind:** West, 3.5 mph

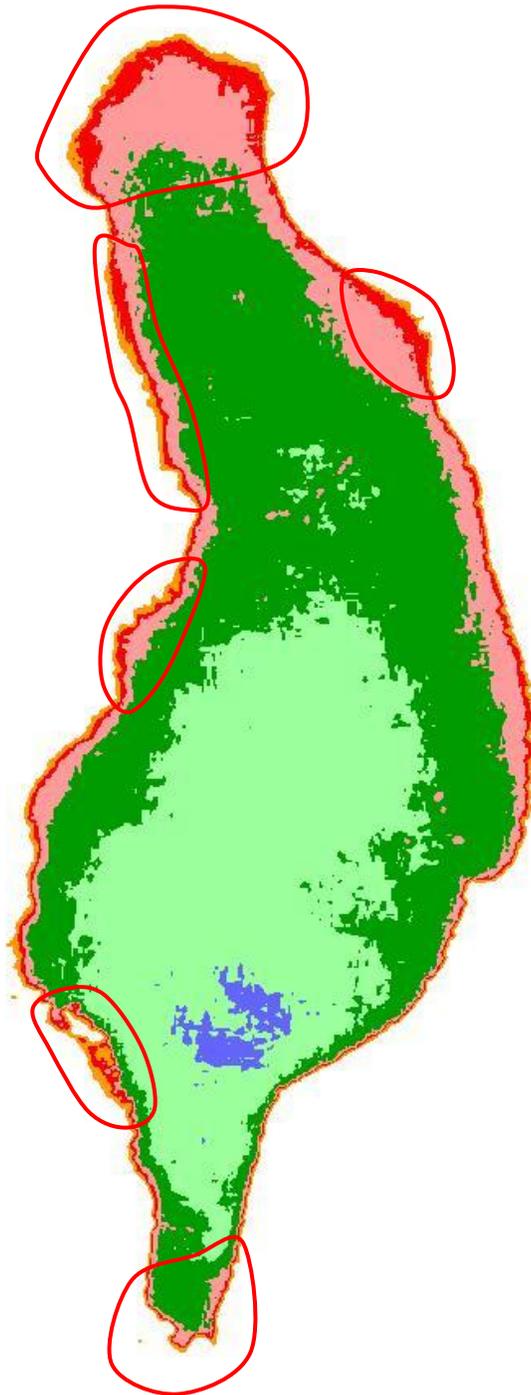
## Visible Image



## Thermal Image



## Trophic Status Index Map



Red circles indicate priority areas of concern.

### TSI VALUES



## Conclusions and Recommendations

The TSI map shows a large variation in TSI values with the highest values along the shorelines. This is due to the fact that the majority of nutrient loading occurs near the shoreline where runoff from roads, lawns and septic leaks from shoreline properties enters the lake. There are a few areas where this loading appears to be heavier that have been circled in red on the TSI Map above.

The majority of the lake shows TSI values between 51 and 70, in the eutrophic range of the TSI scale. The northern end of the lake appears to have the highest levels of nutrient loading with the TSI values higher than the southern half of the lake; the inlet at this end of the lake makes it more susceptible to nutrient loading.

The areas of concern circled in the southern half of the lake contain high concentrations of emergent vegetation and algae that cause the TSI map to show very high TSI or to show up as land (white) in these areas. These high concentrations of plant material are due to higher nutrient input in these parts of the lake, the causes of which should be investigated.

To better understand the impact of nutrient loading on Upper South Long Lake, AWRL recommends the following:

1. The lake association should conduct basic groundtruthing in the areas circled in red on the TSI Maps to determine what potential sources could be contributing to the higher TSI values in these areas.
2. Conduct an Environmental Assessment Overflight in October 2011 of the Nokasippi River inlet into Upper South Long Lake. This flight will identify potential contributors to the high nutrient loading along the Nokasippi River flowing into the northern portion of Upper South Long Lake. Following the flight, identified locations should be groundtruthed by the association with AWRL's assistance.
3. Conduct a Groundwater Intrusion Overflight of the entire lake in the winter of 2011-2012 to pinpoint problem septic systems and springs that are influencing the lake. The information from the flight should then be used to mitigate septic or runoff problems and stop the nutrient loading at the source.