

Indian Lake
Association

of Vicksburg, Inc.
P.O. Box 97
Vicksburg, MI 49097

8th Annual MiCorps Conference
Monitoring Human Impacts to
Michigan's Freshwater Systems
Higgins Lake, MI ♦ October 29-30, 2012



Monitoring Nutrient Inputs on Indian Lake

Kalamazoo County

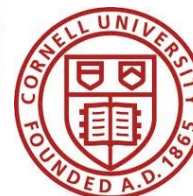
A Study Funded by the Indian Lake Association of Vicksburg, Inc.



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Outline of This Presentation

- ❑ Description of Indian Lake features**
- ❑ Review of water quality data from the Cooperative Lakes Monitoring Program (CLMP) & other sources**
- ❑ Review of data from this study conducted to measure phosphorous and nitrates at sites not included in CLMP**
- ❑ Relationship of Indian Lake to the Portage River watershed & progress toward an updated watershed management plan**



History

Indian Lake - Kalamazoo County



❑ Located in the Nottawaseepee reservation of the Potawatomi.

❑ Ownership ceded by the treaty of 1833. The Potawatomi subsequently deported by the U.S. Army under the command of General Hugh Brady.

❑ Located in Brady Township until township size mandated by statute.

❑ Northern edge of the lake then within Pavilion Township.

❑ Popular resort destination during the “glory days” of the railroads since the Grand Rapids & Indiana and Chicago & Grand Trunk railroads intersected in nearby Vicksburg.

❑ Southern portions of the lake excavated for marl.

❑ Lake now surrounded by 325 privately owned properties all zoned residential.



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Indian Lake - Kalamazoo County



- ❑ 758 acres
- ❑ Mean depth of 29.2 feet
- ❑ 8.67 miles of shoreline
- ❑ 35.5 dwellings/mile, 95% with lawns at the lakefront
- ❑ 54% of the shoreline is armored

Basin #1

- ❑ 675 acres
- ❑ 75 foot maximum depth (Deep Basin site for CLMP measurements)
- ❑ Water inputs from groundwater, lawn runoff and storm sewer runoff
- ❑ Water color is turquoise, likely from calcium carbonate

Basin #2 “Little Indian”

- ❑ 83 acres
- ❑ 29 foot maximum depth
- ❑ Water inputs from Portage River, Dorrance Creek & Basin #1
- ❑ Water output into Portage River
- ❑ Water tea-colored by tannins from bordering wetlands



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Indian Lake - Kalamazoo County



Known Non-Native, Invasive Species

- ☐ Curly-leaf pondweed (*Potamogeton crispus*)
- ☐ Eurasian watermilfoil (*Myriophyllum spicatum*)
- ☐ Fanwort (*Cabomba caroliniana*)
- ☐ Purple loosestrife (*Lythrum salicaria*)
- ☐ Zebra mussels (*Dreissena polymorpha*)
- ☐ Mute swan (*Cygnus olor*)



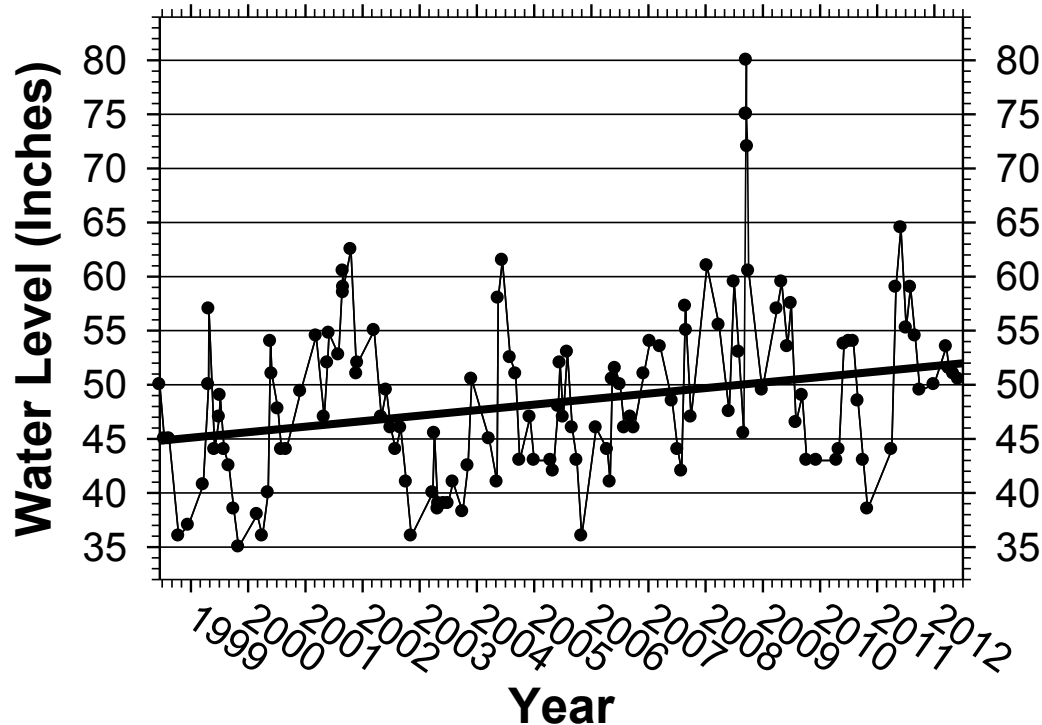
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Miscellaneous Features

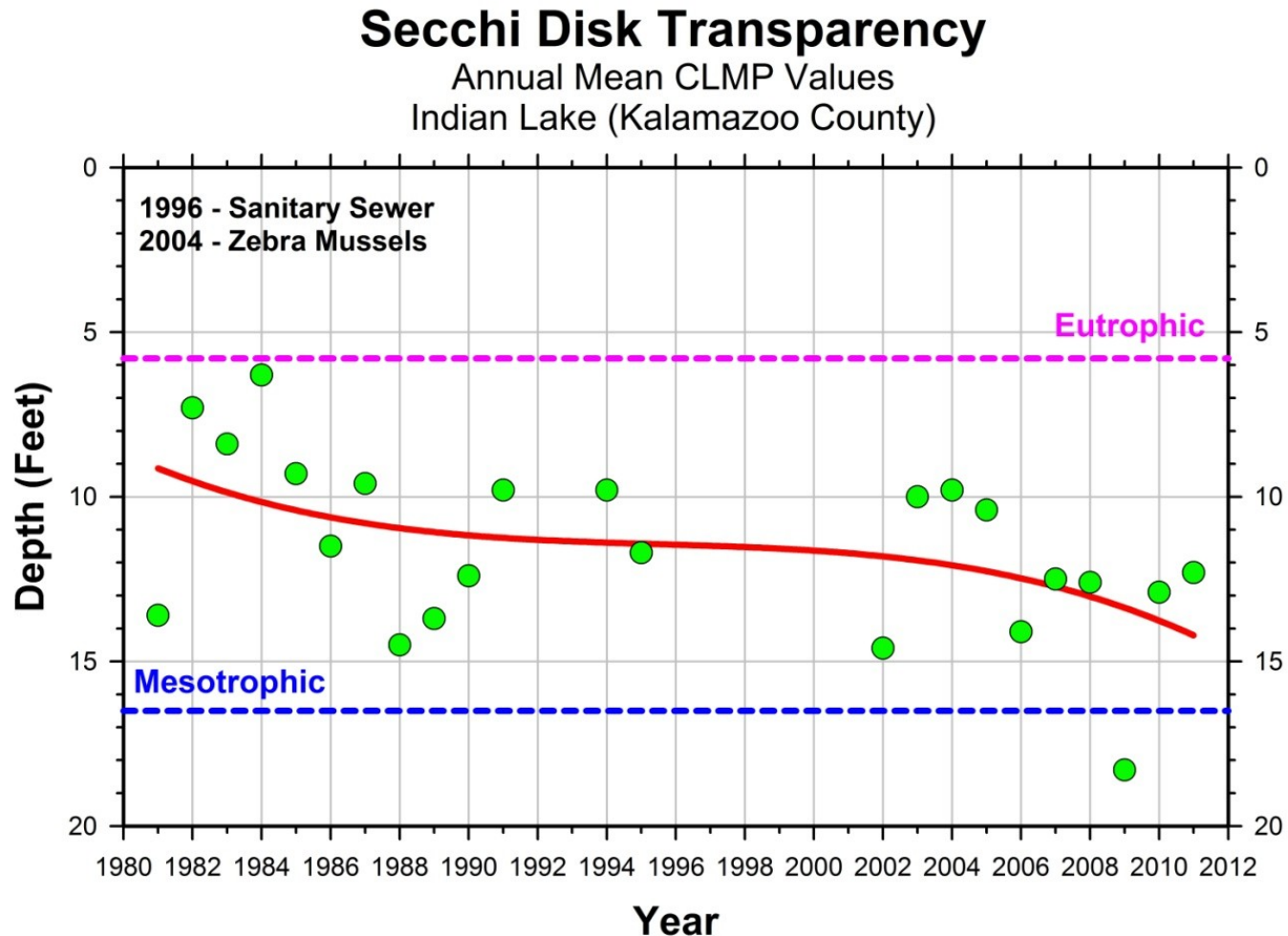
- ☐ No public access. Access at church camp boat ramp limited by township ordinance to residents.
- ☐ DNR fish census in 2010 documented a well-balanced fish community. Prominent species include bluegill, rock bass, largemouth bass, northern pike and smallmouth bass.
- ☐ One of only 100 lakes in Michigan containing the threatened fish species, cisco, although currently a remnant of the once abundant population.
- ☐ Diverse species of aquatic vegetation including endangered wild rice.
- ☐ Special assessment districts for weed control since 2004.
- ☐ Troublesome vegetation growth impairing recreation primarily from the native species: wild celery/eelgrass (*Vallisneria americana*); Illinois pondweed (*Potamogeton illinoensis*) & various-leaved watermilfoil (*Myriophyllum heterophyllum*).

Indian Lake Does Not Have a Statutory Water Level

**Indian Lake, Kalamazoo County
Relative Water Levels, 1998-2012**



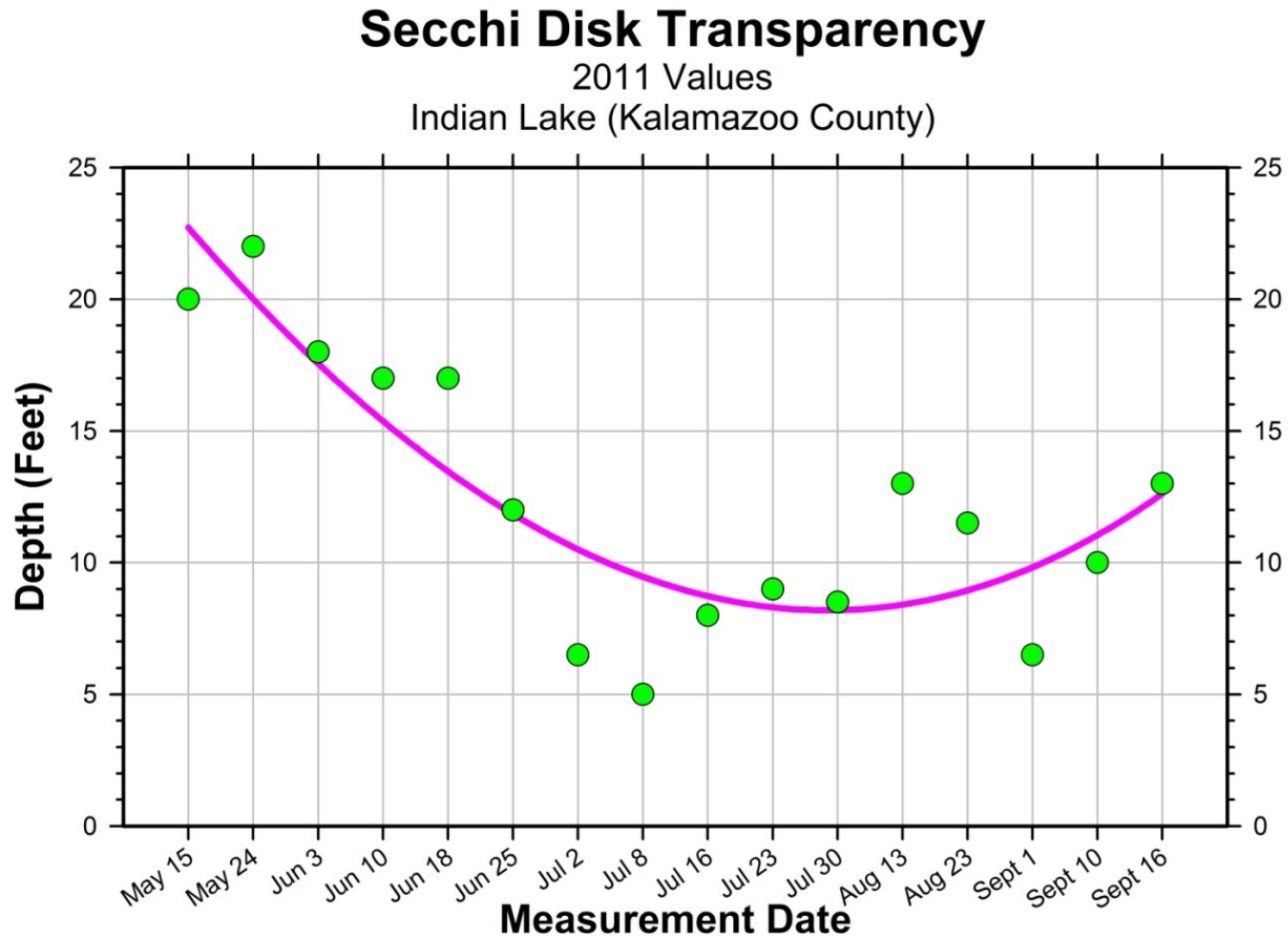
CLMP Secchi Disk Data Indicate Indian Lake is Mesotrophic



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Secchi Disk Values Decline During the Summer



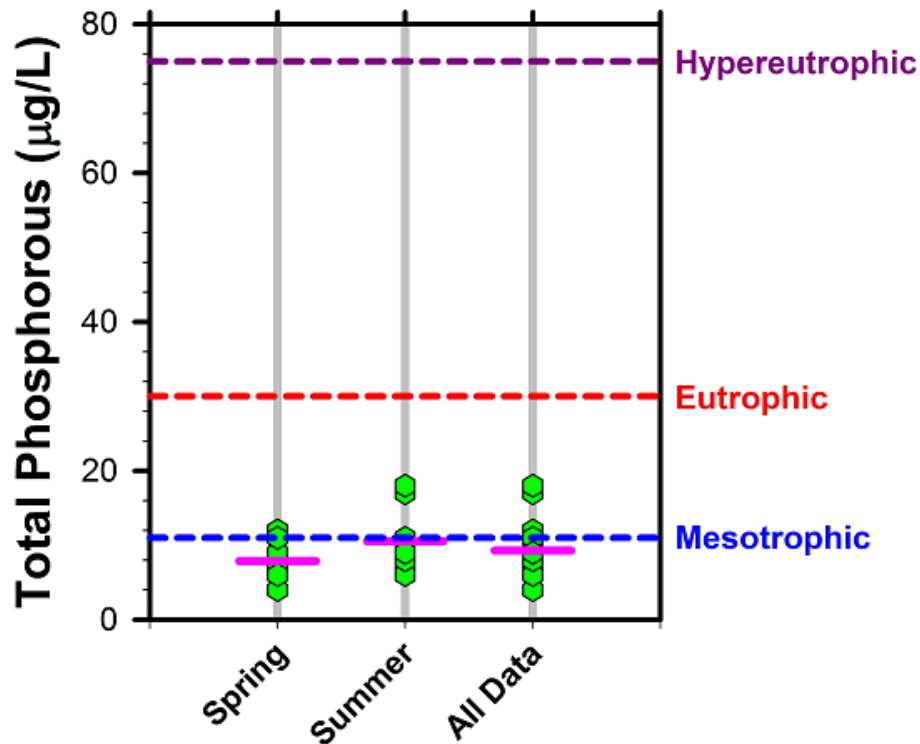
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CLMP Phosphorous & Chlorophyll- α Data Indicate Indian Lake is Oligotrophic/Mesotrophic

CLMP Phosphorous

1995 & 2003-2012 Deep Basin

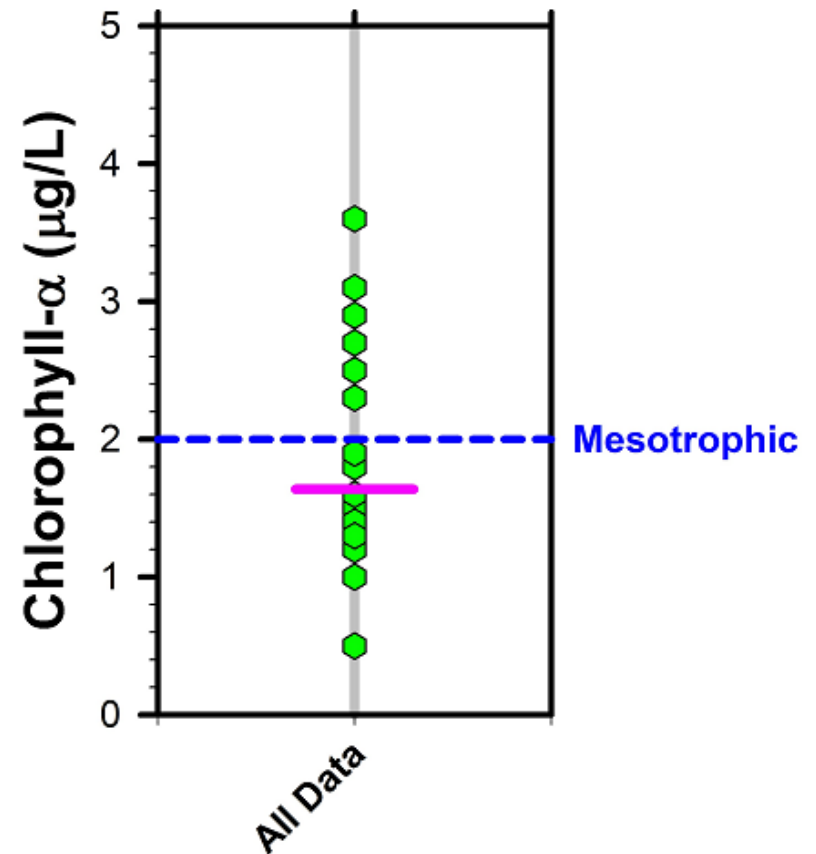
● Observed Values with Mean



CLMP Chlorophyll- α

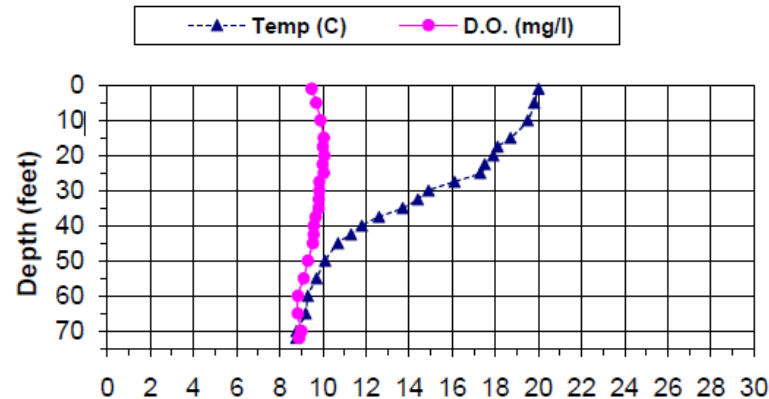
2003-2011 Deep Basin

● Observed Values with Mean

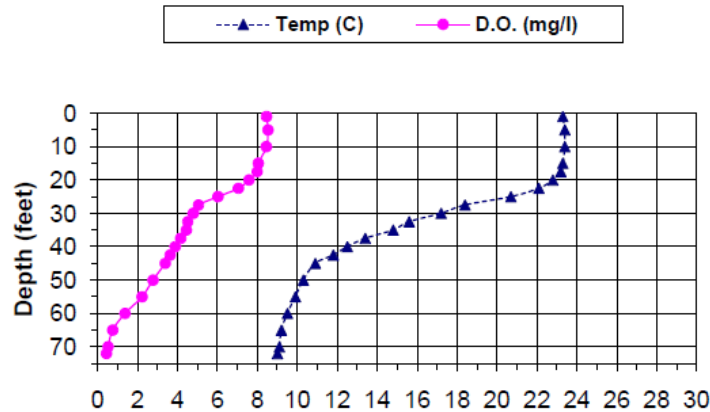


CLMP Dissolved Oxygen & Temperature Data Indicate Indian Lake is Stratified With Oxygen Depletion in the Hypolimnion

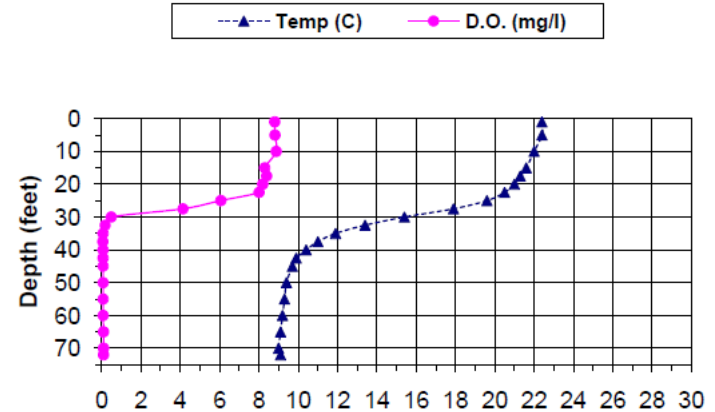
May 24, 2009



August 2, 2009



September 12, 2009



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If Basin #1 is Oligotrophic/Mesotrophic, Why Is It So Weedy?



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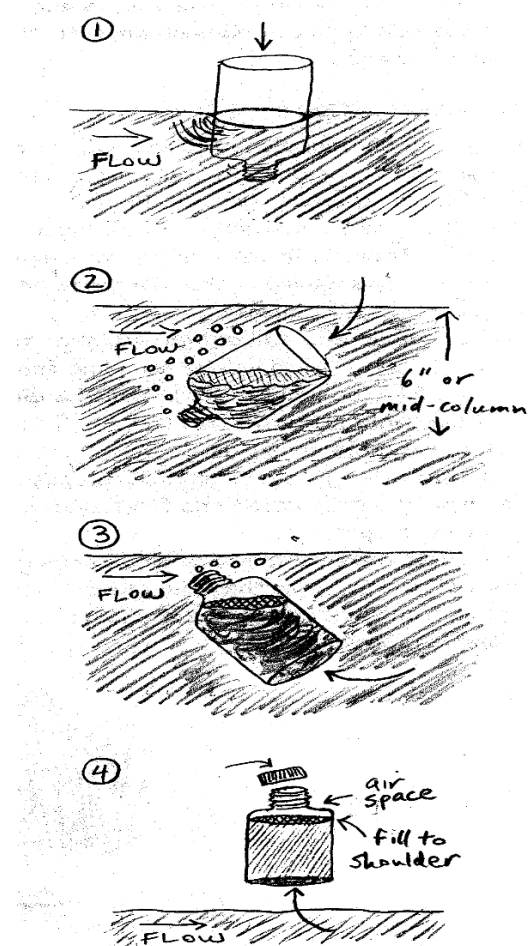
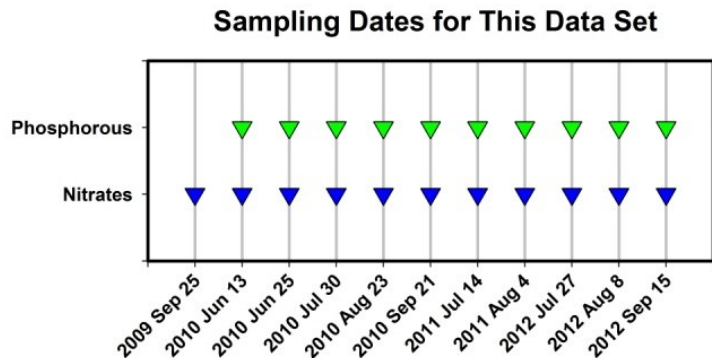
Objectives of This Study

- ☐ Are nitrates involved in the growth of aquatic vegetation?
- ☐ Do water nutrient concentrations at shoreline lawns differ from CLMP data?
- ☐ What are the nutrient concentrations at road culvert sites?
- ☐ What are the nutrient concentrations entering Basin #2 through Portage River & Dorrance Creek?
- ☐ Learn through peer & expert review of our data.



Study Design

- ❑ “Grab” samples at 30 different sites in the lake, and in streams north of the lake.
- ❑ Littoral water samples collected 20 – 50 feet from the ordinary high watermark.
- ❑ Exploratory sampling in 2009 for determination of nitrates only.
- ❑ Measurement of both phosphorous and nitrates in samples collected 2010 – 2012.



Nitrate Methods

2009



Nitrate-Nitrite Test Kit, Model NI-12

Description :	NitraVer 6 Powder Pillows
Method Name:	Cadmium Reduction
Parameter:	Nitrate
Quantity:	100/pk
Range:	0.01 - 0.50 mg/L NO ₃ -N



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2010 - 2012



Nitrate Smart USB Sensor



Range: 0.1 to 14,000 ppm
Reproducibility: ± 4%

Phosphorous Method



Method	Range
8048 Pocket Colorimeter PhosVer 3 (Ascorbic Acid) Method	0.02 - 3.00 mg/L PO ₄



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Phosphorous Measurements in the Center of Basin #1 From 2009-2012

Indicate Basin #1 is Oligotrophic/Mesotrophic

❑ Designations of trophic status are based on Carlson's Trophic State Index.

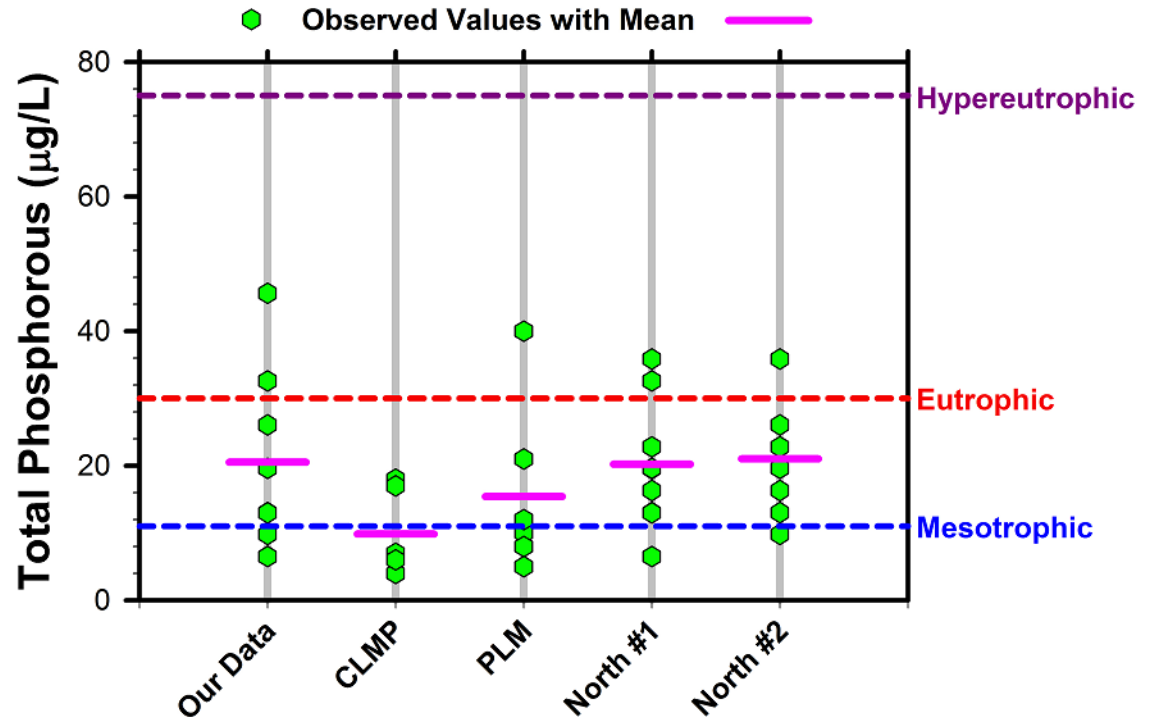
❑ Our Data were obtained in the Deep Basin at various times during the summer month.

❑ CLMP data were obtained in the Deep Basin at prescribed dates in spring & late summer.

❑ PLM data were obtained in the Deep Basin twice each summer by PLM Professional Lake & Land Management Corp. at part of the special assessment districts for weed control.

❑ Measurements at North #1 & North #2 were taken 1.0 & 1.3 miles northeast of the Deep Basin, respectively.

❑ Data obtained outside of CLMP tended to be more variable with mean values approximately 2-fold higher.



Nitrate Measurements in the Center of Basin #1 From 2009-2012

Indicate Basin #1 is Mesotrophic

□ Designations of trophic status are based on definitions used by PLM Professional Lake & Land Management Corp.

Oligotrophic = $<250 \mu\text{g/L}$

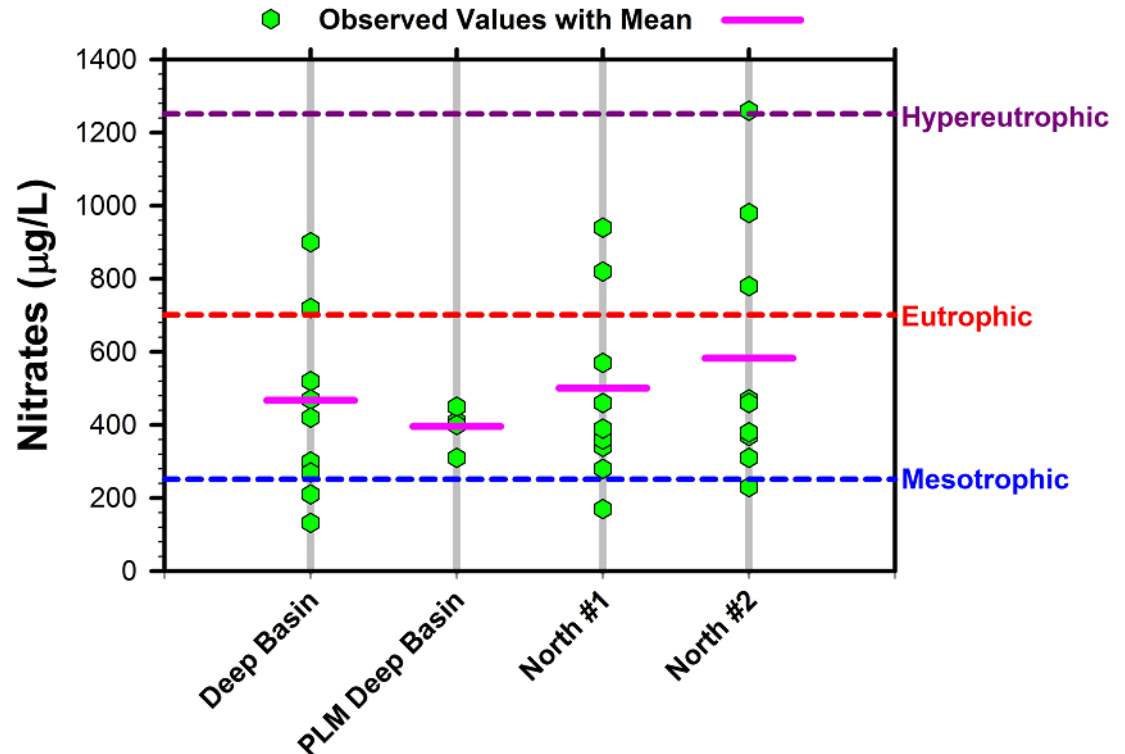
Mesotrophic = $251\text{--}700 \mu\text{g/L}$

Eutrophic = $701\text{--}1250 \mu\text{g/L}$

Hypereutrophic = $>1250 \mu\text{g/L}$

□ Measurements at North #1 & North #2 were taken 1.0 & 1.3 miles northeast of the Deep Basin, respectively.

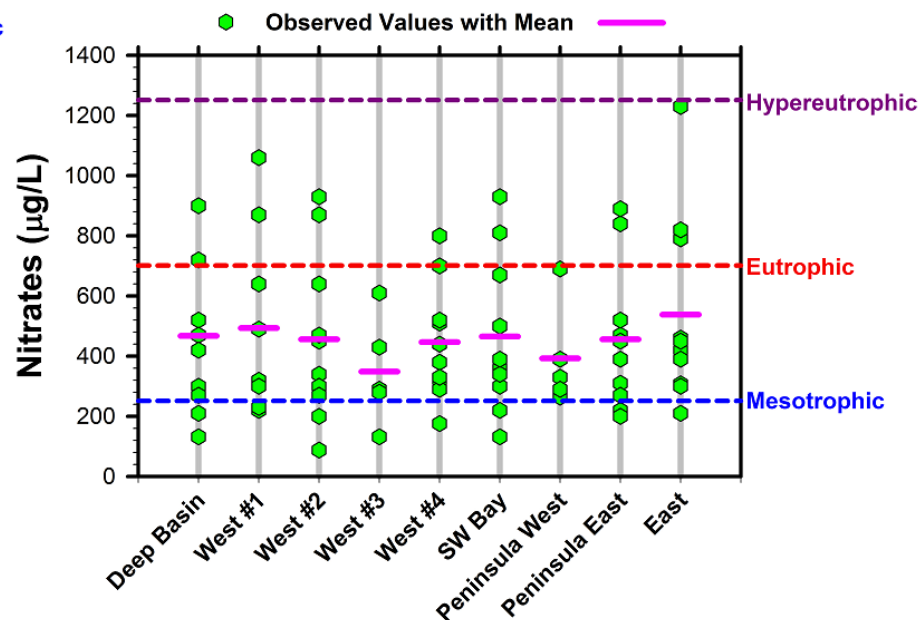
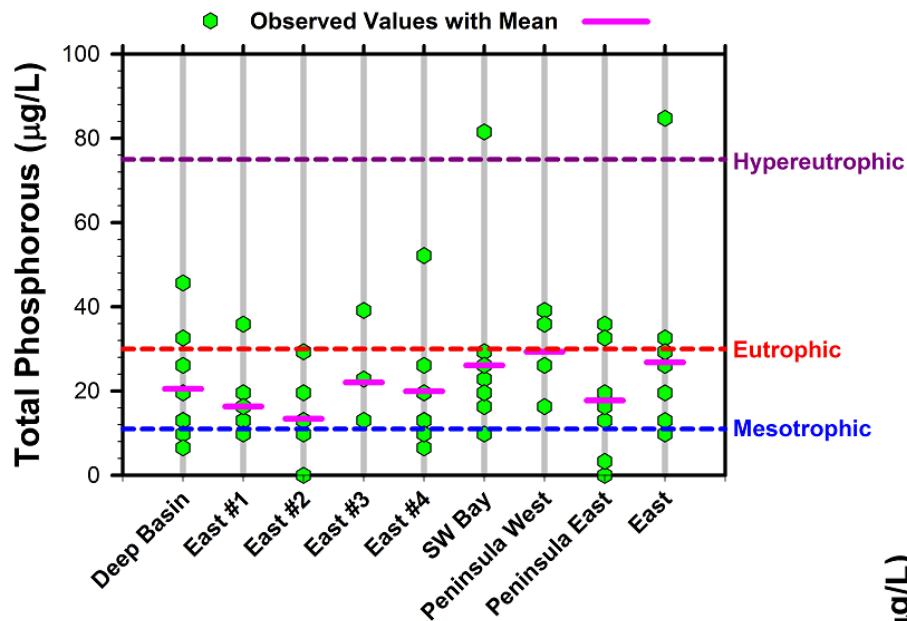
□ Individual values are variable with mean values in the mesotrophic range.



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Phosphorous & Nitrate Measurements at Lawn Shorelines in Basin #1

From 2009-2012 Indicate Basin #1 is Mesotrophic



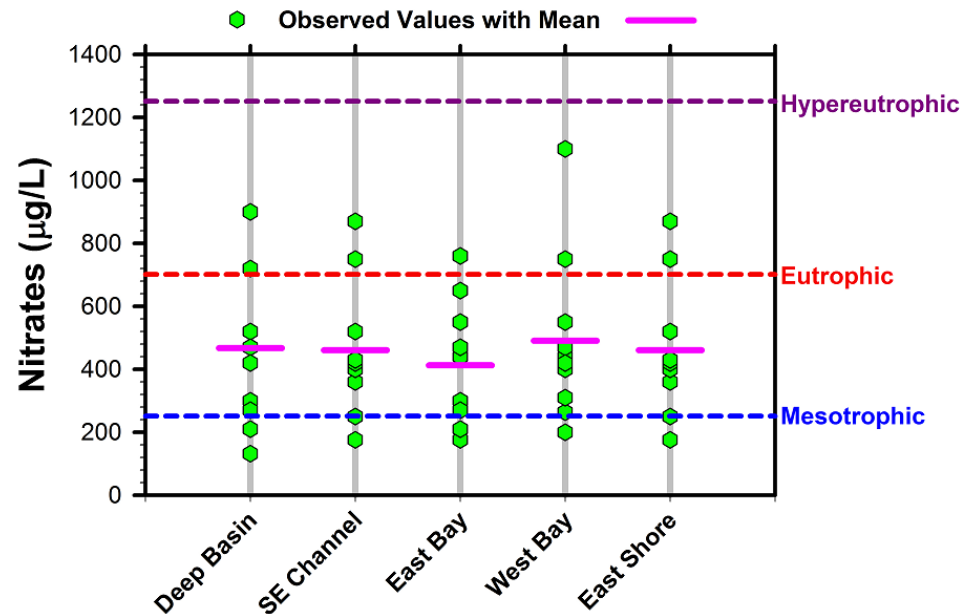
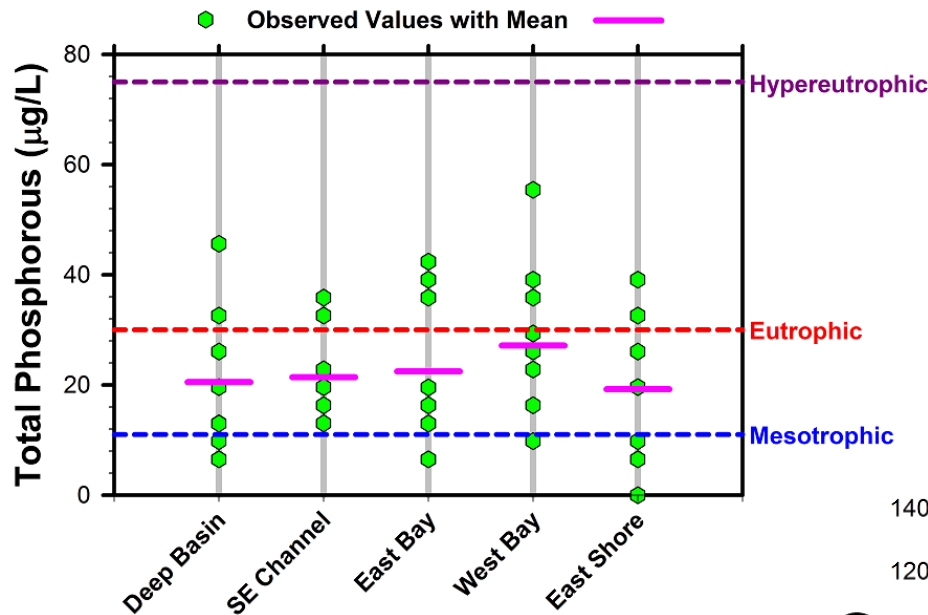
Road Culverts - Stormwater Runoff in Basin #1



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Phosphorous & Nitrate Measurements at Road Culverts in Basin #1

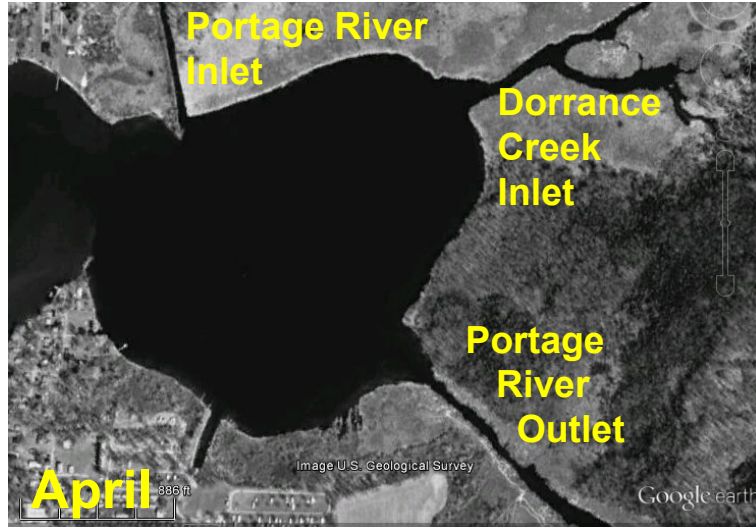
From 2009-2012 Indicate Basin #1 is Mesotrophic



Why Is Basin #2 (“Little Indian Bay”) So Weedy?

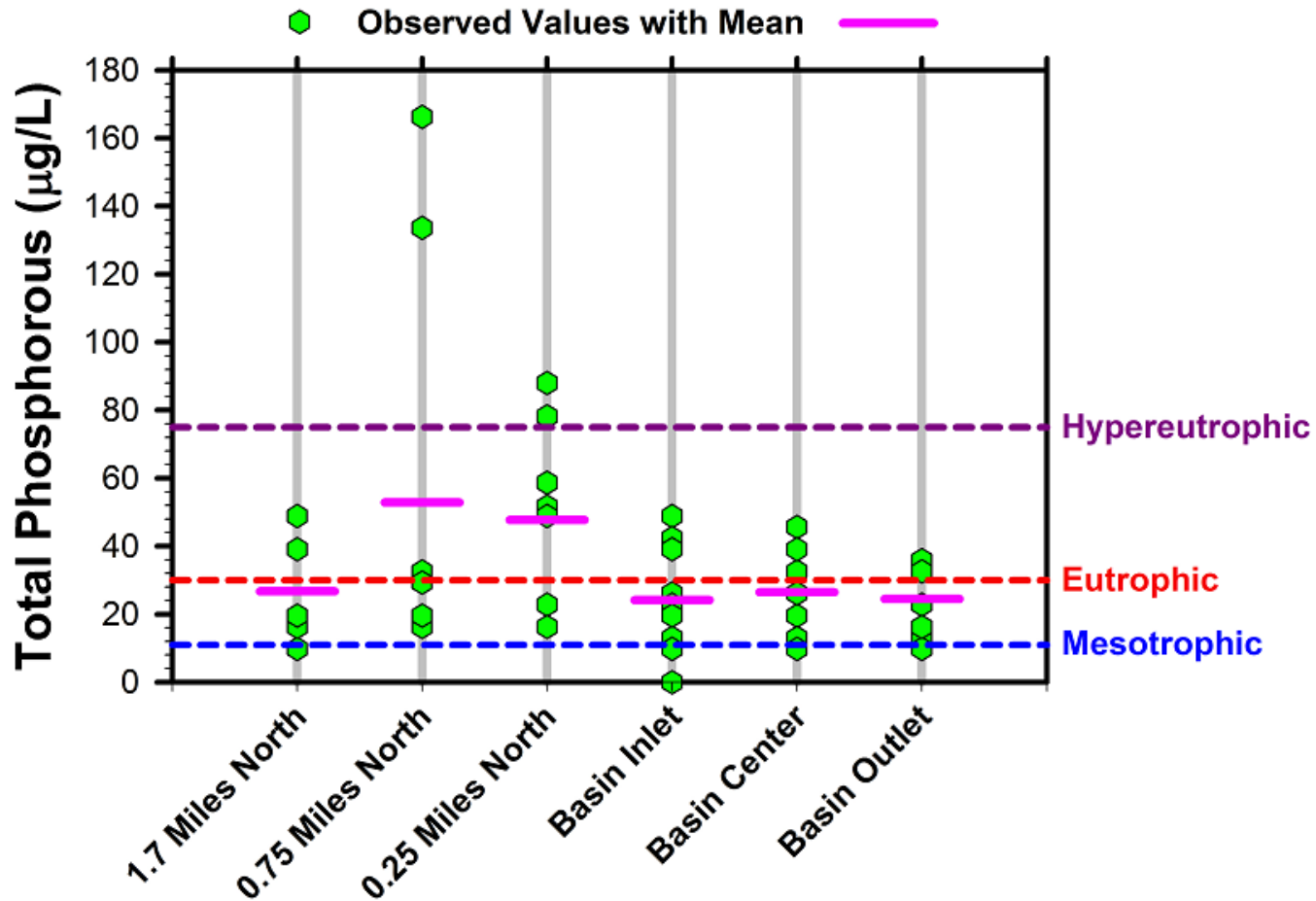


Why Is Basin #2 (“Little Indian Bay”) So Weedy?

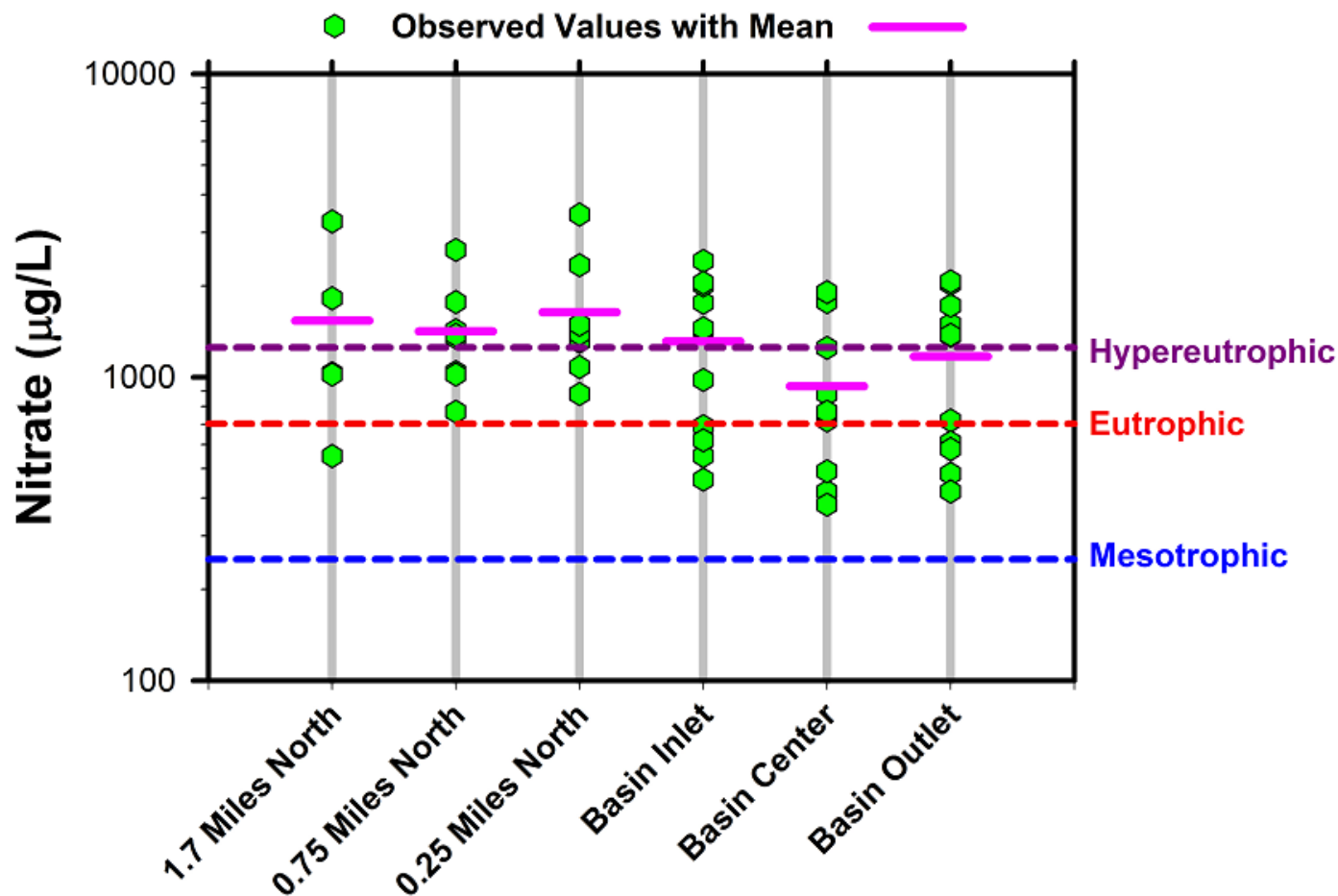


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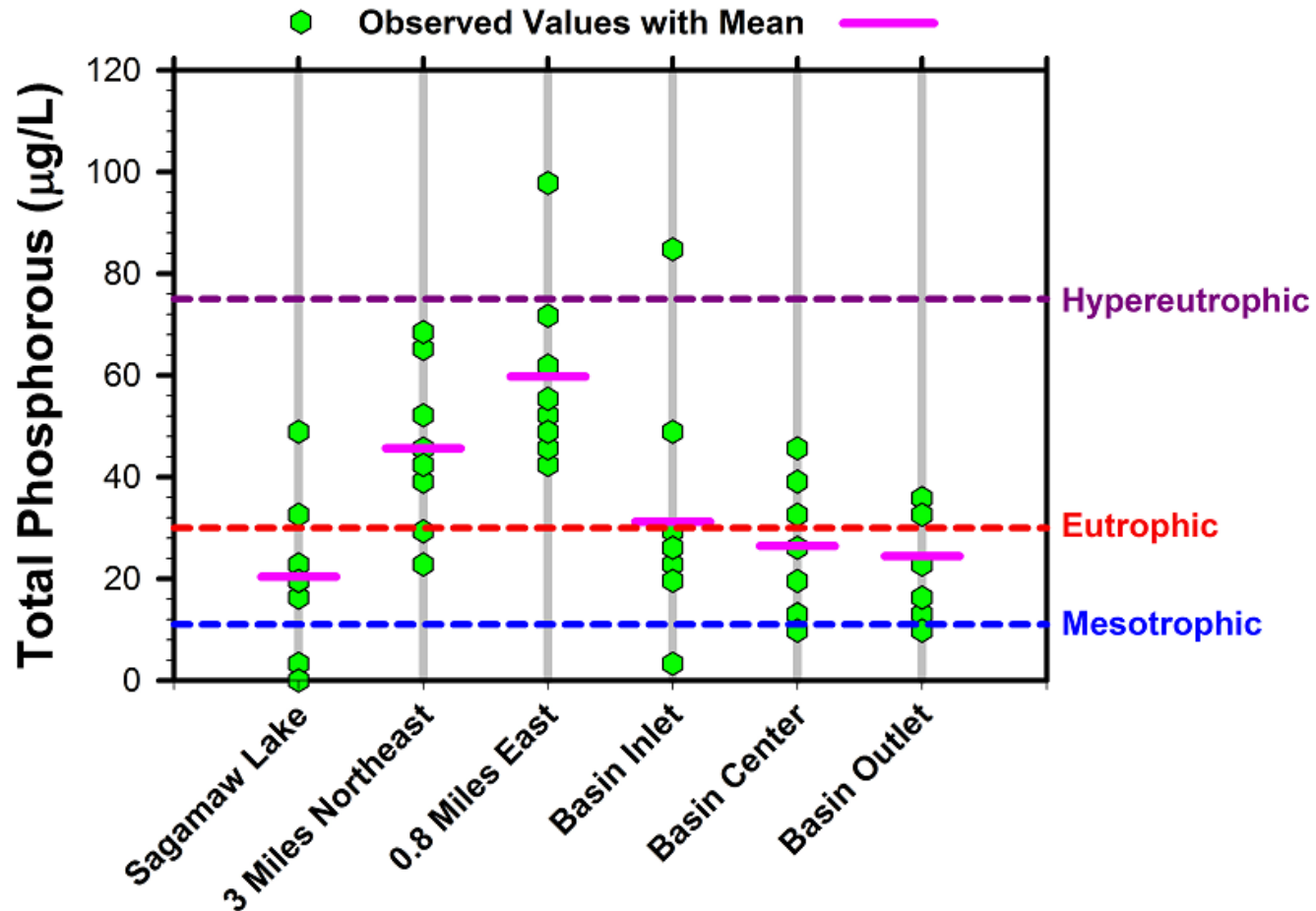
Mean Phosphorous Values in Portage River North of Basin #2 & in Basin #2 During 2009-2012 Range from Eutrophic to Mesotrophic



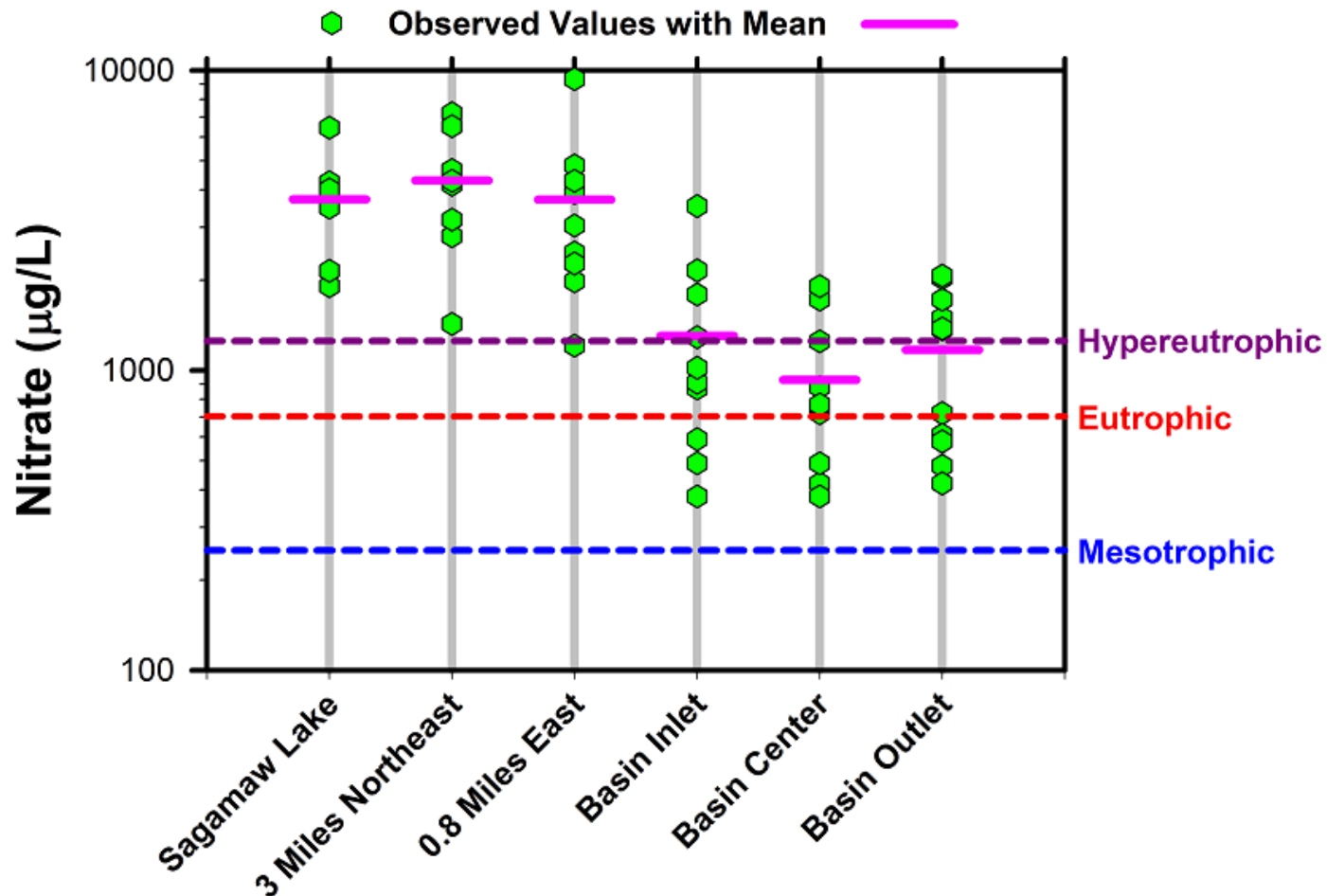
Mean Nitrate Values in Portage River North of Basin #2 & in Basin #2 During 2009-2012 Range from Hypereutrophic to Eutrophic



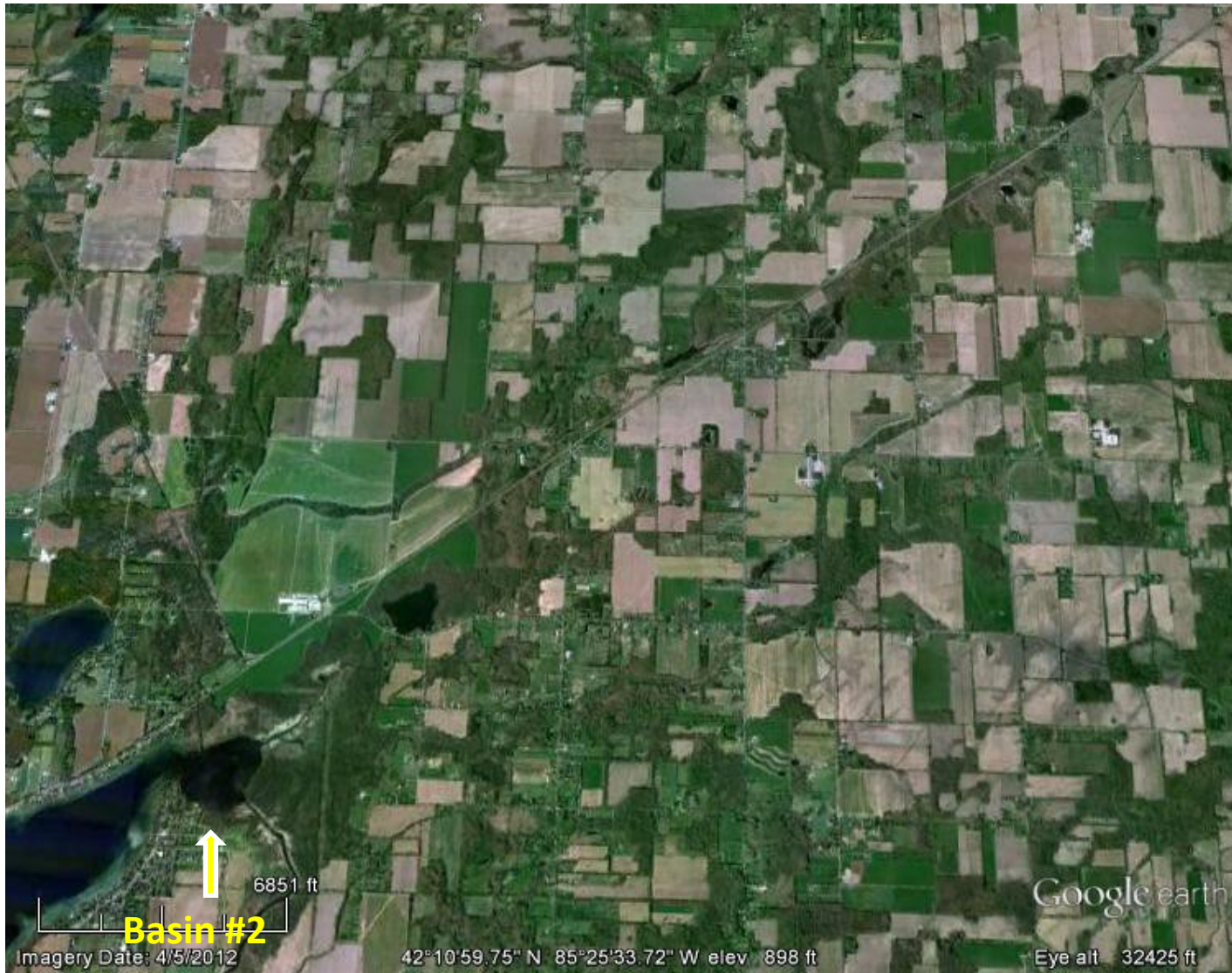
Mean Phosphorous Values in Dorrance Creek North & East of Basin #2 & in Basin #2 During 2009-2012 Range from Eutrophic to Mesotrophic



Mean Nitrate Values in Dorrance Creek North & East of Basin #2 & in Basin #2 During 2009-2012 Range from Hypereutrophic to Eutrophic



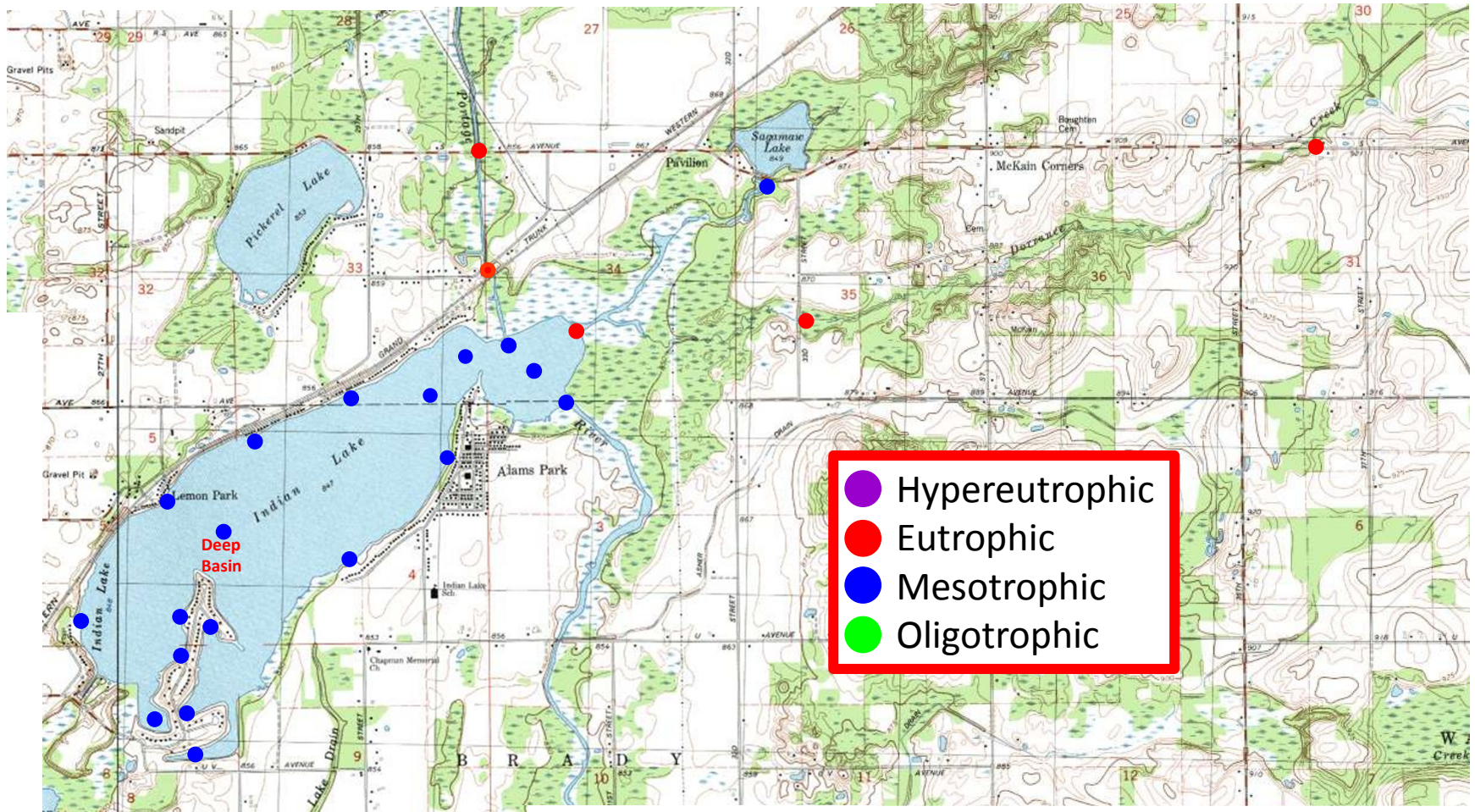
Agriculture is the Predominant Land Use North & East of Basin #2



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Phosphorous Status Summary 2010-2012

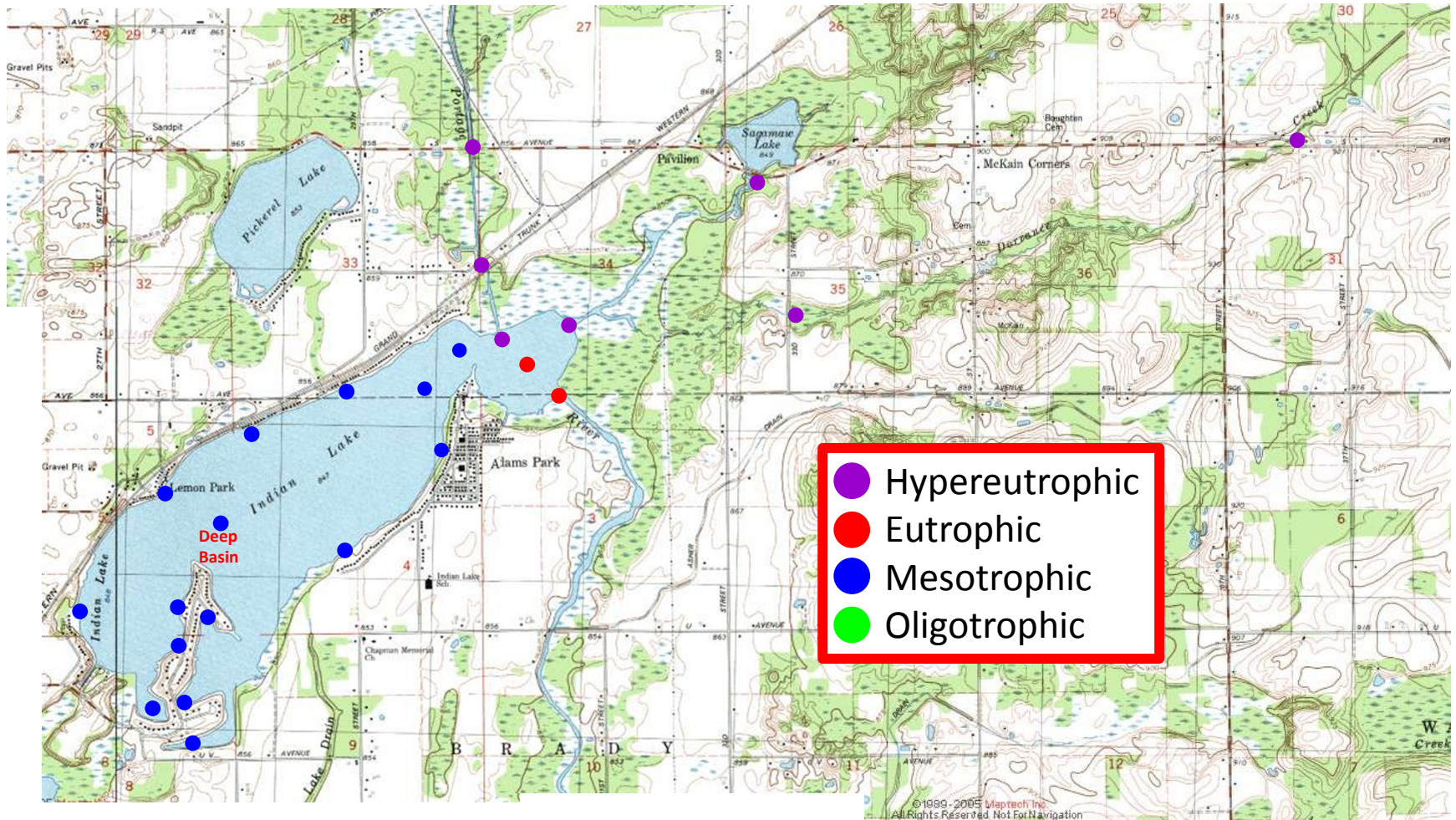
Indian Lake, Kalamazoo County



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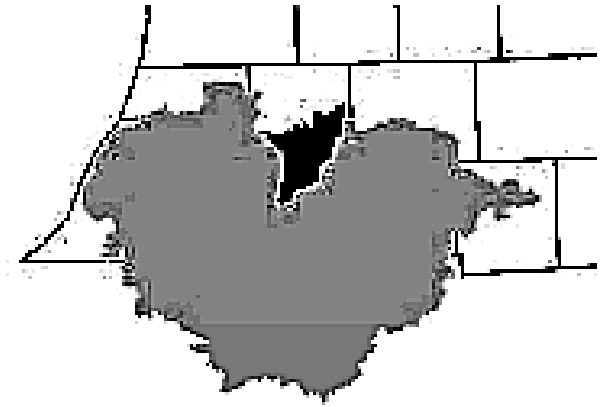
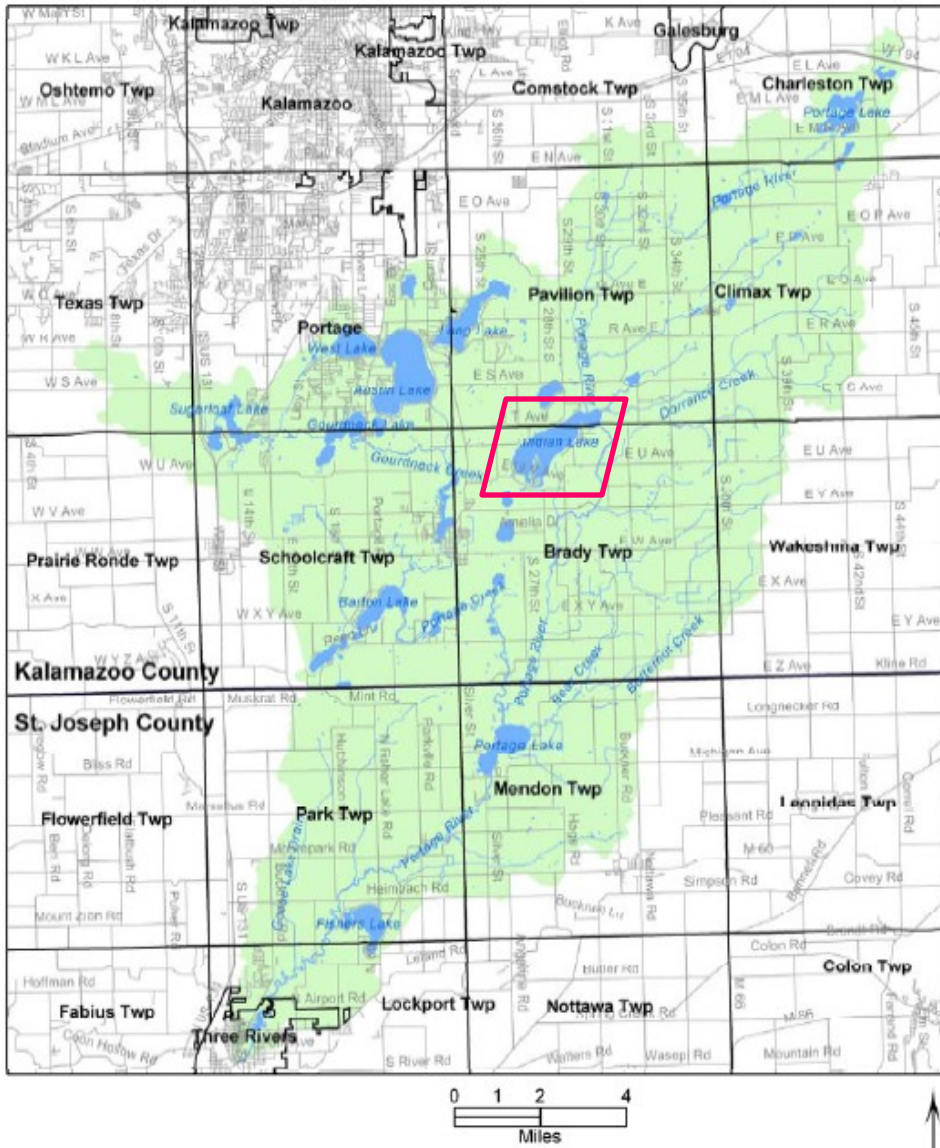
Nitrate Status Summary 2009-2012

Indian Lake, Kalamazoo County



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Indian Lake Is At The Center Of The Portage River Watershed



- The Portage River Watershed encompasses 196 square miles in Kalamazoo and St. Joseph counties.
- The Portage River is a component of the St. Joseph River Watershed occupying 4,685 square miles in southwest Michigan and northern Indiana.
- Elevation of 843 feet at Indian Lake falls to 804 feet at confluence with the St. Joseph River.



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Portage River Watershed Management Plan (WMP)

- ❑ WMP prepared in 2006 by the Kalamazoo Conservation District.
- ❑ The Indian Lake Association's accumulating data were shared with Christina Bauer, Environmental Quality Analyst, MDEQ, Water Resources Division, Kalamazoo.
- ❑ The Indian Lake Association asked if the 2006 WMP could assist in dealing with nutrient pollution in Portage River & Dorrance Creek.
- ❑ The Association learned the 2006 WMP satisfied requirements for a Municipal Separate Storm Sewer System (MS4) permit, but did not meet the necessary criteria to qualify for nonpoint source grants.
- ❑ The Indian Lake Association was asked to update the WMP, or prepare a mini-WMP, to qualify for nonpoint source grants. This is too large a task for our volunteer group, but the Association offered to actively participate with others in a new WMP.
- ❑ Christina Bauer identified stakeholders in an updated WMP, and a series of planning meetings were held in 2011. The group moved forward with a grant proposal for a new WMP for Portage River and Little Portage Creek with the leadership from Calhoun Conservation District.
- ❑ The Indian Lake Association made presentations to the Trustees of Brady, Climax & Pavilion Townships to obtain letters of support for an upgraded WMP.
- ❑ The MDEQ in June, 2012 awarded \$223,718 for preparation of a new WMP through the Nonpoint Source Program.



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Portage River Watershed Requires a Total Daily Maximum Load (TDML) for *E. coli* by 2018

Michigan Public Health Code

Total Body Contact Recreation

Shall not contain >300 colonies/100 ml at any time

Shall not contain >130 colonies/100 ml as 30 day mean

Indian Lake Association Data

Portage River Inlet (2005-12)

0/11 Samples >130 colonies/100 ml

Range: <1 to 96 colonies/100 ml

Dorrance Creek Inlet (2005-12)

0/5 Samples >130 colonies/100 ml

Range: 2 to 17 colonies/100 ml

Little Indian Bay Center (2005-12)

0/5 Samples >130 colonies/100 ml

Range: <1 to 84 colonies/100 ml

Kalamazoo County Data

Portage River

0.25 Miles North of Lake (2001-09)

44/89 Samples >300 colonies/100 ml

23/89 Samples – 130-299 colonies/100 ml

0.75 Miles North of Lake (2008-09)

2/12 Samples >300 colonies/100ml

6/12 Samples – 130-299 colonies/100ml

Dorrance Creek

1.8 Miles North of Lake (2001-09)

52/81 Samples >300 colonies/100 ml

16/81 Samples – 130-299 colonies/100 ml

3.0 Miles North of Lake (2001-2009)

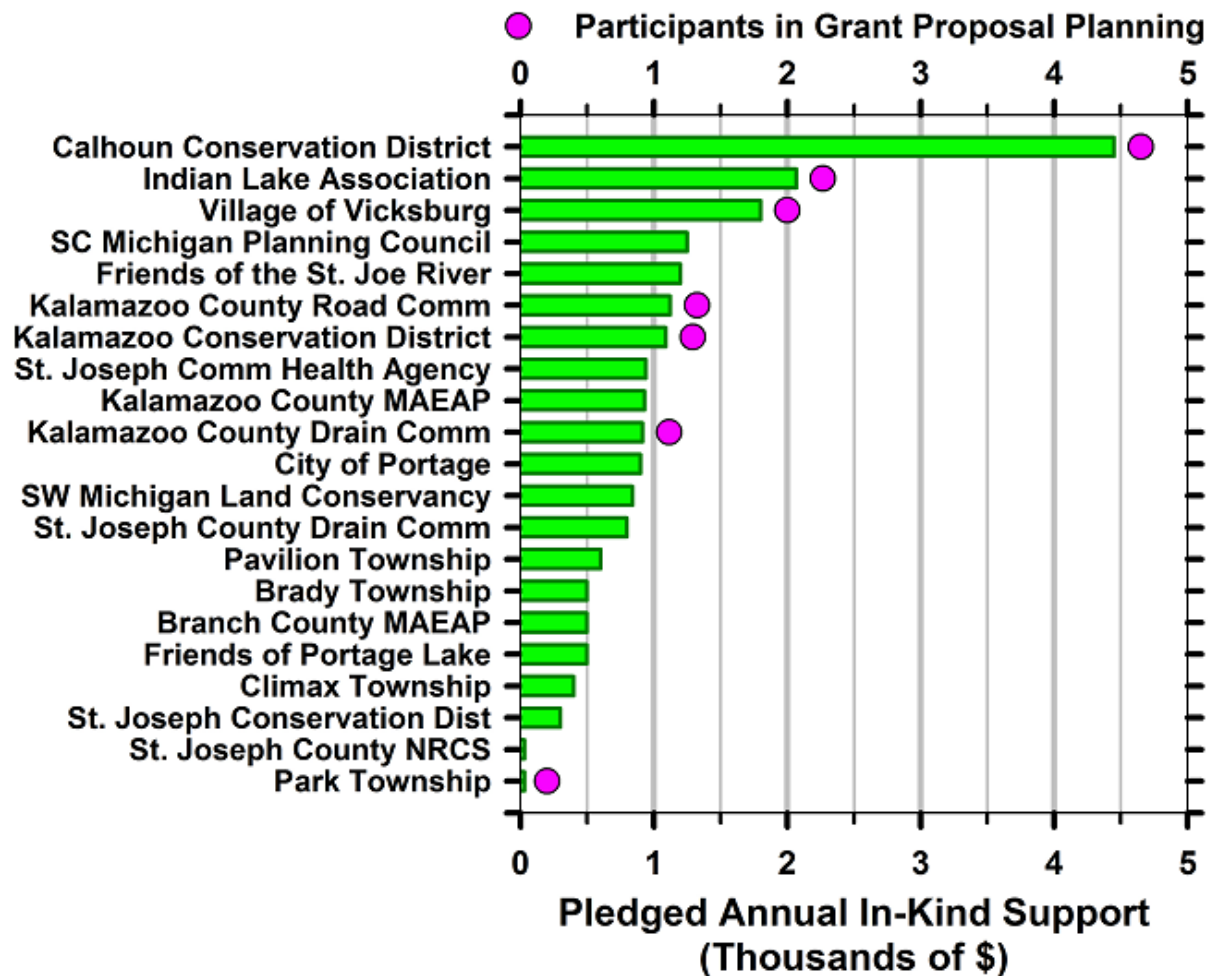
44/89 Samples >300 colonies/100 ml

18/89 Samples – 130-299 colonies/100 ml



The Indian Lake Association Will Participate in Developing of a New WMP

Steering Team: Portage River Watershed Management Plan



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Lessons Learned

- ❑ Lake basins will differ dramatically in water quality, especially when streams enter a lake.
- ❑ Phosphorous is likely the limiting nutrient for aquatic vegetation & algae growth in Basin #1.
Theory: Nitrogen is rate limiting when the ratio of N:P is less than 10:1; values between 10:1 and 15:1 are transitional; and values greater than 15:1 are phosphorous limited.
- ❑ Phosphorous concentrations at shoreline lawns are 2-fold greater than CLMP measurements, but still in the mesotrophic range.
- ❑ Nitrate concentrations at shoreline lawns are in the mesotrophic range.
- ❑ Nutrient concentrations at road culvert sites are in the mesotrophic range



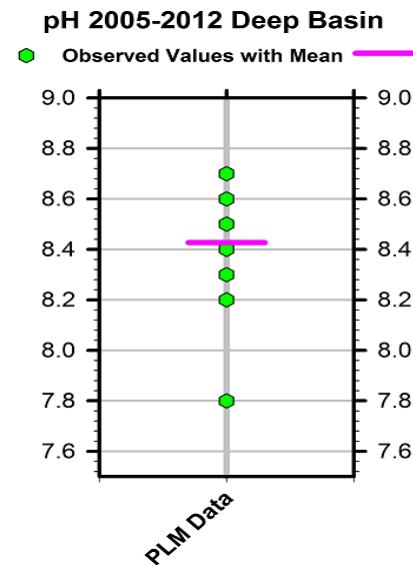
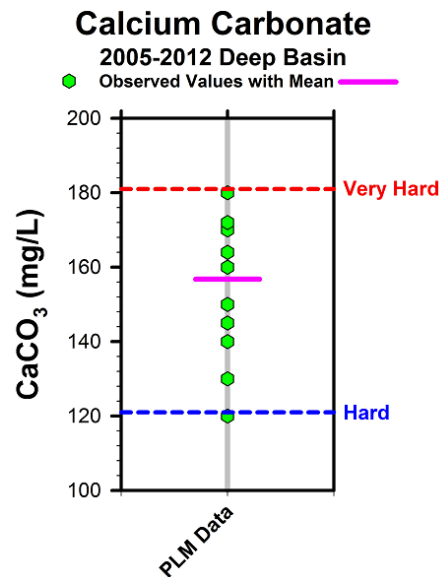
Lessons Learned

- ☐ **Elevated nutrients entering Indian Lake through Portage River & Dorrance Creek are likely contributing to vegetation and algae growth in Basin #2, including harmful algae blooms.**
- ☐ **Individual sample variation demands continuing assessments to establish consensus trophic status, & changing trends in nutrient status.**
- ☐ **Water quality volunteers should leverage their data & expertise to initiate change at their lakes & streams by working with other agencies or groups.**



Unanswered Questions

- ☐ Will establishment of a TDML for *E. coli* also reduce nutrient loads?
- ☐ Are zebra mussels contributing to the growth of aquatic vegetation?
- ☐ Does climate change contribute to the recent excessive growth of aquatic vegetation?
- ☐ Does phosphorous in lake sediments control the growth of aquatic vegetation due to precipitation by calcium carbonate ?



Acknowledgements

Indian Lake Association

CLMP Volunteers

Greg Nichols

Ron & Carol Scheff

Jeff Schimp

Gene Robinson

Additional Water Quality Volunteers

Authors of this Study

Liz & Larry Smith

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Andy Tomaszewski

MDEQ

Chris Bauer

Calhoun Conservation District

Tracy Bronson

Melanie Stoughton

Brett Riser

Lakeshore Environmental, Inc.

Jennifer Jermalowicz-Jones



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