

# CyanoHAB Remediation Case Study: Campus Lake

**Dr. Marj Brooks**

**is Lake Management Association  
32nd Annual Conference  
March 30th – April 1st**

**31 March 2017**





## Acknowledgements

- Physical Plant at Southern Illinois Uni
- Scott Weber, Kevin Bame, David Tipp
- Bret Dougherty, Andrea Palmer, Just
- Brad Dillard

# Acknowledgements

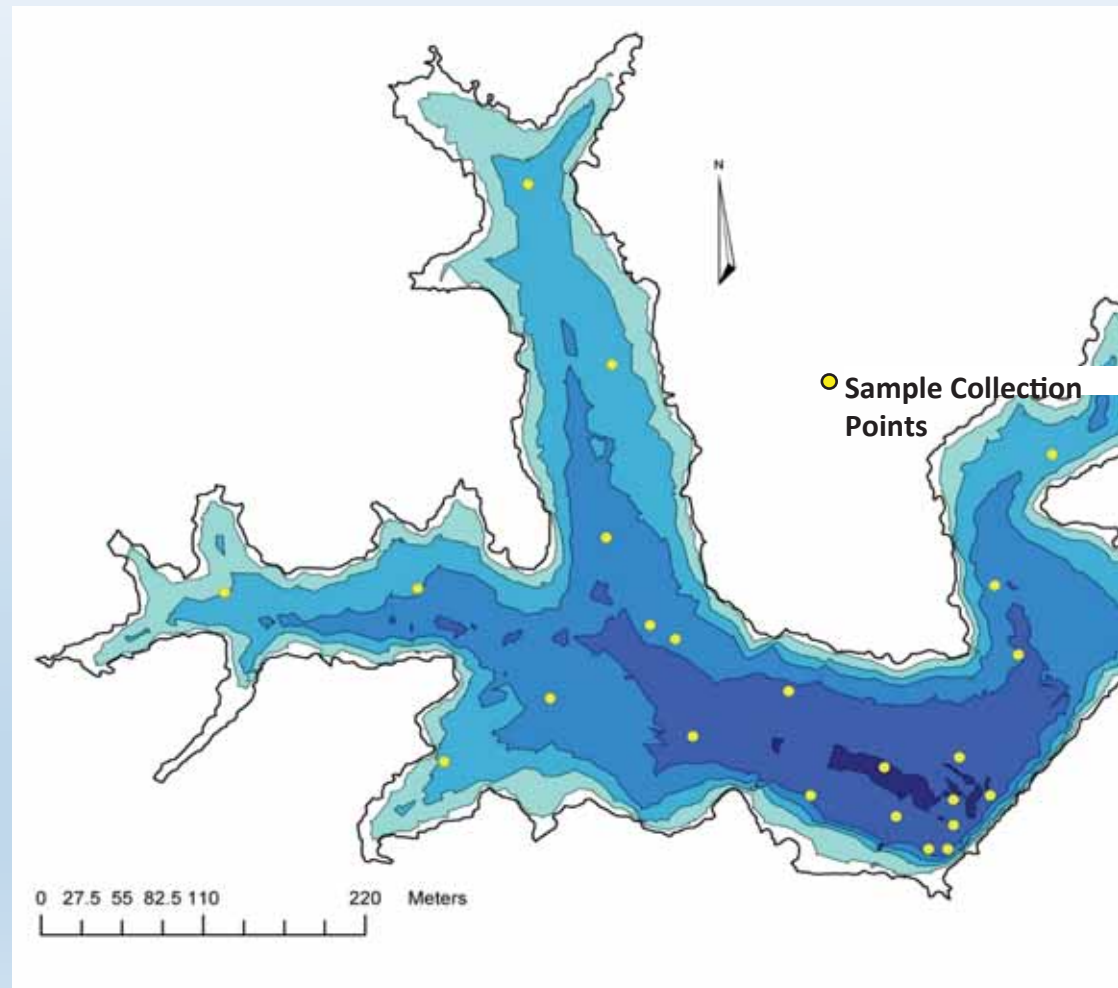
Terra Club, Shawnee Chapter

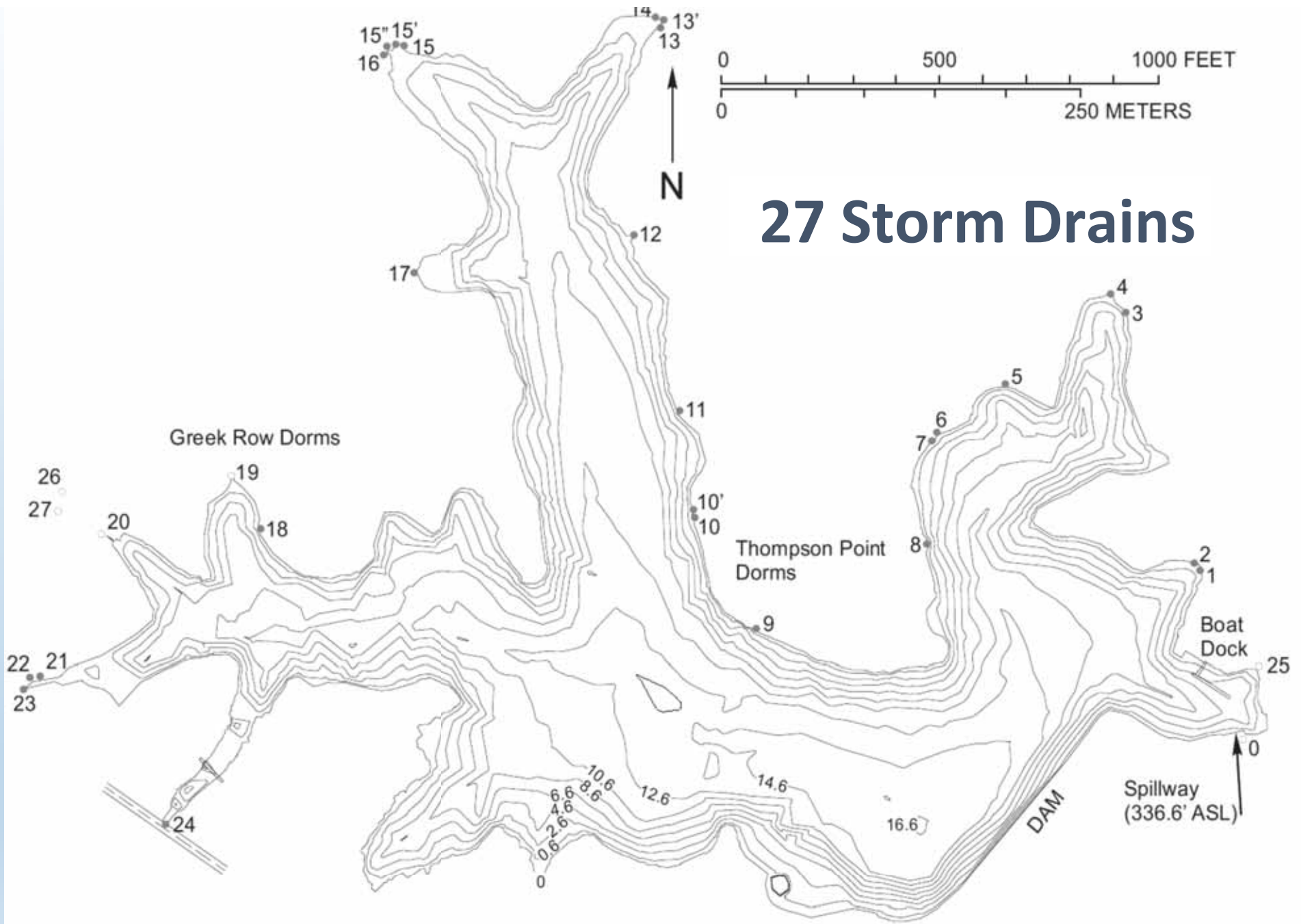


# Basic facts about Campus Lake

contains 40 acre-feet or  
14,272,320 gallons of water  
total volume refreshes ~1.75 years  
shoreline under consideration  
2,900 feet long

Campus lake has an **income** of  
nutrients from 23 storm drains  
also has a **savings account** of  
dying algae—wet compost that  
utilizes the harmful cyanobacteria





**PO<sub>4</sub> (mg/L)**

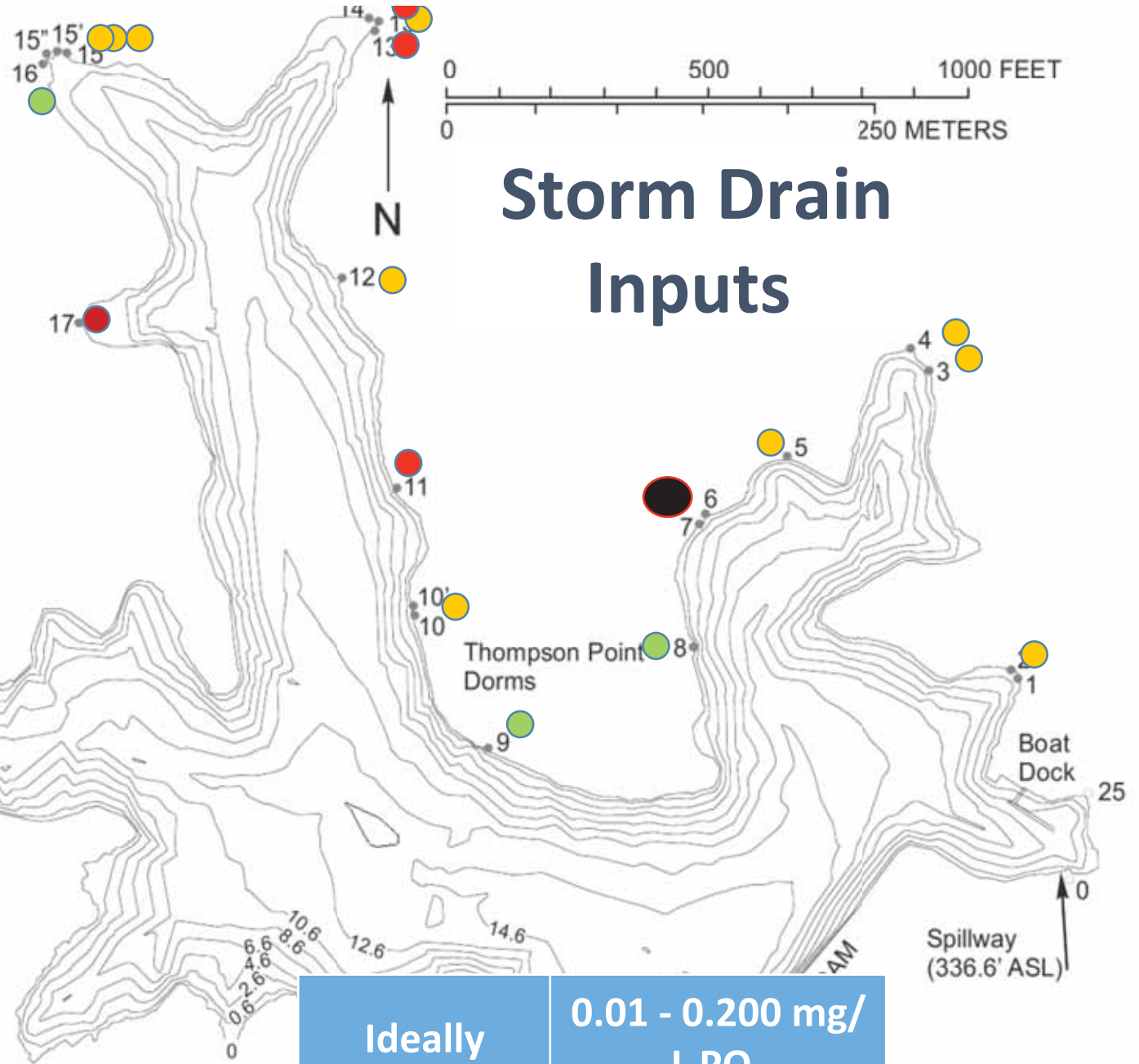
**>0.40**

**0.20 - 0.39**

**0.10 - 0.19**

**0.05-0.09**

**0.00 - 0.049**

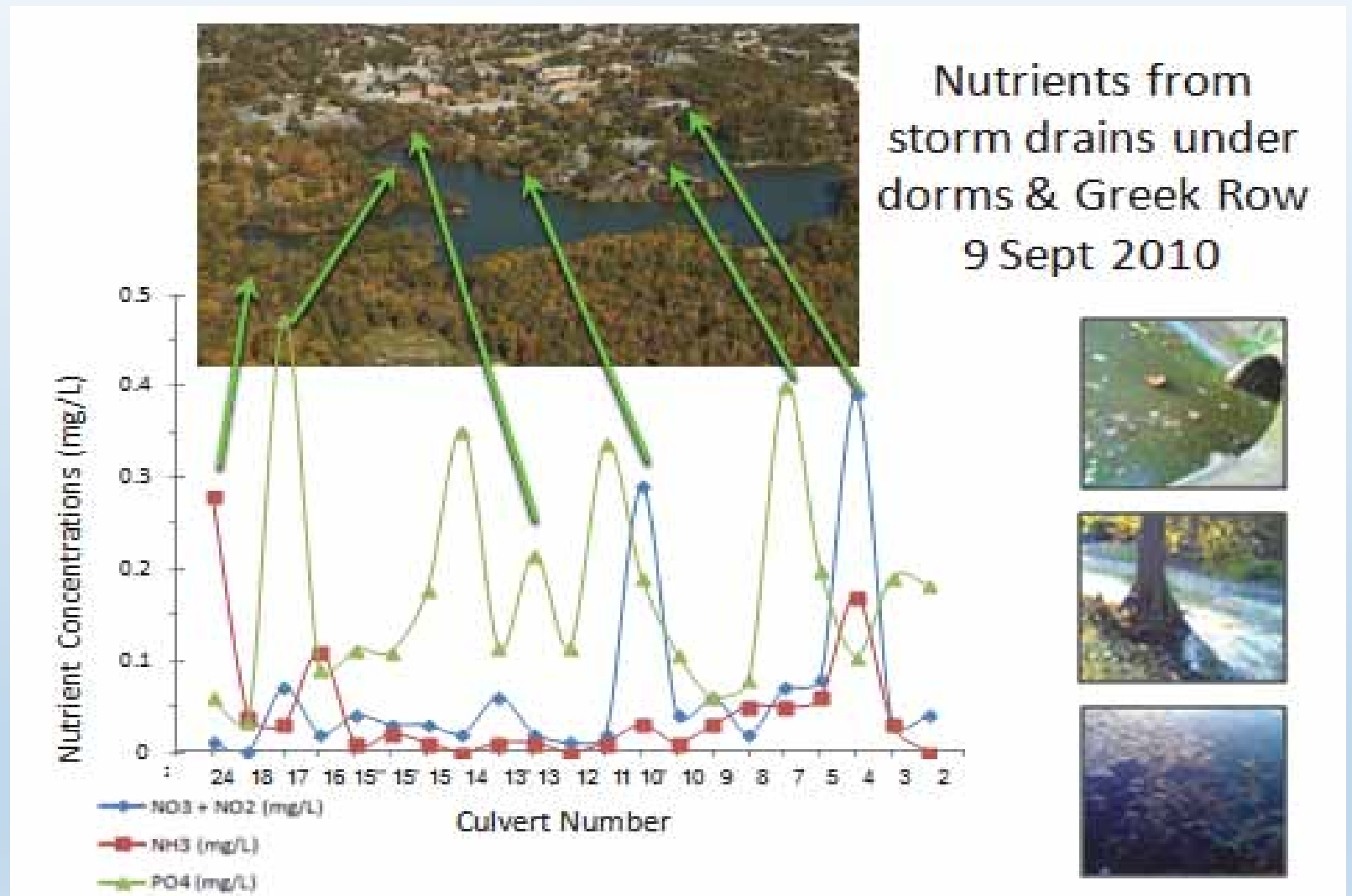


# Storm Drain Inputs

<b>Ideally</b>	<b>0.01 - 0.200 mg/ L PO<sub>4</sub></b>
<b>Data Range</b>	<b>0.06 - 0.47</b>

# Nutrient hotspots around Campus Lake

0 Data



Brooks et al. 2013. Phase II Implementation: Report for Campus Lake, Jackson, Illinois, Illinois Environmental Protection Agency. Illinois Clean Lakes Program

**PO<sub>4</sub> (mg/L)**

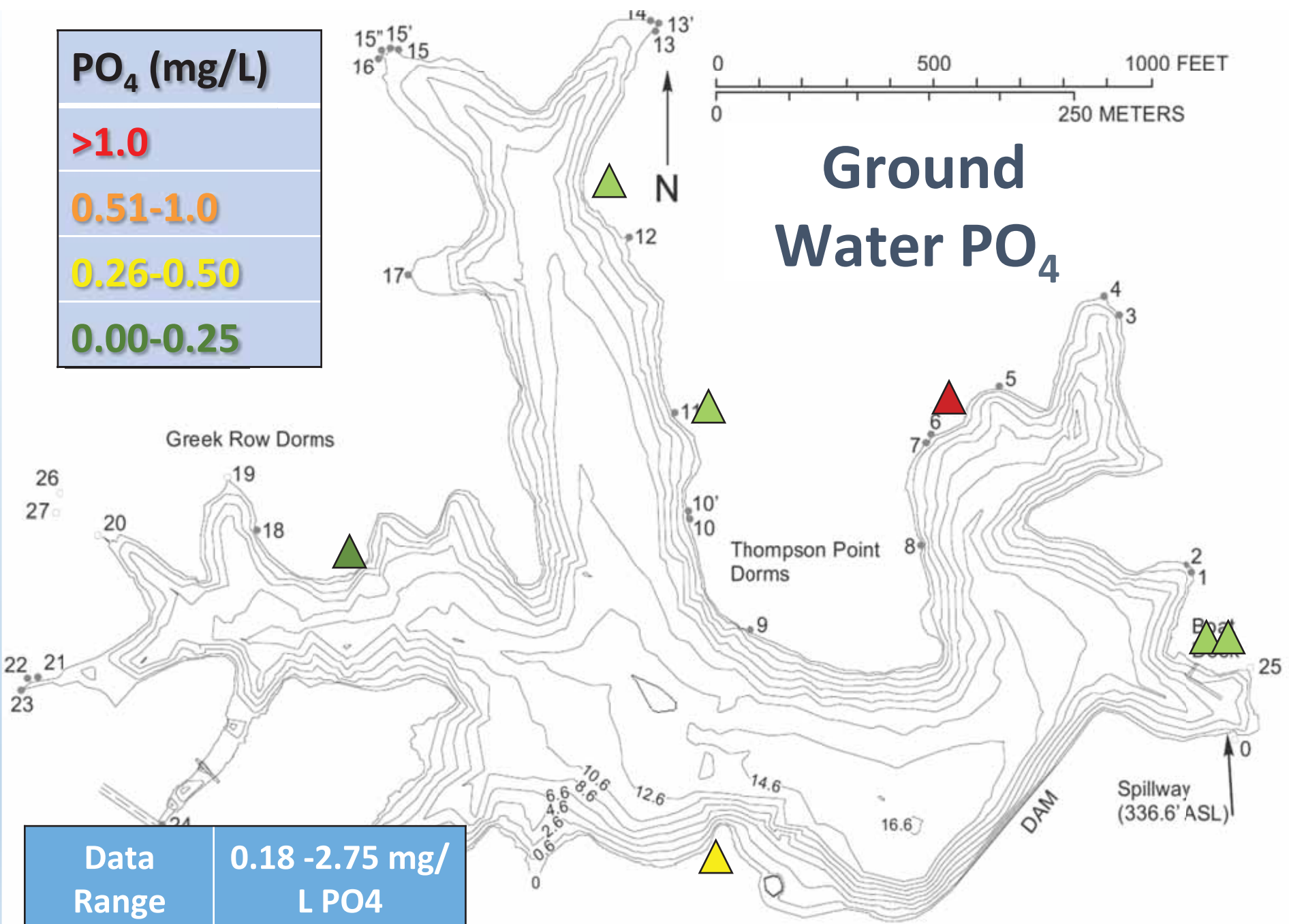
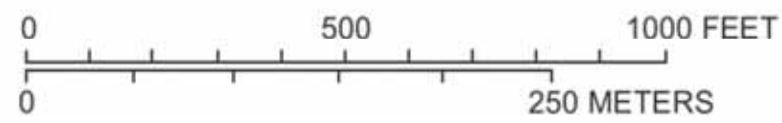
**>1.0**

**0.51-1.0**

**0.26-0.50**

**0.00-0.25**

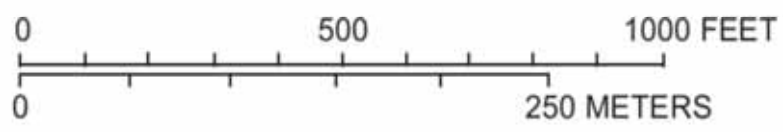
# Ground Water PO<sub>4</sub>



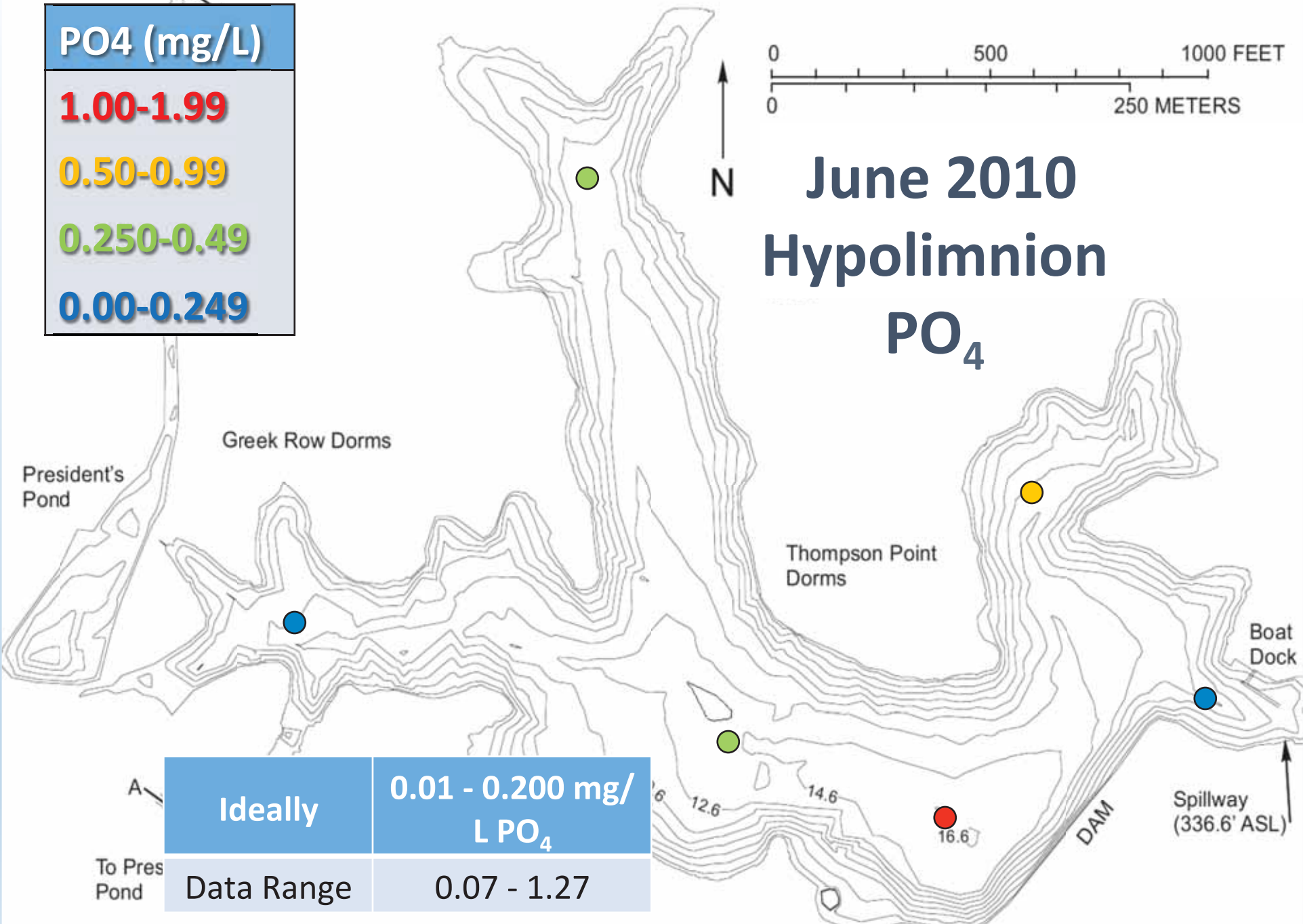
Data Range	0.18 -2.75 mg/L PO <sub>4</sub>
------------	---------------------------------



PO4 (mg/L)	
1.00-1.99	
0.50-0.99	
0.250-0.49	
0.00-0.249	



# June 2010 Hypolimnion PO<sub>4</sub>

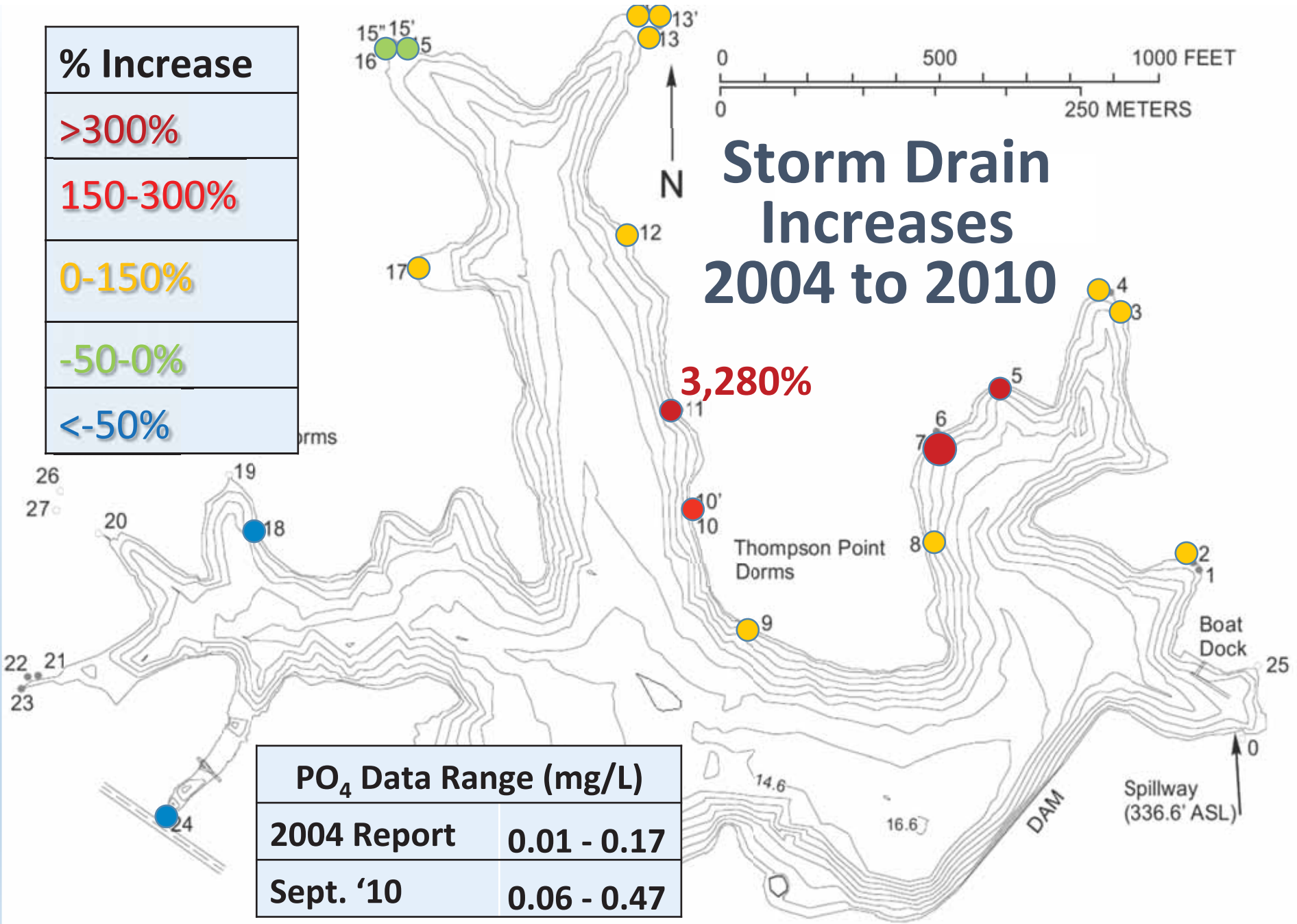
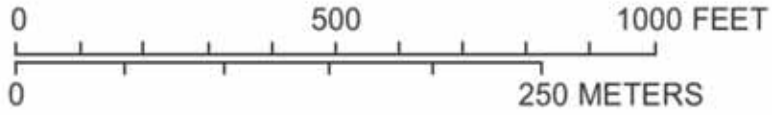


Ideally	0.01 - 0.200 mg/L PO <sub>4</sub>
Data Range	0.07 - 1.27

To Pres Pond

% Increase	
>300%	Red
150-300%	Red
0-150%	Yellow
-50-0%	Green
<-50%	Blue

# Storm Drain Increases 2004 to 2010



PO <sub>4</sub> Data Range (mg/L)	
2004 Report	0.01 - 0.17
Sept. '10	0.06 - 0.47

# 2013 Average Nitrate



## Legend

Campus Lake V

Mean Nitrate

- 0.00 - 0.25
- 0.26 - 1.25
- 1.3 - 2.00
- 2.01 - 3.20
- 3.21 - 5.00

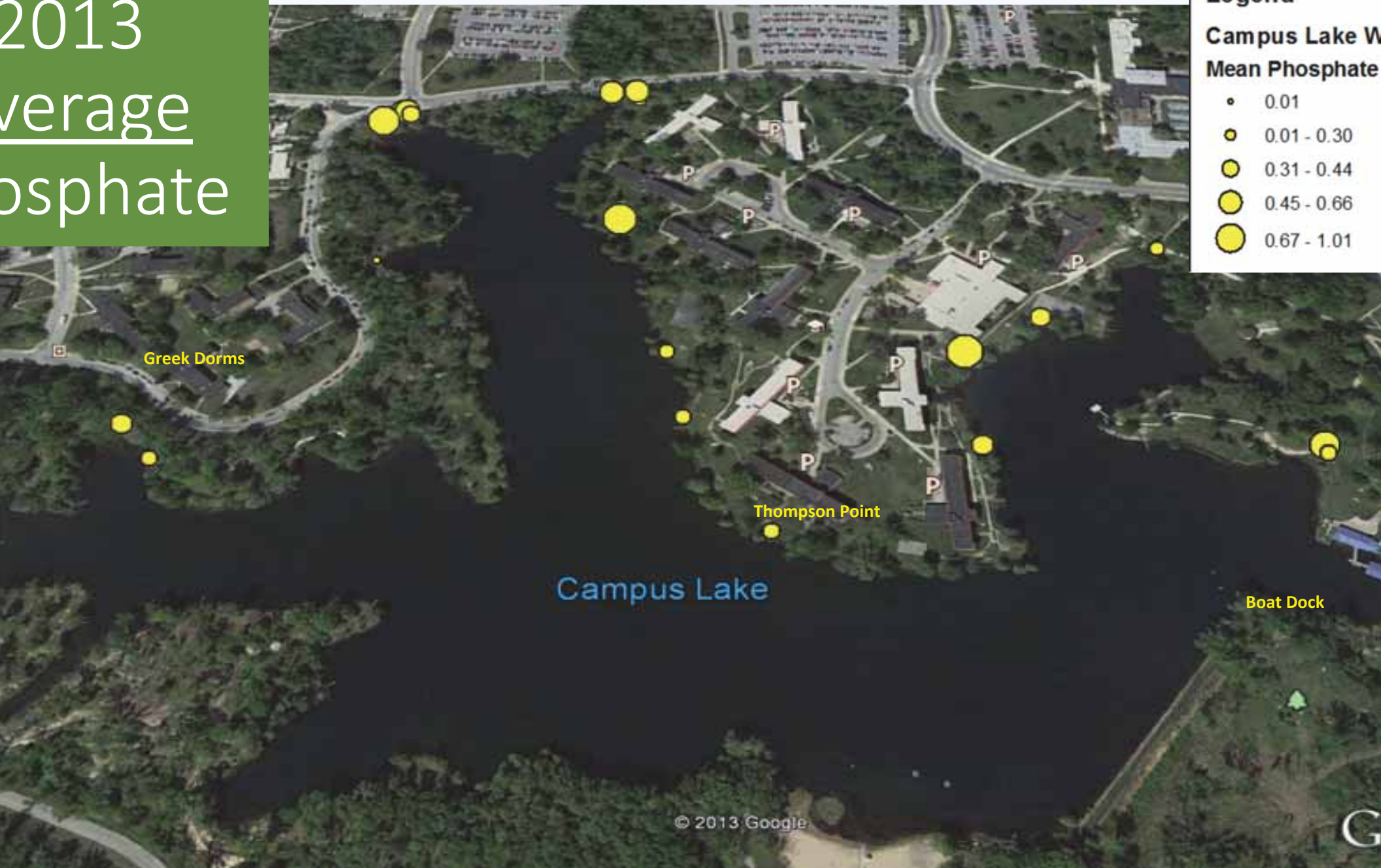
Greek Dorms

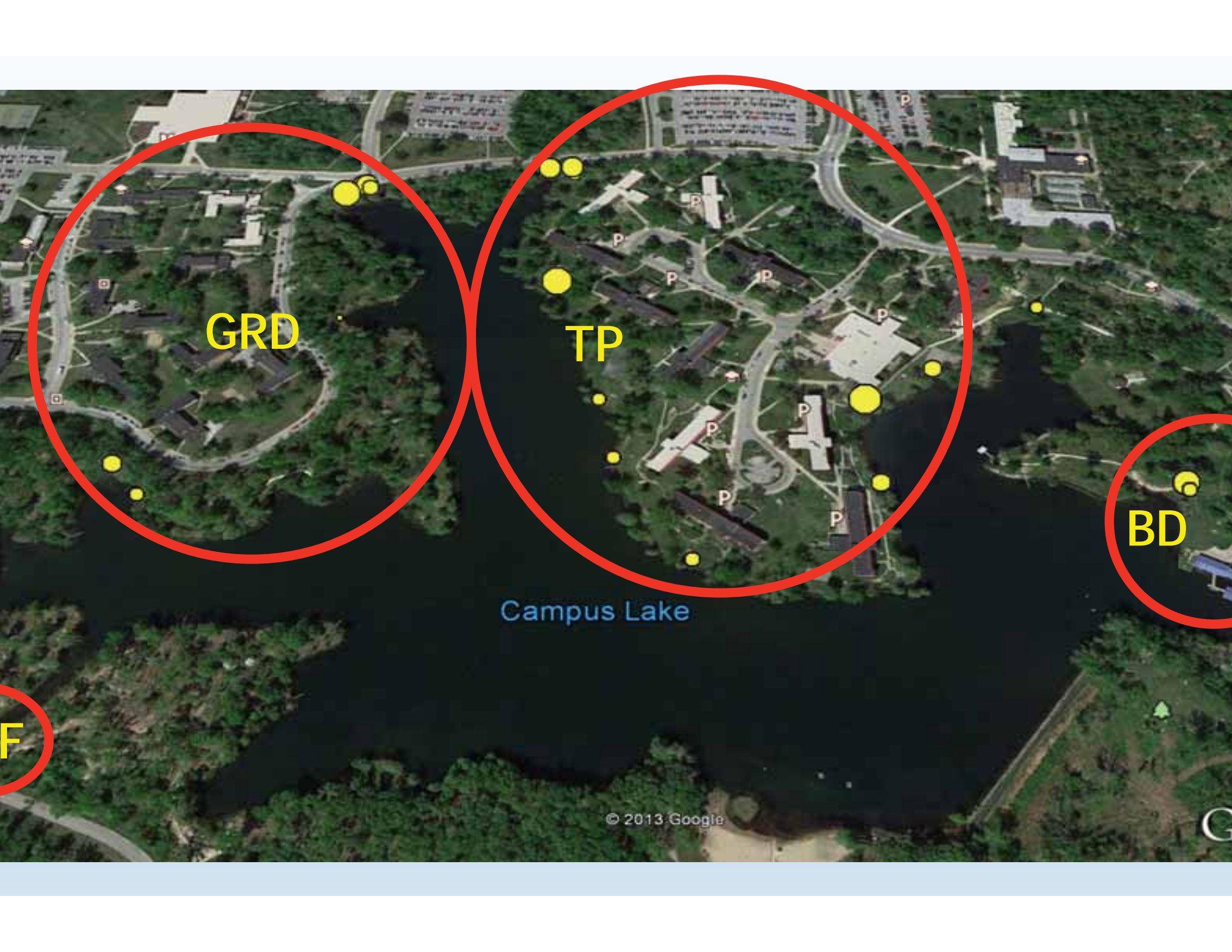
Thompson Point

Boat Dock

Campus Lake

# 2013 Average Phosphate





GRD

TP

BD

F

Campus Lake

© 2013 Google

### 3 Data

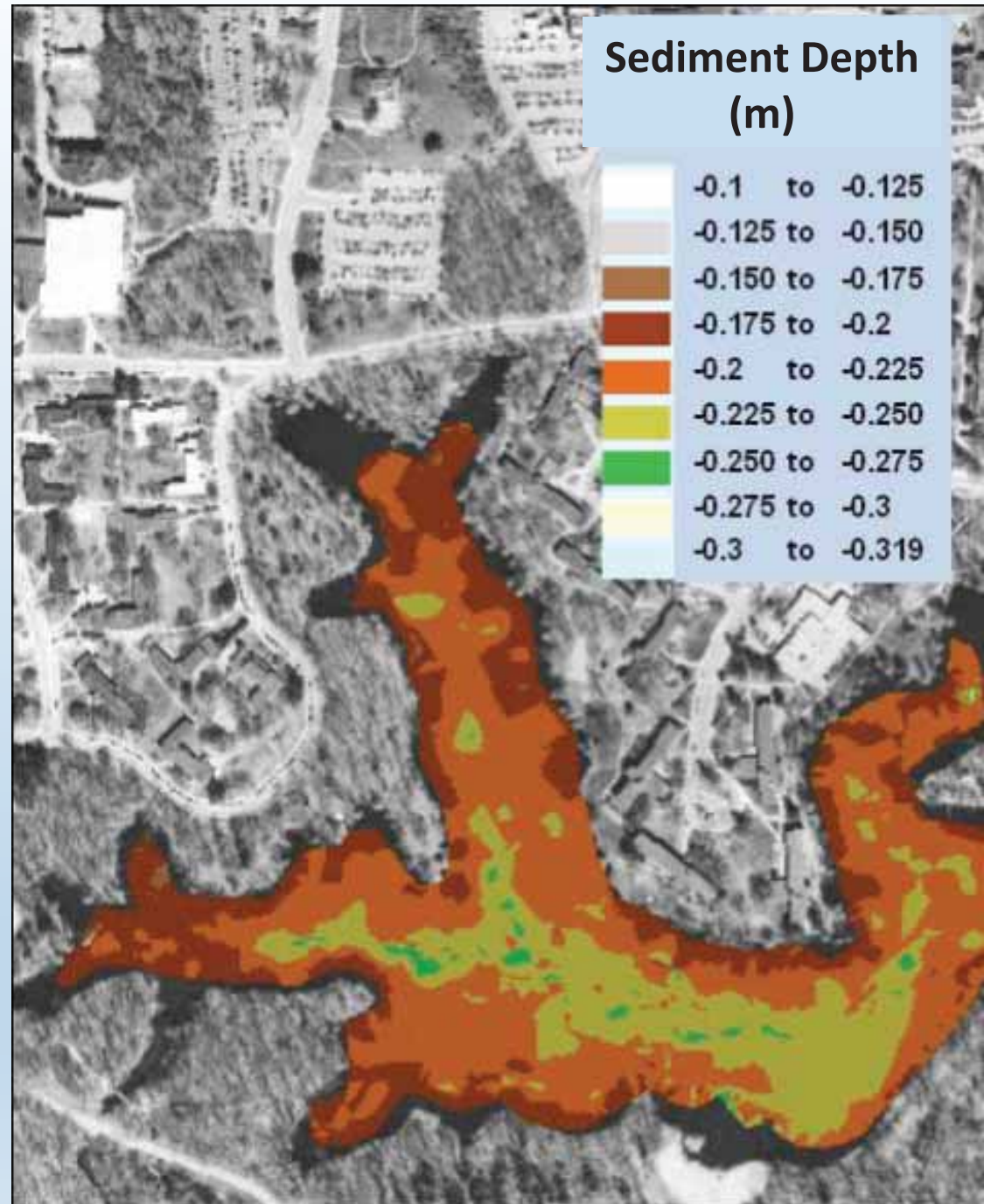
	Summer ( $\mu\text{g/L}$ )	Late Fall ( $\mu\text{g/L}$ )	Limit between "Low" to "Moderate" nutrients as $\text{NO}_3$ , $\text{PO}_4$ , or $\text{NH}_3$ ( $\mu\text{g/L}$ )	How many multiples of limit
Nitrate ( $\text{NO}_3$ )	500	11,000	1,356	8
Phosphate ( $\text{PO}_4$ )	521	1,825	31	<b>58</b>
Ammonia ( $\text{NH}_3$ )	900	250	119	8

In general, the nutrient levels are ~10 to ~60 times higher than concentrations that support moderate algal growth in lakes.

## L Sediment Depths

ments are not deep, however, siltation build up is significant.

map does not show floating algae, but a conservative estimate is a one-foot depth by one-foot buildup along the shore and the entire lake.



**2015**

**Identified savings account of wet compost**

**→ partially decomposed filamentous al**

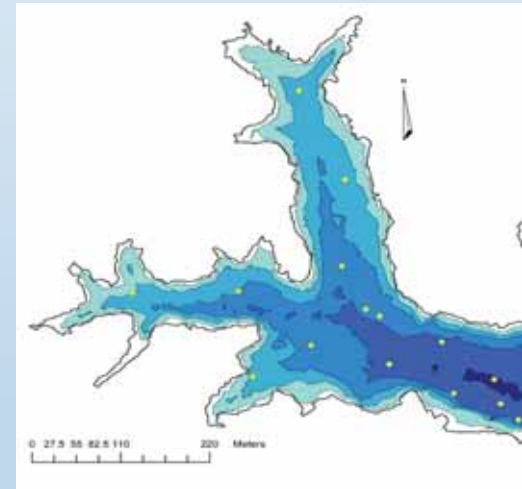


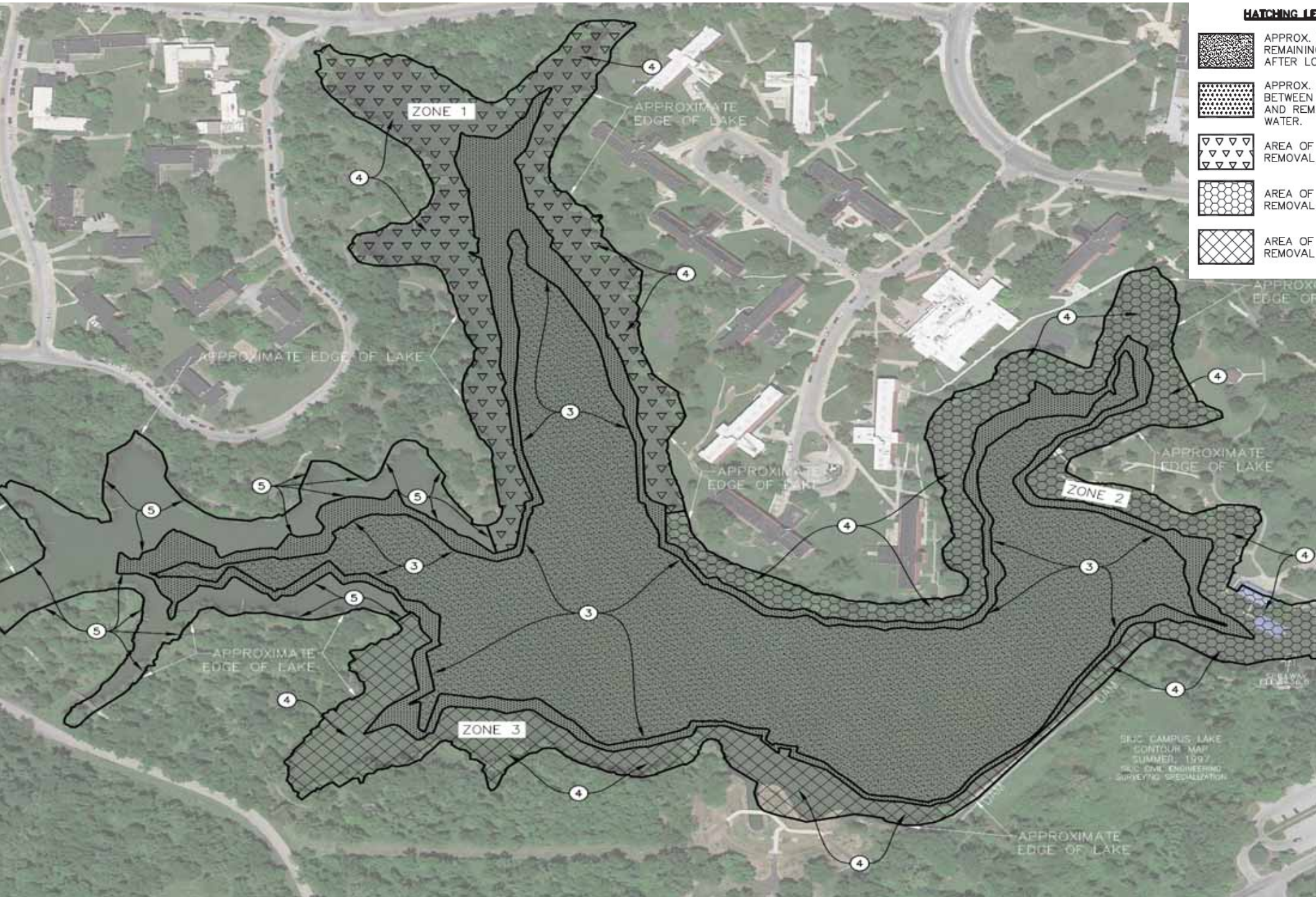


# Stored nutrients in decaying algae and estimated time to naturally flush Campus Lake






Scenarios	Best 1	Moderate 2	Worst 3
-----------	-----------	---------------	------------

ed cubic feet of algae /  
oot of shoreline





**HATCHING LE**

-  APPROX. REMAINING AFTER LO...
-  APPROX. BETWEEN AND REM. WATER.
-  AREA OF REMOVAL
-  AREA OF REMOVAL
-  AREA OF REMOVAL

SKIDMORE COLLEGE  
CAMPUS LAKE  
CONTOUR MAP  
SUMMER, 1997  
SKIDMORE CIVIL ENGINEERING  
SURVEYING SPECIALIZATION

016 Southern Illinois University invested  
400,000 in lowering lake level and dredging detritu





Detrital algae deposited at shoreline  
→ buoyant starch & lipid reserves

Build up of decaying algae

Low nutrient mud flat

- CyanoHAB

- Futon





Unconsolidated high organic detritus above  
reticulated low-nutrient mud flat  
Clay liner underlies lake

11.2.16



11.3.16



Beginning 24 Oct



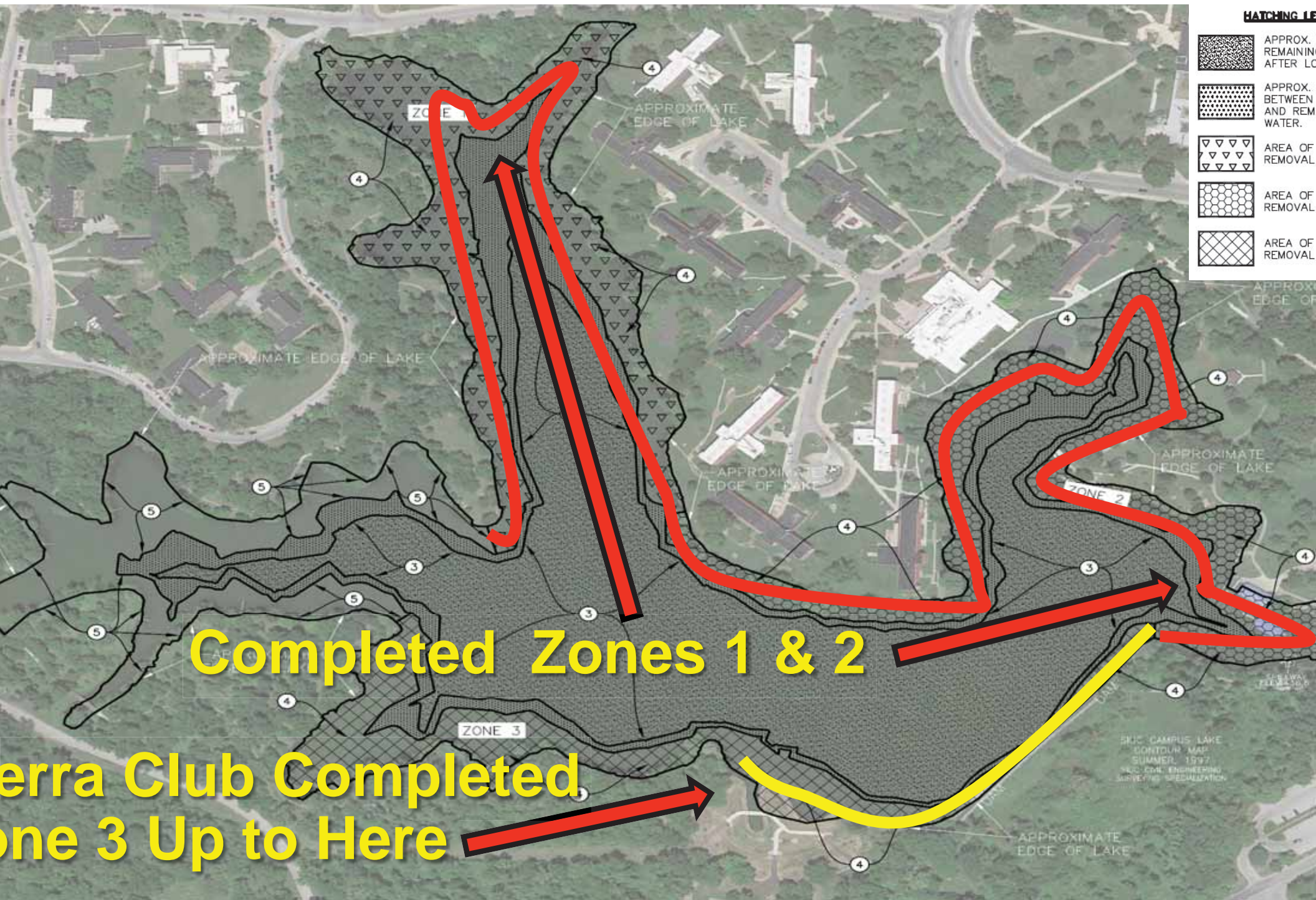






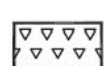






23,240 tons removed



**HATCHING LEGEND**

-  APPROX. REMAINING AFTER LOG SKIMMING
-  APPROX. BETWEEN AND REMOVAL
-  AREA OF REMOVAL
-  AREA OF REMOVAL
-  AREA OF REMOVAL

**Completed Zones 1 & 2**

**erra Club Completed  
one 3 Up to Here**

SKIC CAMPUS LAKE  
CONTOUR MAP  
SUMMER, 1997  
P.E. CIVIL ENGINEERING  
SURVEYING SPECIALIZATION

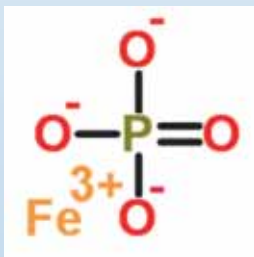
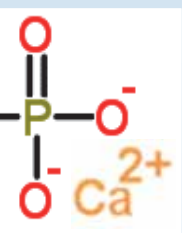
Where did the spoils go?



# Next steps: Inhibit CyanoHAB growth

## Operate

In the water column, Lake contains 40 x more Fe and Ca than required to bind all  $\text{PO}_4$

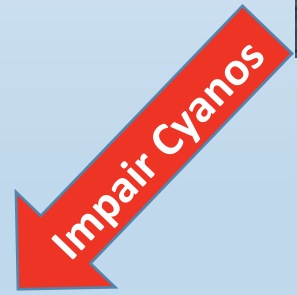
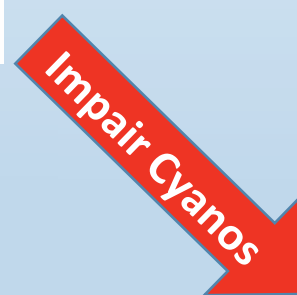


but that sequestration is seasonal

bind  $\text{PO}_4$  with alum

## • Cool

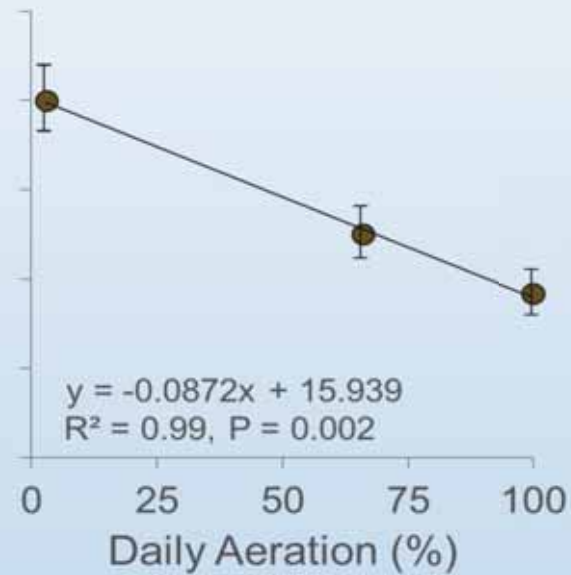
One calorie cools 1 gram of  $\text{H}_2\text{O}$  by  $1^\circ\text{C}$



- 540 calories of heat loss per gram  $\text{H}_2\text{O}$  evaporation
- Heat loss / one liter is can cool by  $3^\circ\text{C}$
- $3^\circ\text{C}$  cooling from  $27$  to  $24^\circ\text{C}$  slows cyanobacterial growth

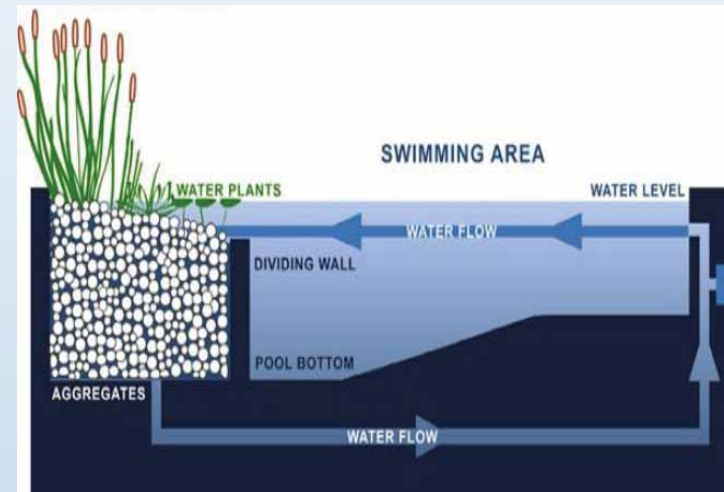
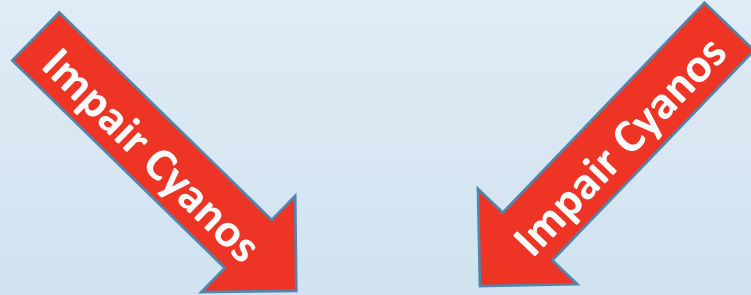
# Next steps: Inhibit CyanoHAB growth

## Aerate



counts dropped by 54% in  
week, 16:8 h light:dark  
photoperiod, constant 30 °C  
y?  
ation inhibits N<sub>2</sub> fixation

## • Wetlands & Swimming Area



- 2 x 9 m wetland can remove
- 2 kg NO<sub>3</sub> per day
- 125 kg of organic carbon → future

# Sustainable Eco-Recreation Designed by Students



## Key Projects:

Water maze as an obstacle course for paddle boarders

Swimming pool with wetland water treatment

## Goals:

Renewable Energy

Interdisciplinary Experiential Education

Team Building. Tiered funding tied to meeting deadlines, outreach, team-building

Produce sustainable answers to a worldwide environmental problem

Patents and Products → Think Burton snowboards.



Questions?

