Georgica Pond Progress: Executing a Sustainable Plan for Remediation

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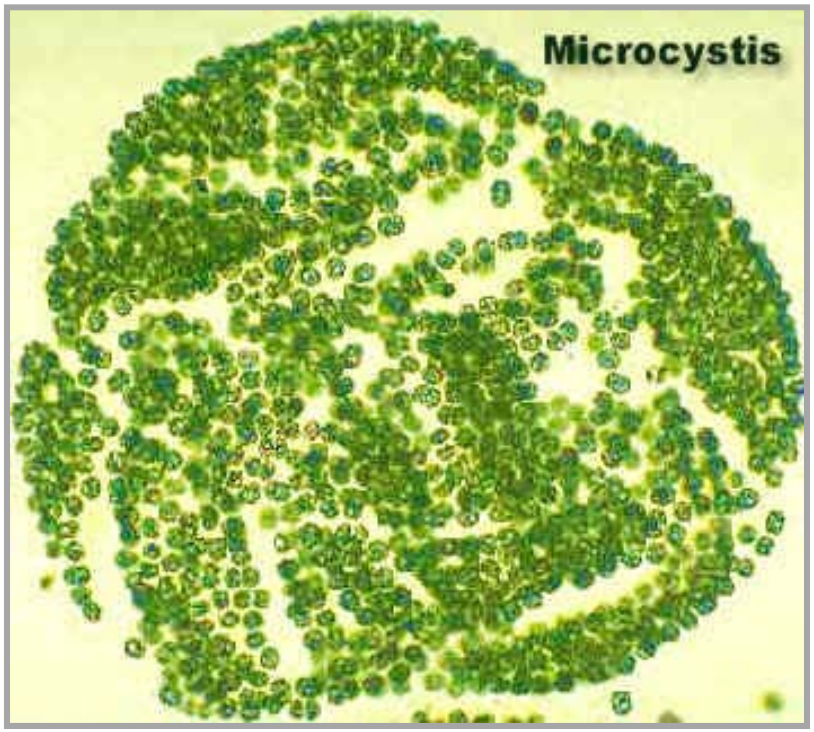
Outline of presentation

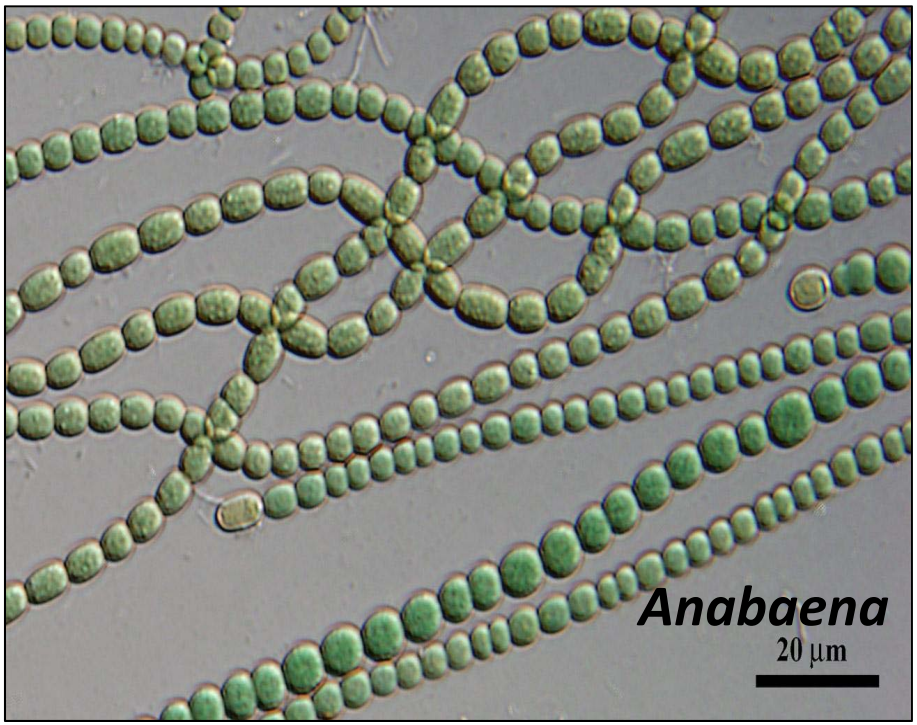
- Background on Georgica Pond
- 2016 status and trends
- Options for improving the conditions in Georgica Pond

What has been ailing Georgica Pond?

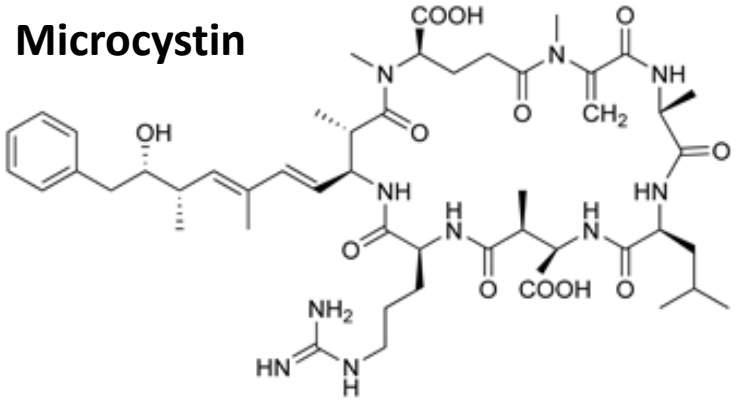
Georgica Pond, blue green algae

Dangers of cyanotoxins

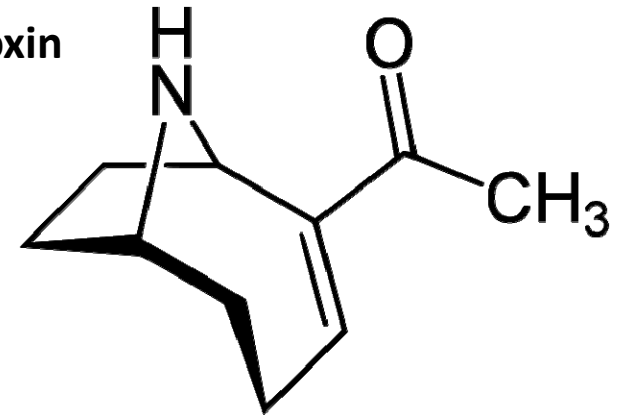




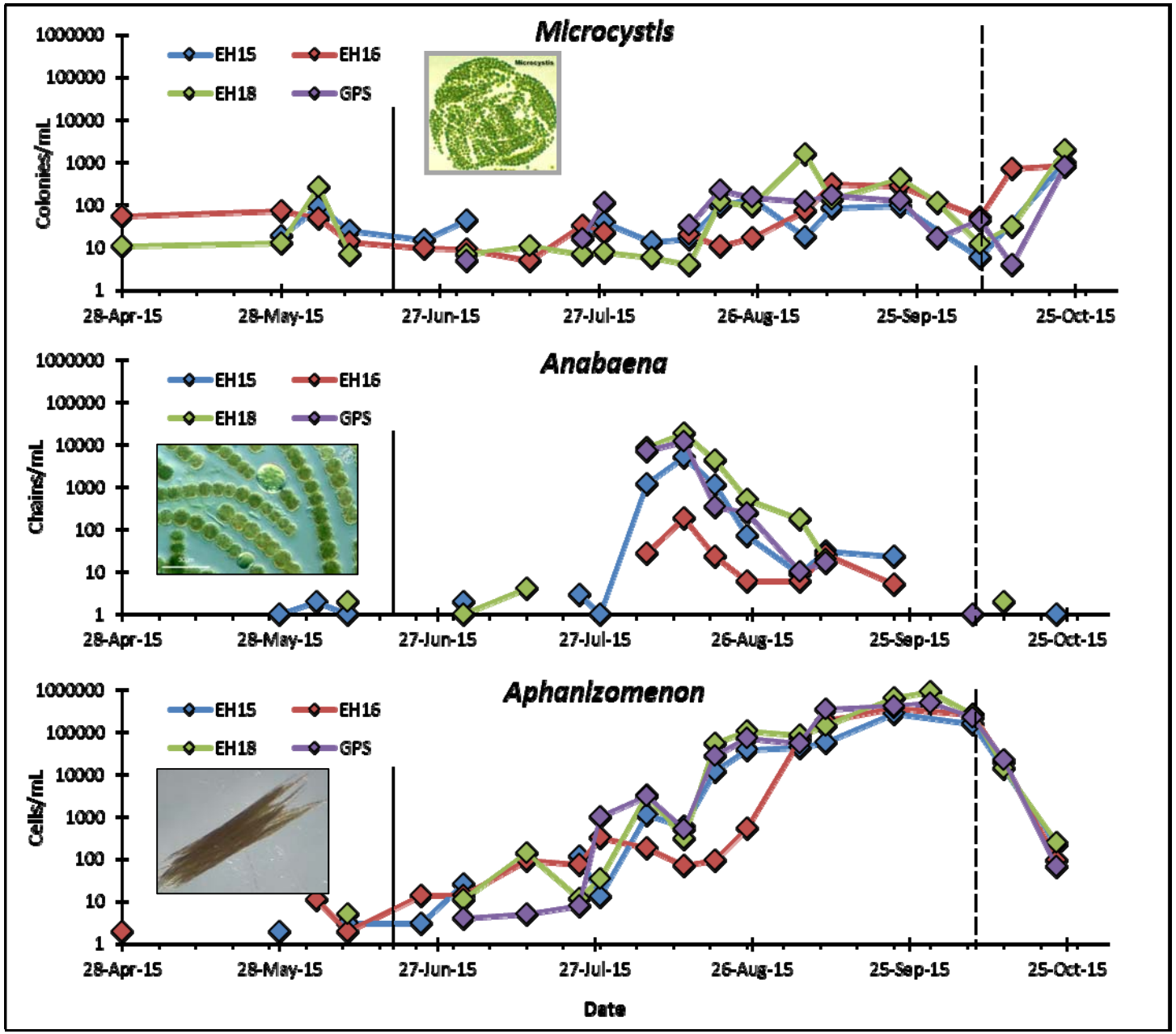
Microcystin



Anatoxin

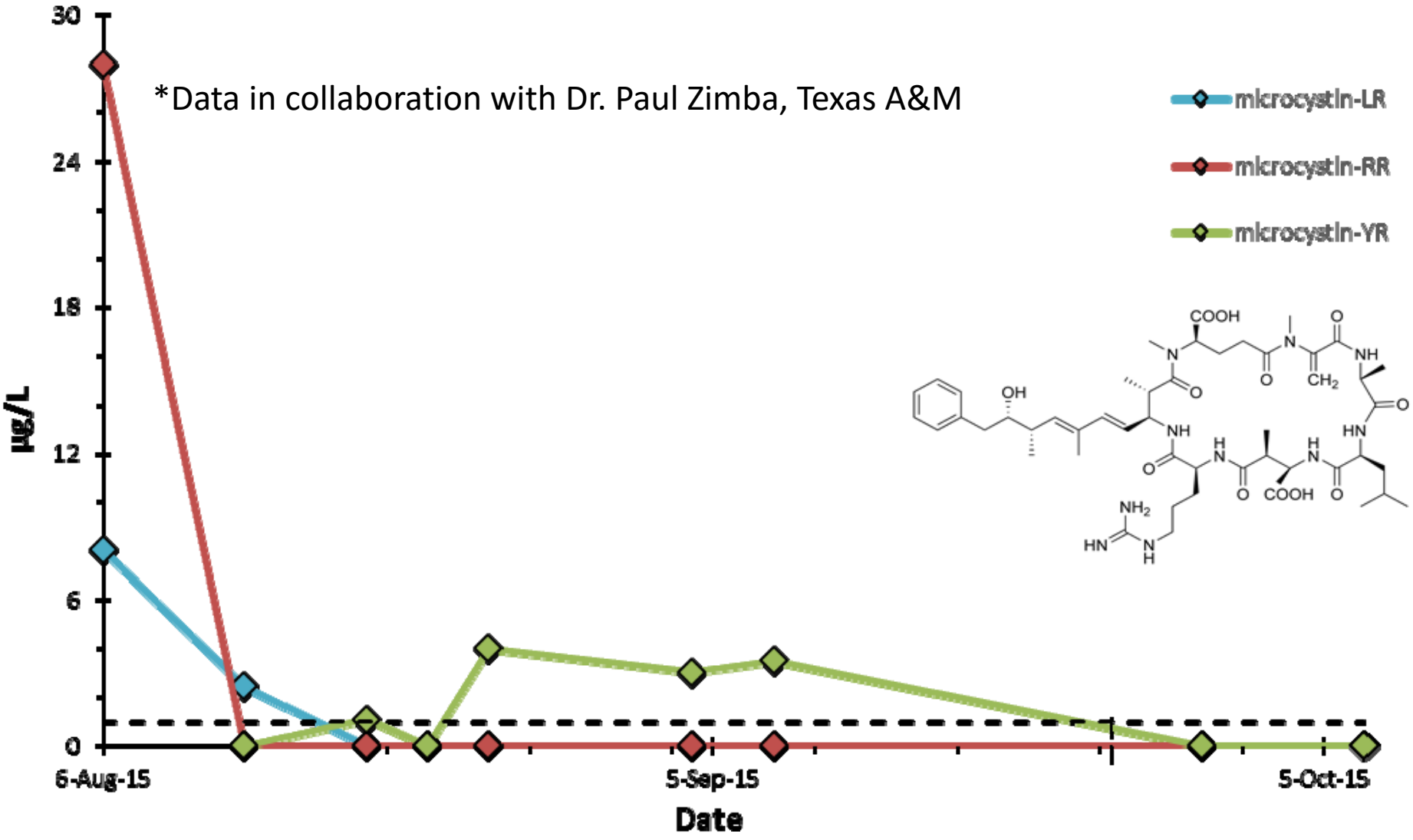


Temporal dynamics of blue-green algae, 2015



Microcystin congeners, 2015

*Data in collaboration with Dr. Paul Zimba, Texas A&M

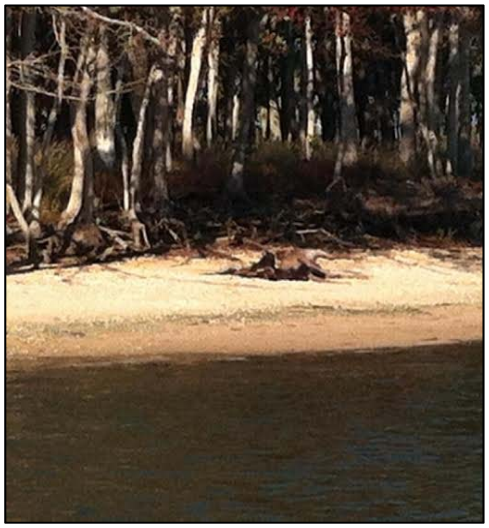


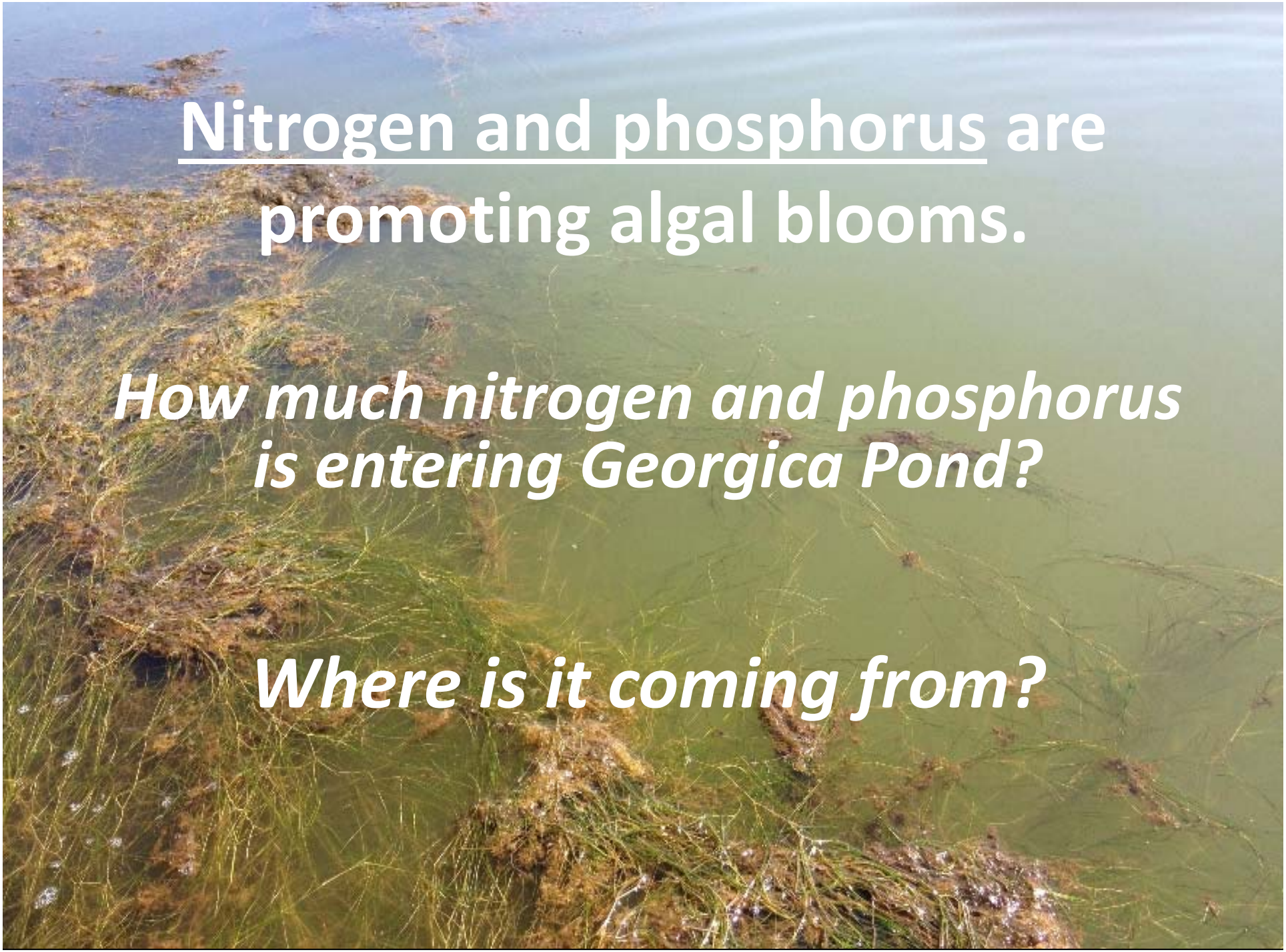
Macroalgae

Low oxygen, death of wildlife



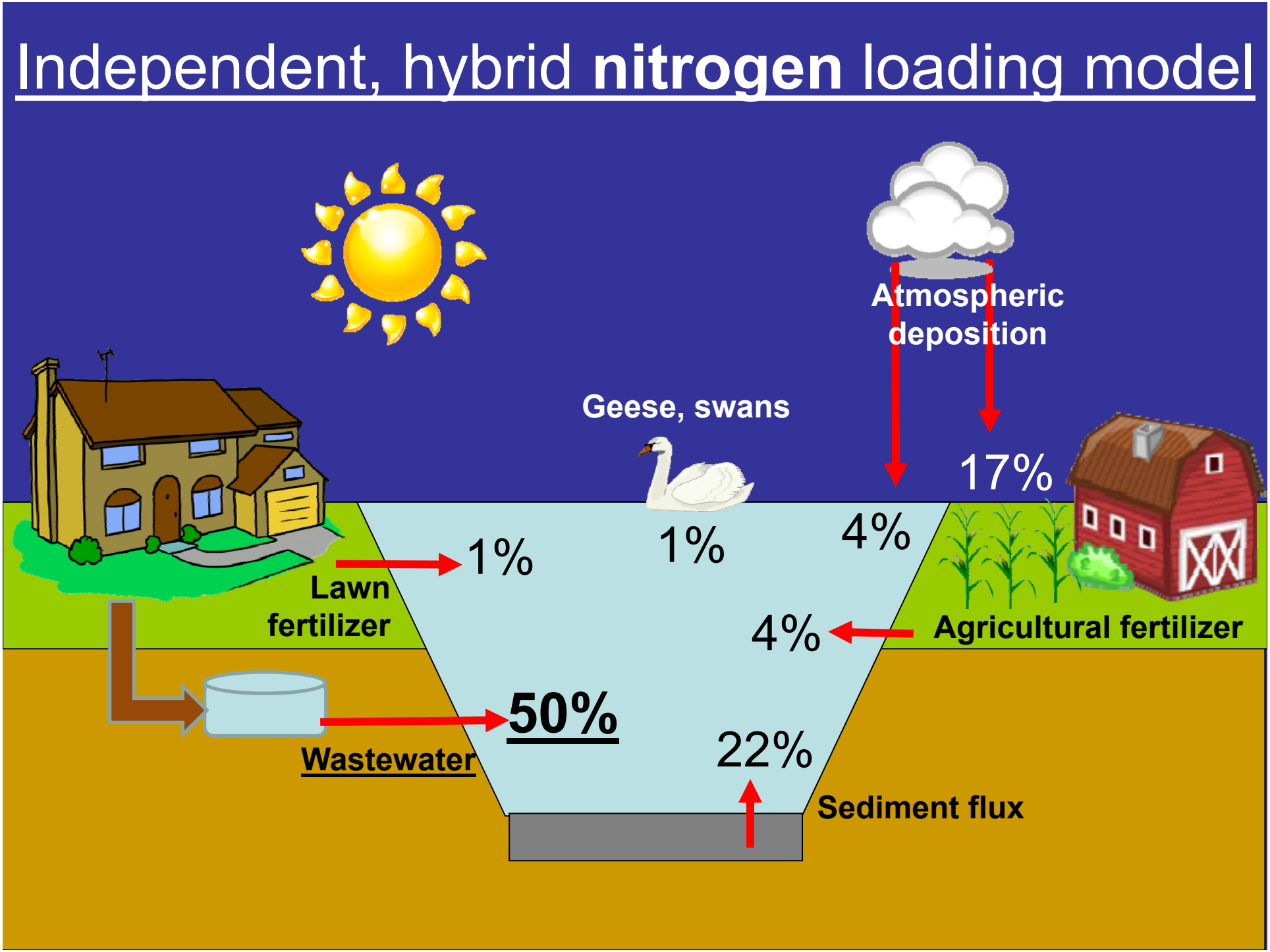


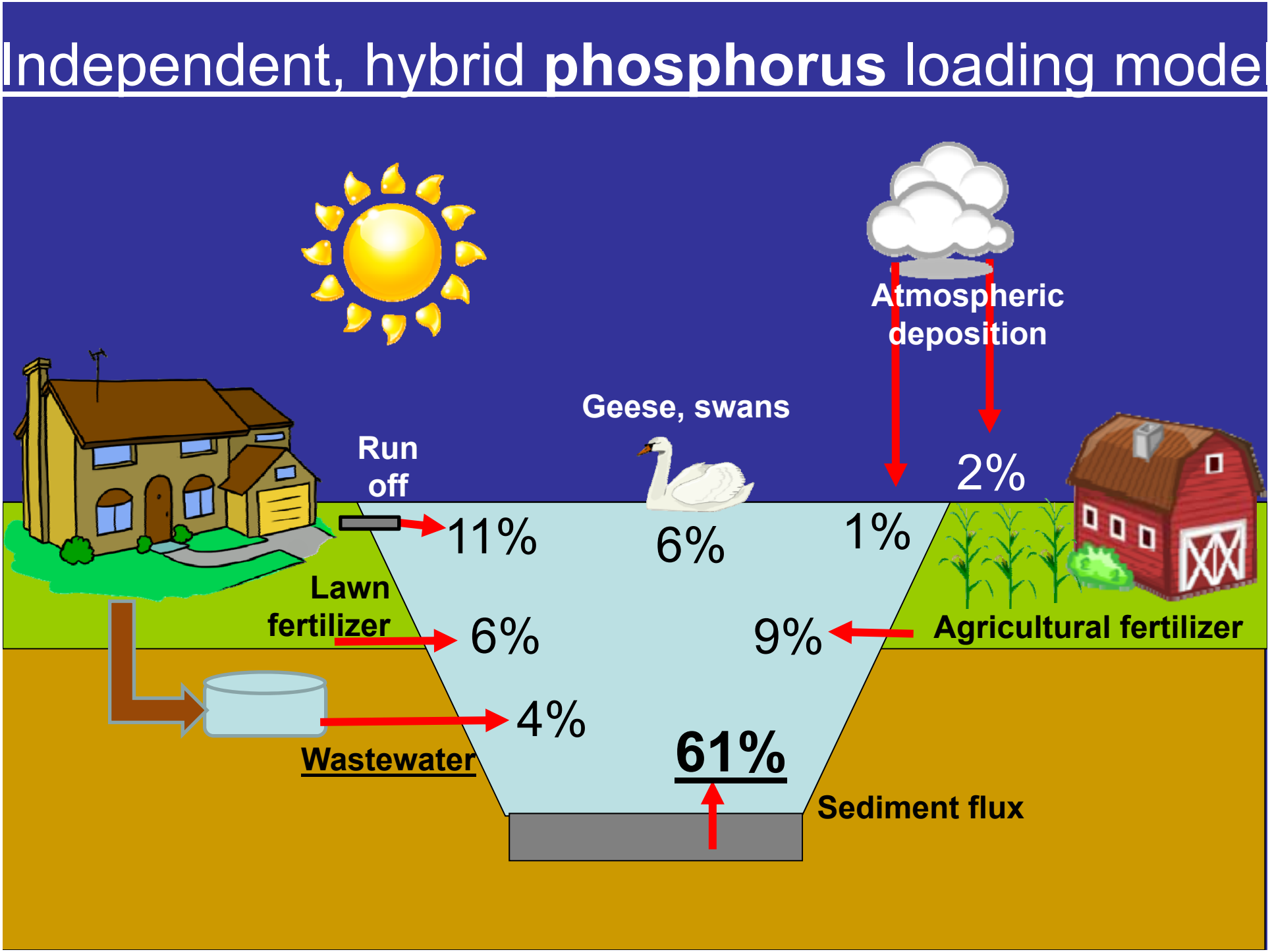

Nitrogen and phosphorus are promoting algal blooms.
How much nitrogen and phosphorus is entering Georgica Pond?
Where is it coming from?

Homes (>2,000) within the Georgica Pond watershed

Independent, hybrid **nitrogen** loading model



Independent, hybrid **phosphorus** loading model



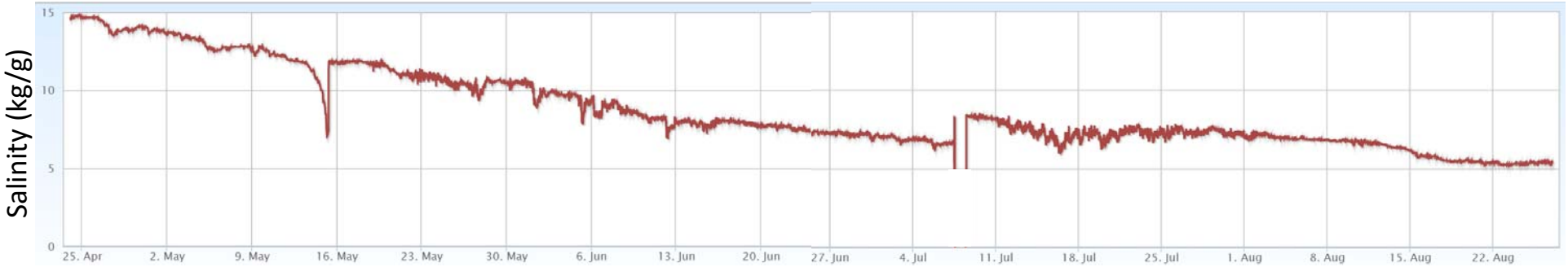

2016?

2016 general overview

- Cut was open to the ocean through late March.
- Upon closing in mid-spring, the cut has remained close.
- In 2015, the cut was open for the first six months of the year.

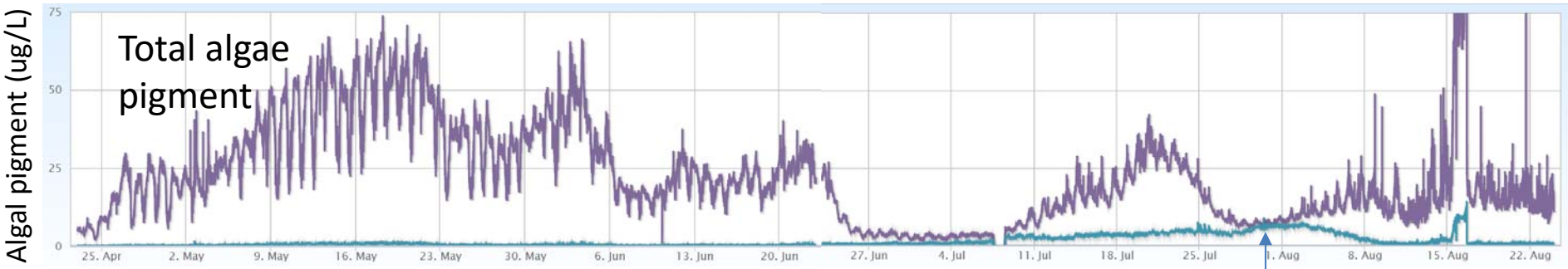
Salinity, 2016

- ocean salinity is 31



- Salinity fell below 15 by late April
- Currently 5
- < 10 is ideal for blue-green algae
- >15 is inhospitable for blue-green algae
- Lower salinity also brings more nutrients of other algae

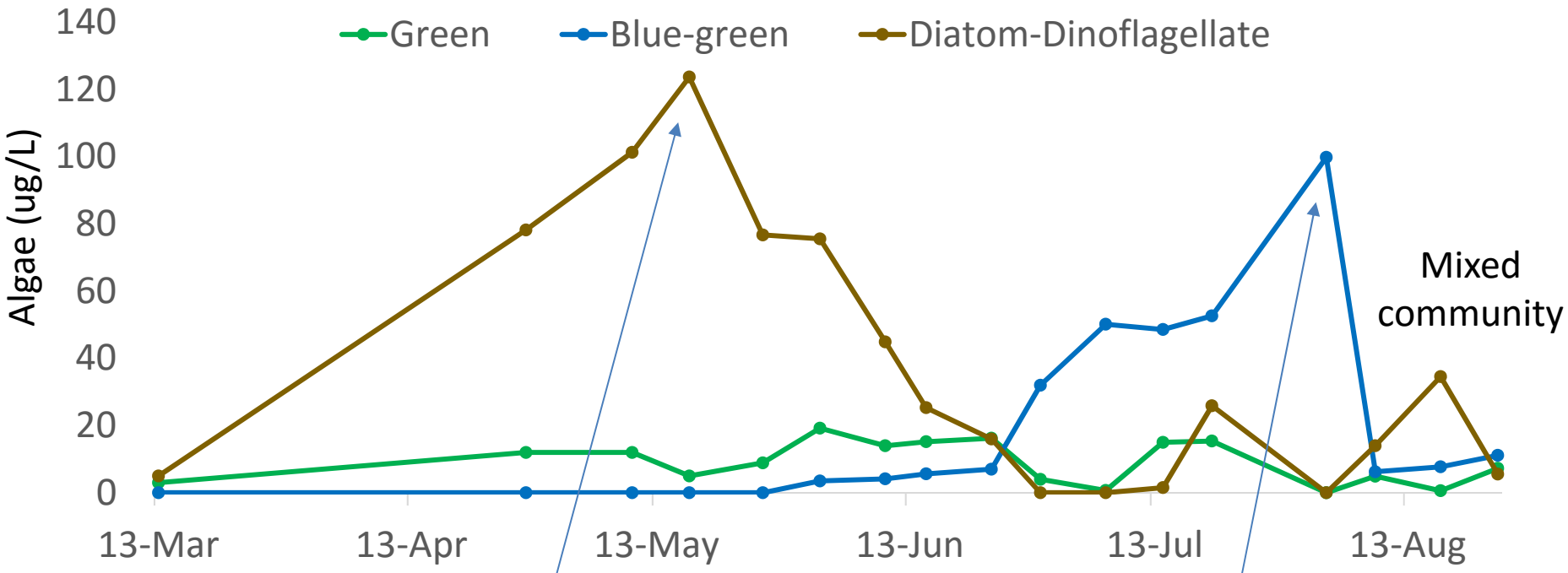
Algal blooms, 2016



Mahogany Tide, May - June

Blue-green algae, July

Algal blooms, 2016, fluoroprobe



Mahogany Tide, May - June

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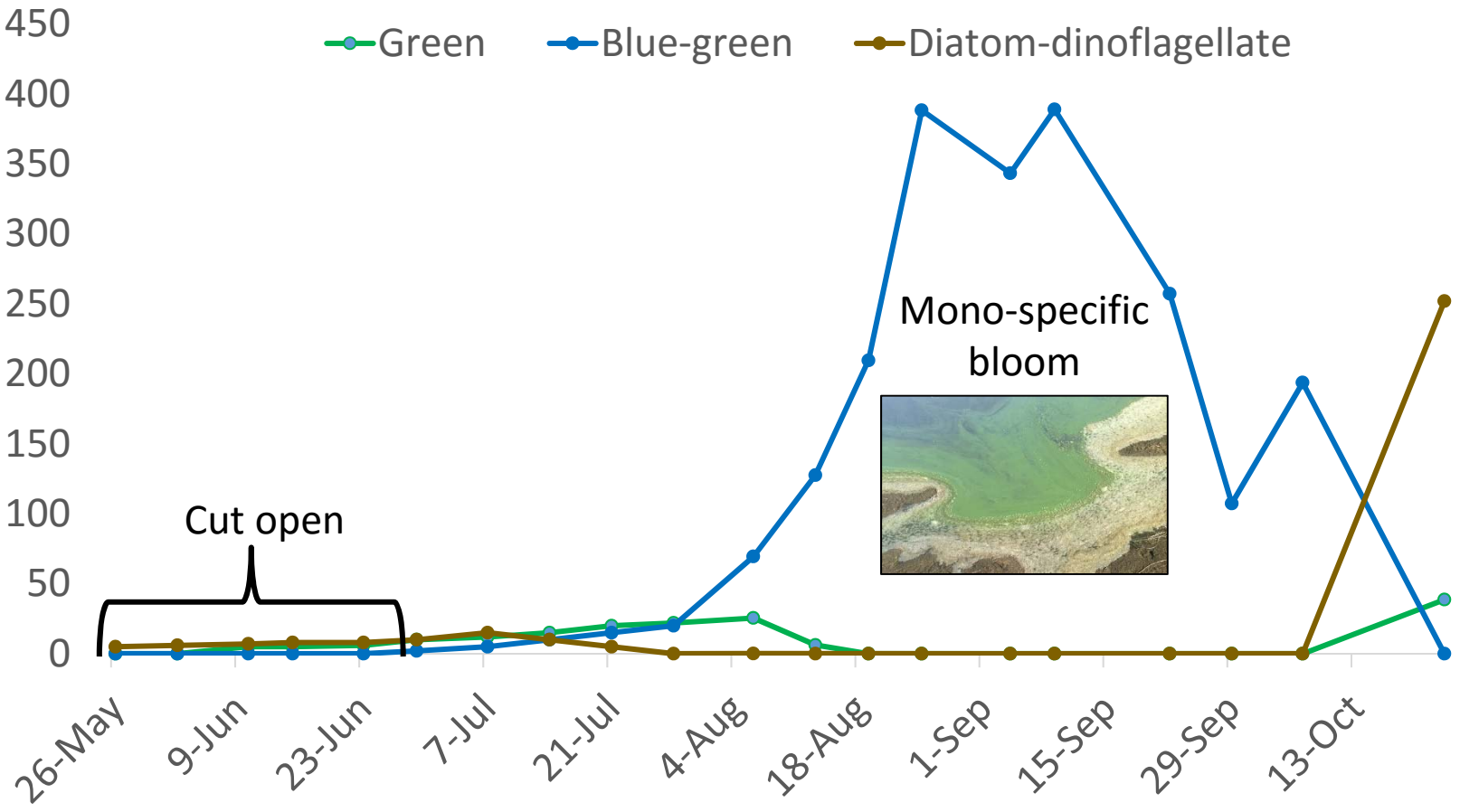
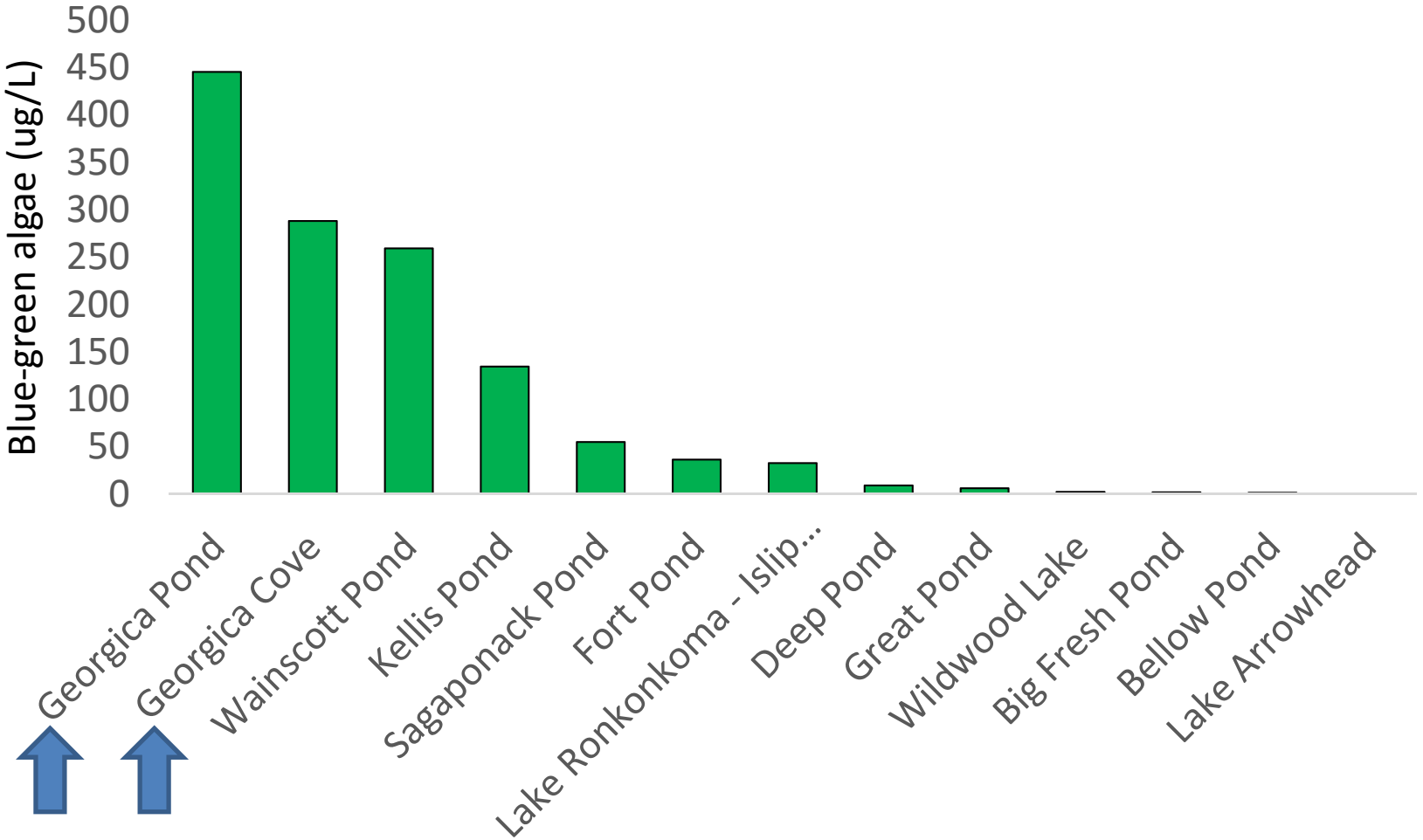
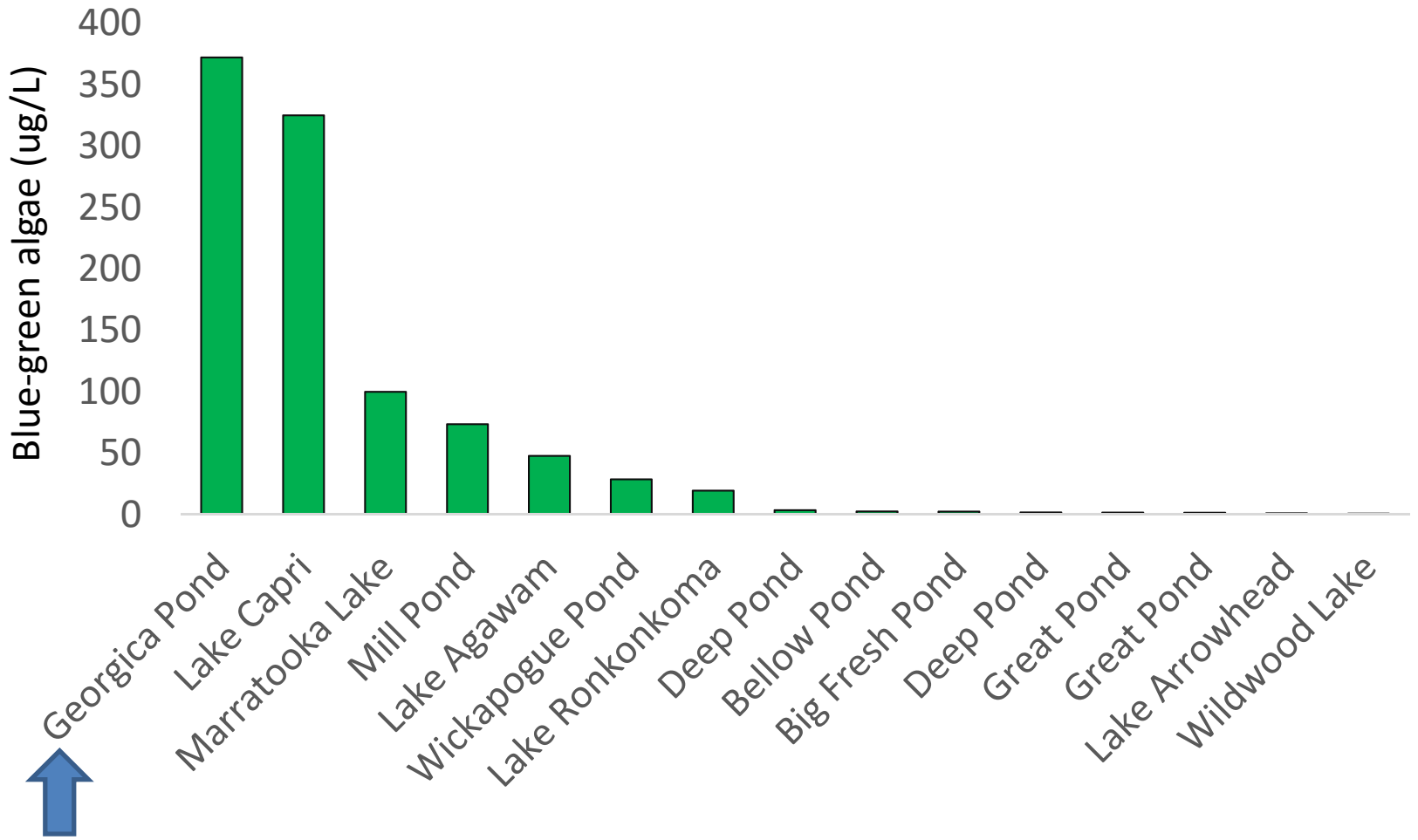


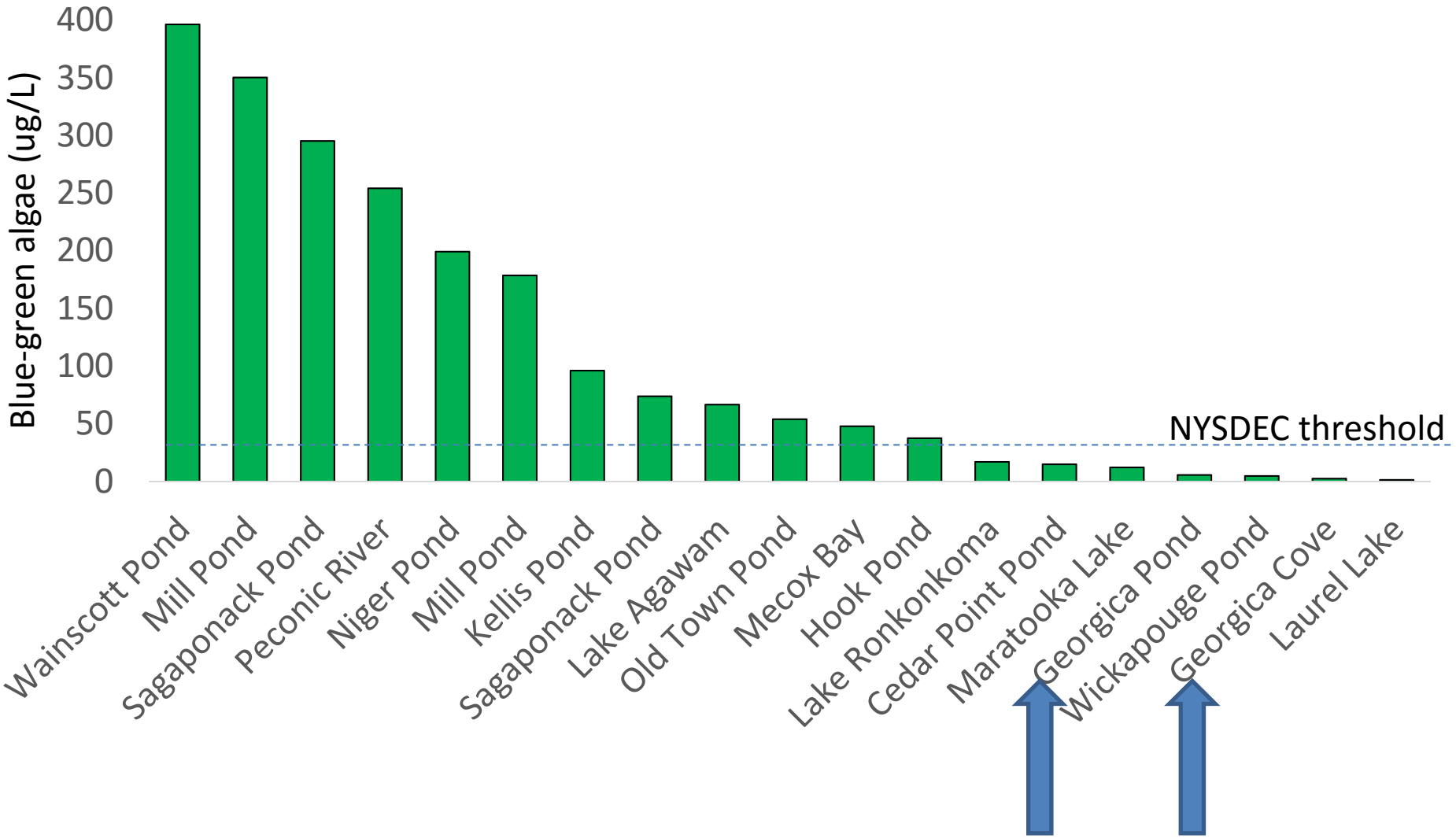
Blue green algae, August **2015**



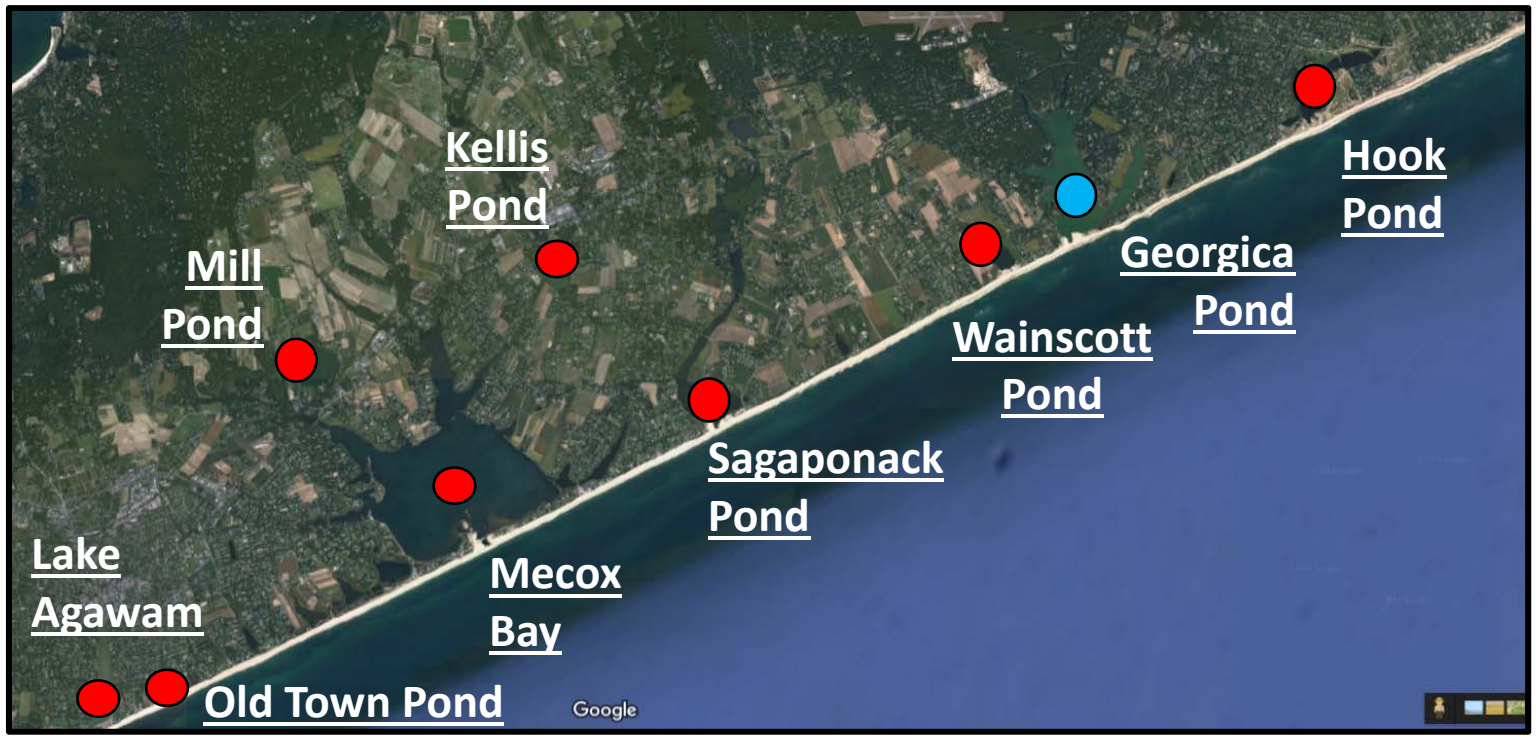
Blue green algae, August **2014**



Blue green algae, August **2016**



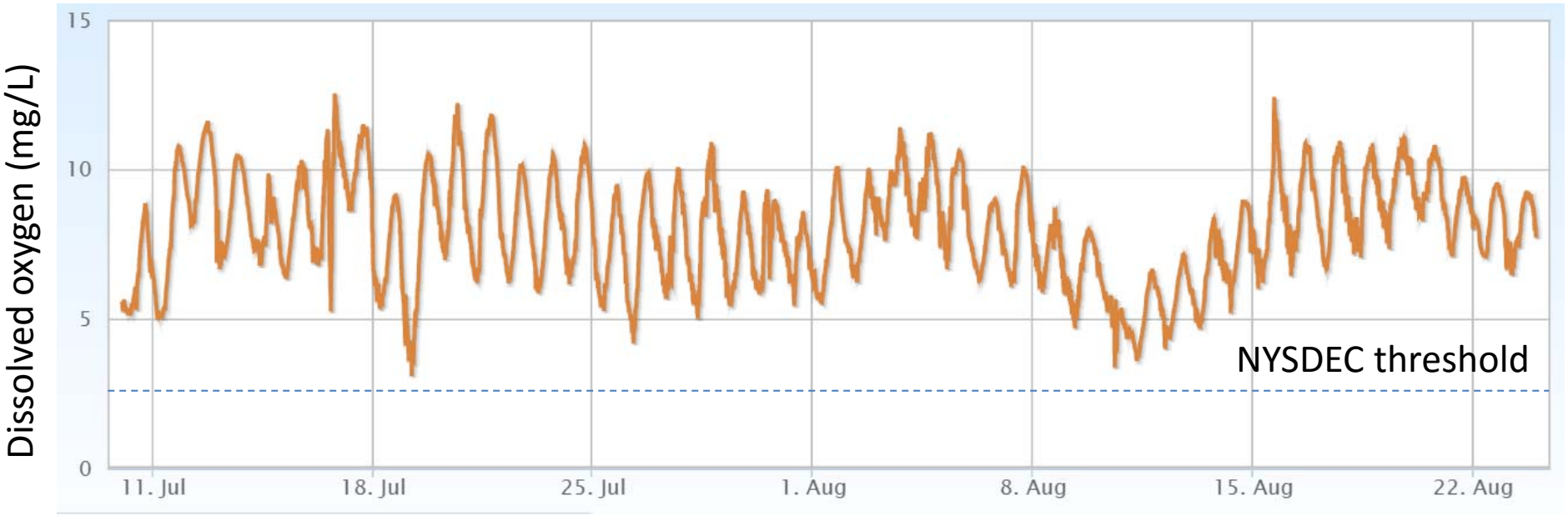
Current south fork blue green algal blooms



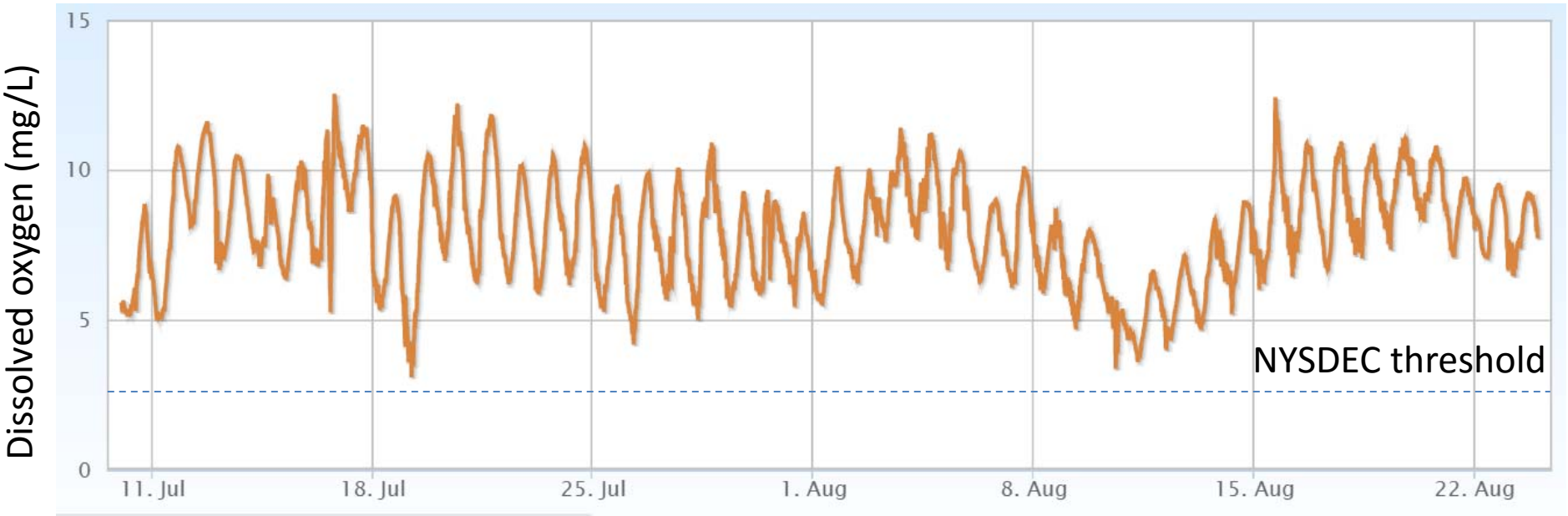
= Blue green algae bloom

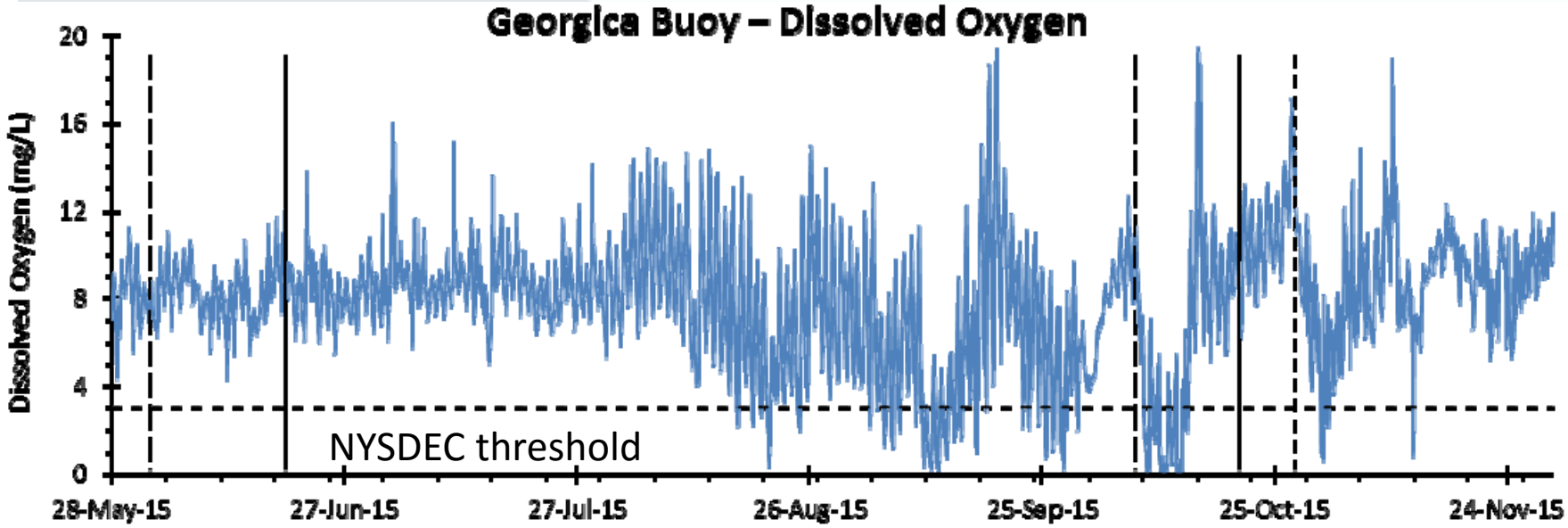
= No blue green algae bloom

Dissolved oxygen, 2016



Dissolved oxygen levels, 2015 v 2016





Management options - 2015

What can be done to reduce nutrient delivery and mitigate algal blooms in Georgica Pond?

2015: Harvesting macroalgae to mitigate nitrogen and phosphorus

- Preliminary analyses indicate macroalgae contain **3%** nitrogen and **0.2%** phosphorus.
- Algae re-grow weekly (good).
- Weekly removal of macroalgae during summer months would represent a significant removal of nutrients.
- Preliminary discussions with NYSDEC Marine Habitat Section Head have been positive; a path forward for 2016 has been established.

2016: NYSDEC permits obtained, FoGP funded, harvesting began in May

What are that macroalgae?

Sago Pondweed

Cladophora

Macroalgal harvest

June: 2.43 tons removed
July: **11.12** tons removed

For July:
~25% of July phosphorus load
~10% of July nitrogen load

The fate of the harvested macroalgae?

- Renewable resource.
- Gobler lab investigating converting macroalgae into **fertilizer**.
- Preliminary results suggest multiple, marketable products can be yielded from this material.

Management options

What can be done to reduce nutrient delivery and mitigate algal blooms in Georgica Pond?

First step recommendations

- **Upgrade septic systems** to maximize the removal of nitrogen.
- **Minimize fertilizer** use; switch to organic fertilizers.
- Create and expand the growth of local and natural vegetation adjacent to Georgica Pond to create **buffers** that are not fertilized and intercept land runoff.

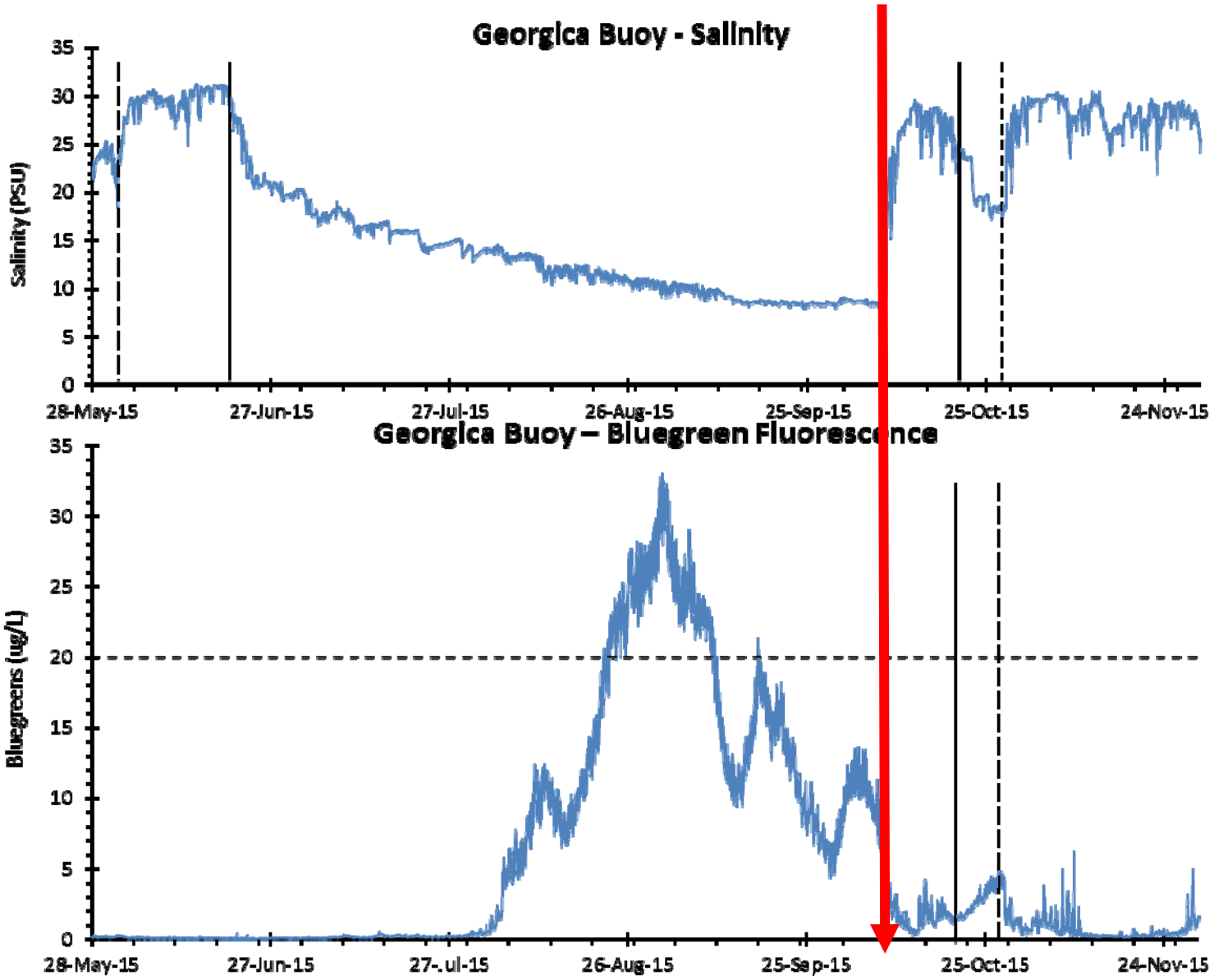
Opening the cut on a regular basis

Opening the cut:

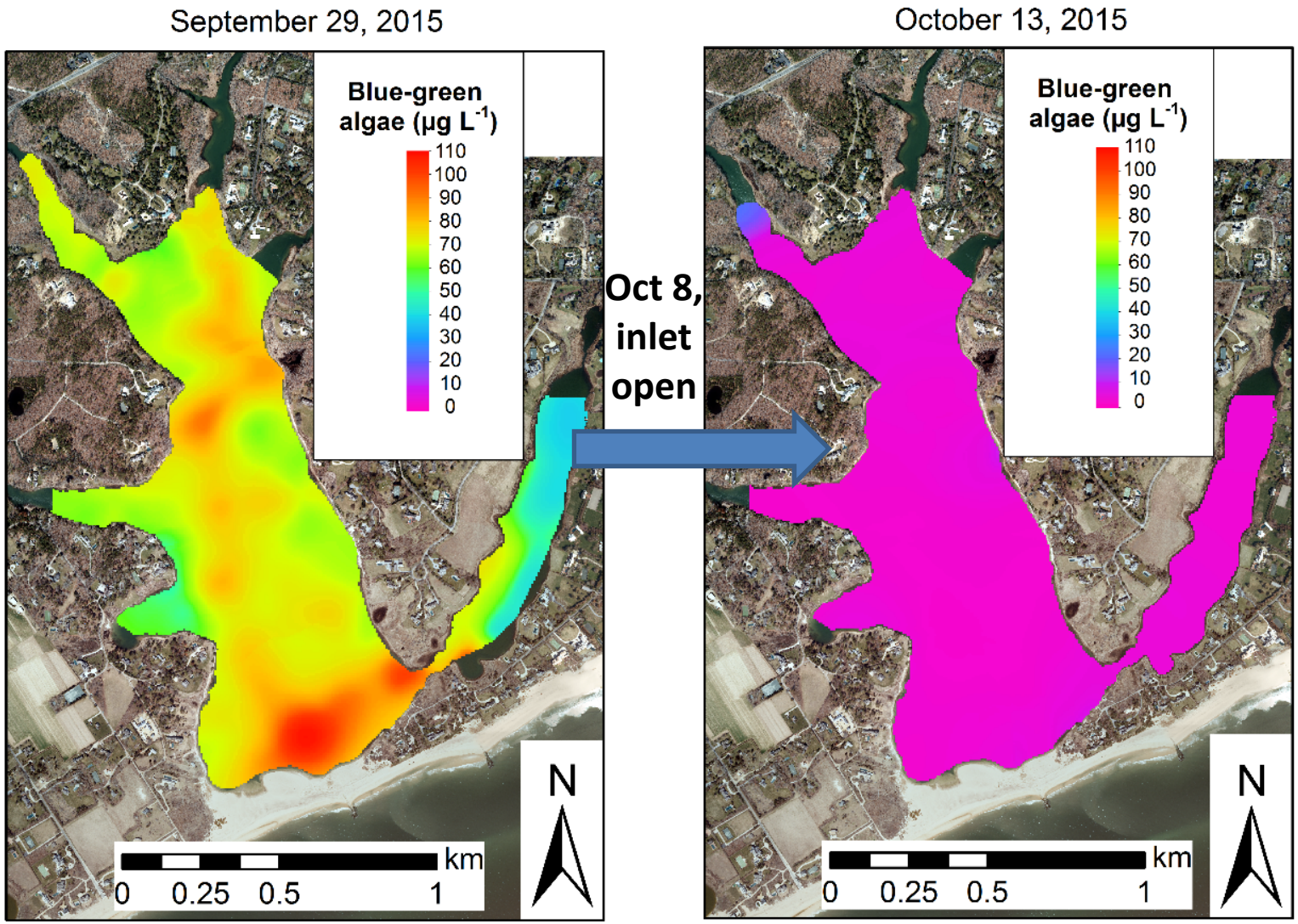
- Flushes out nutrients and algal blooms.
- Keeps salinity too high for blue-green algae.
- Restricts the regions covered by macroalgae

- Being open for **> six months** reduces the accumulation of nitrogen and phosphorus and reduces the need for other reductions.

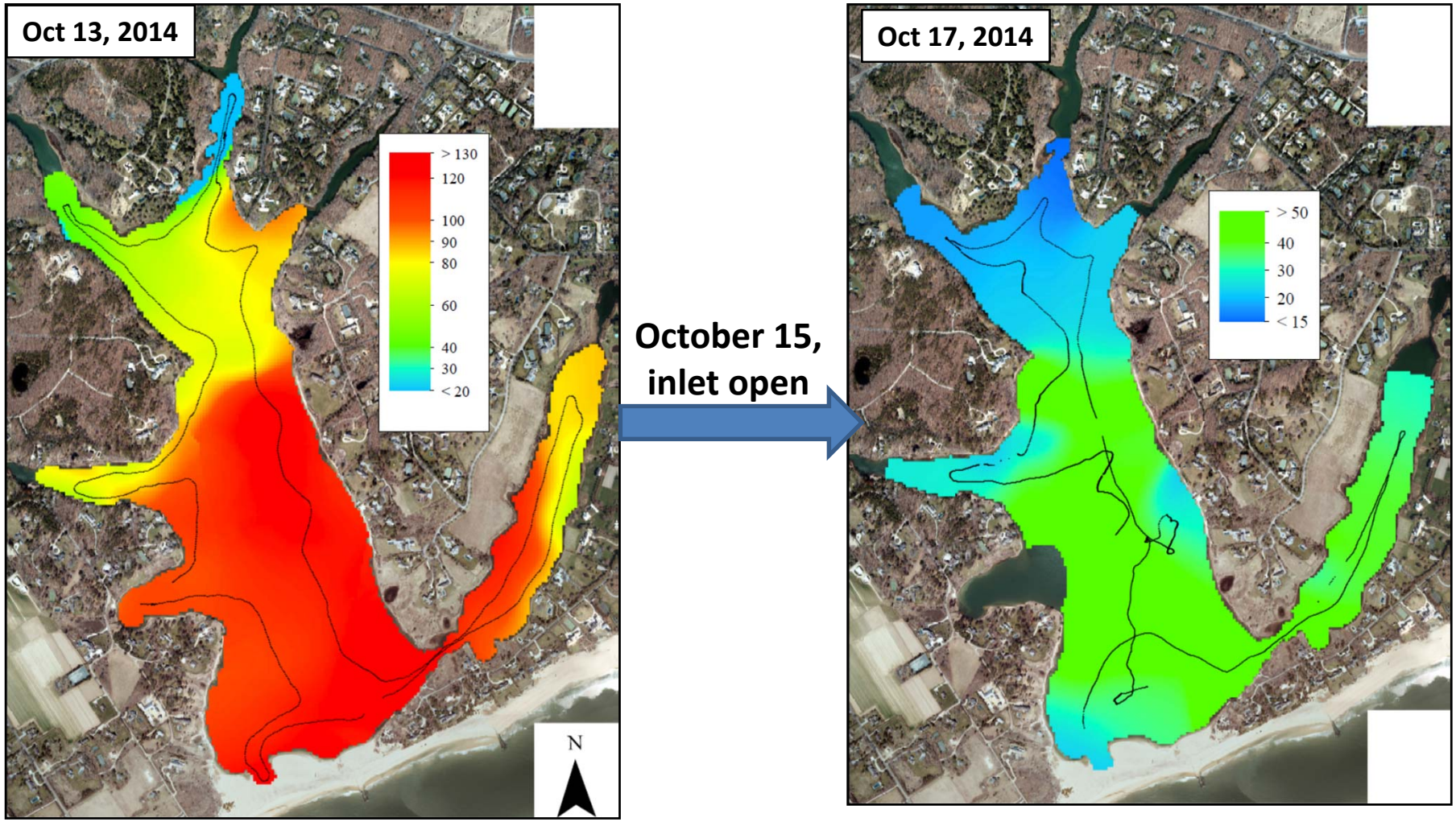
Effect of cut on salinity, blue-green algae, 2015

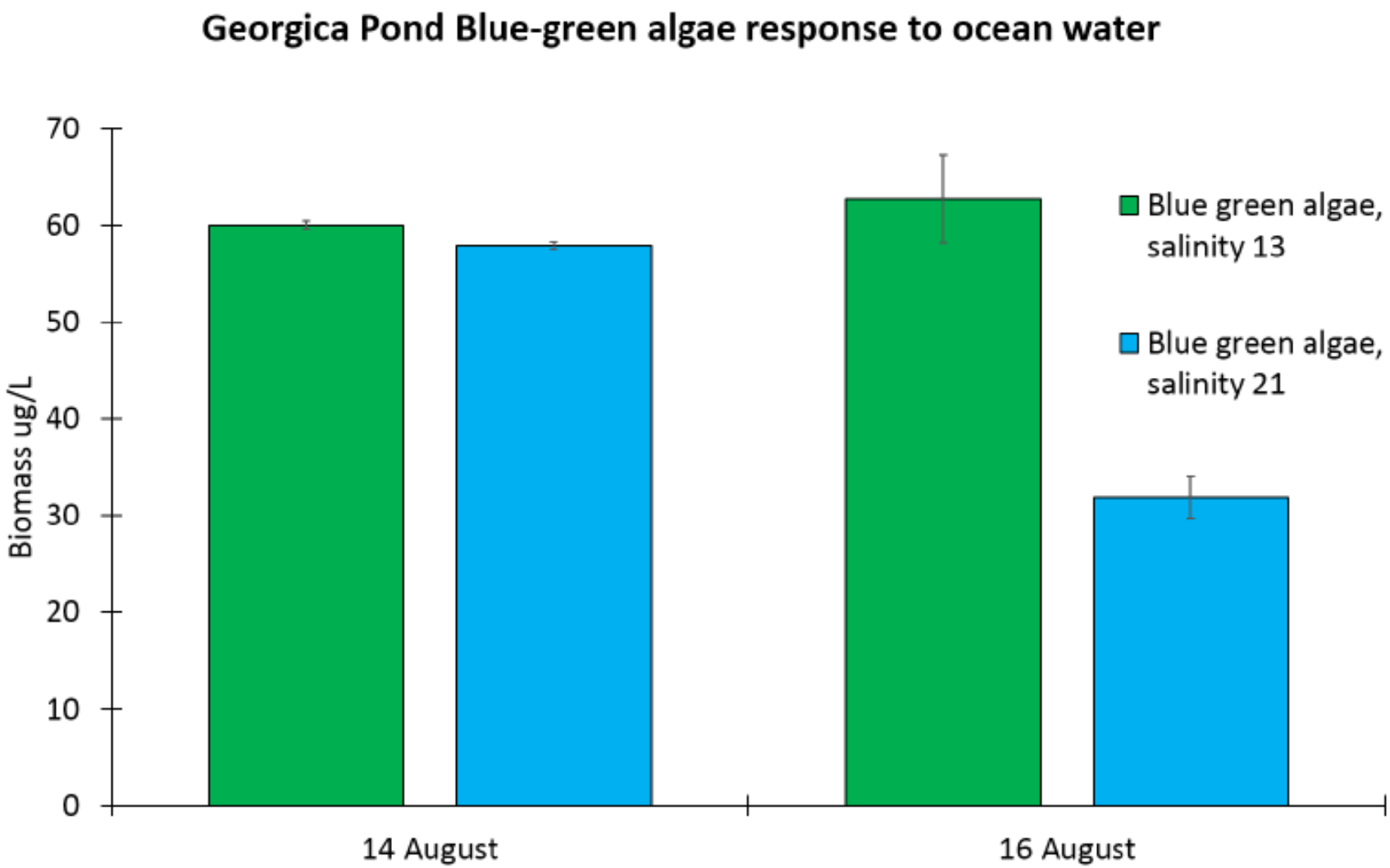


Opening the Georgica ocean inlet, change in blue green algae, 2015



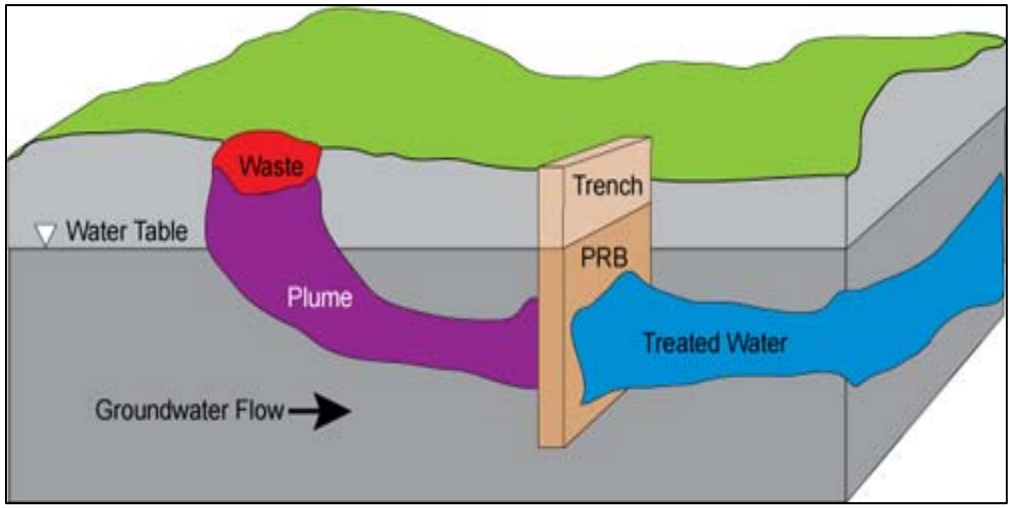
Opening the Georgica ocean inlet, change in blue green algae, 2014




Georgica Pond Blue-green algae response to ocean water
Biomass ug/L
70
60
50
40
30
20
10
0
14 August
16 August
Blue green algae, salinity 13
Blue green algae, salinity 21

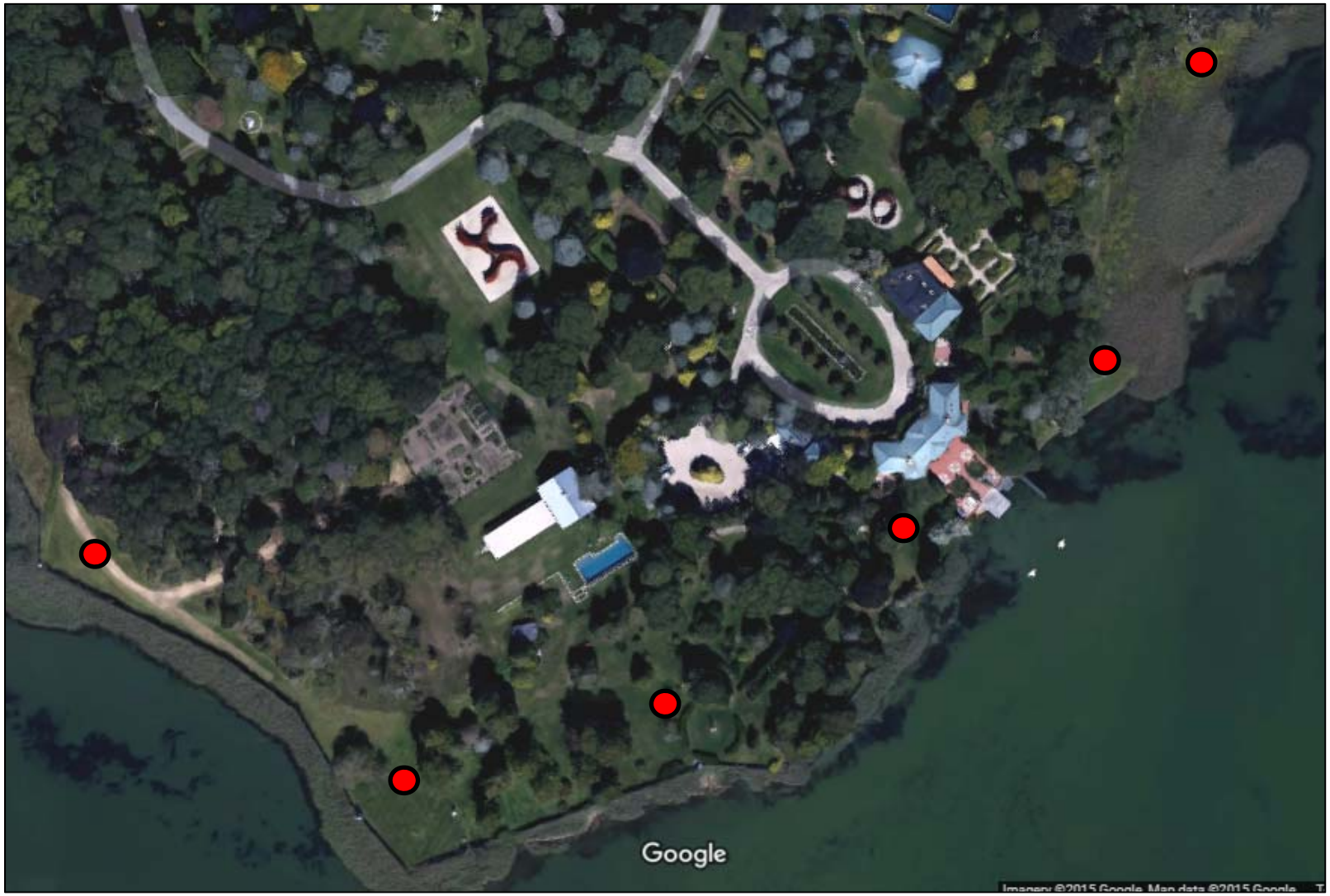
Permeable reactive barriers (PRB) to remove nitrogen, phosphorus

- PBR can **remove N (and perhaps P) from groundwater before it enters Georgica Pond**.
- Targeted placement of PBRs could alleviate nitrogen loading in regions with heavy loads, poor flushing, or both.



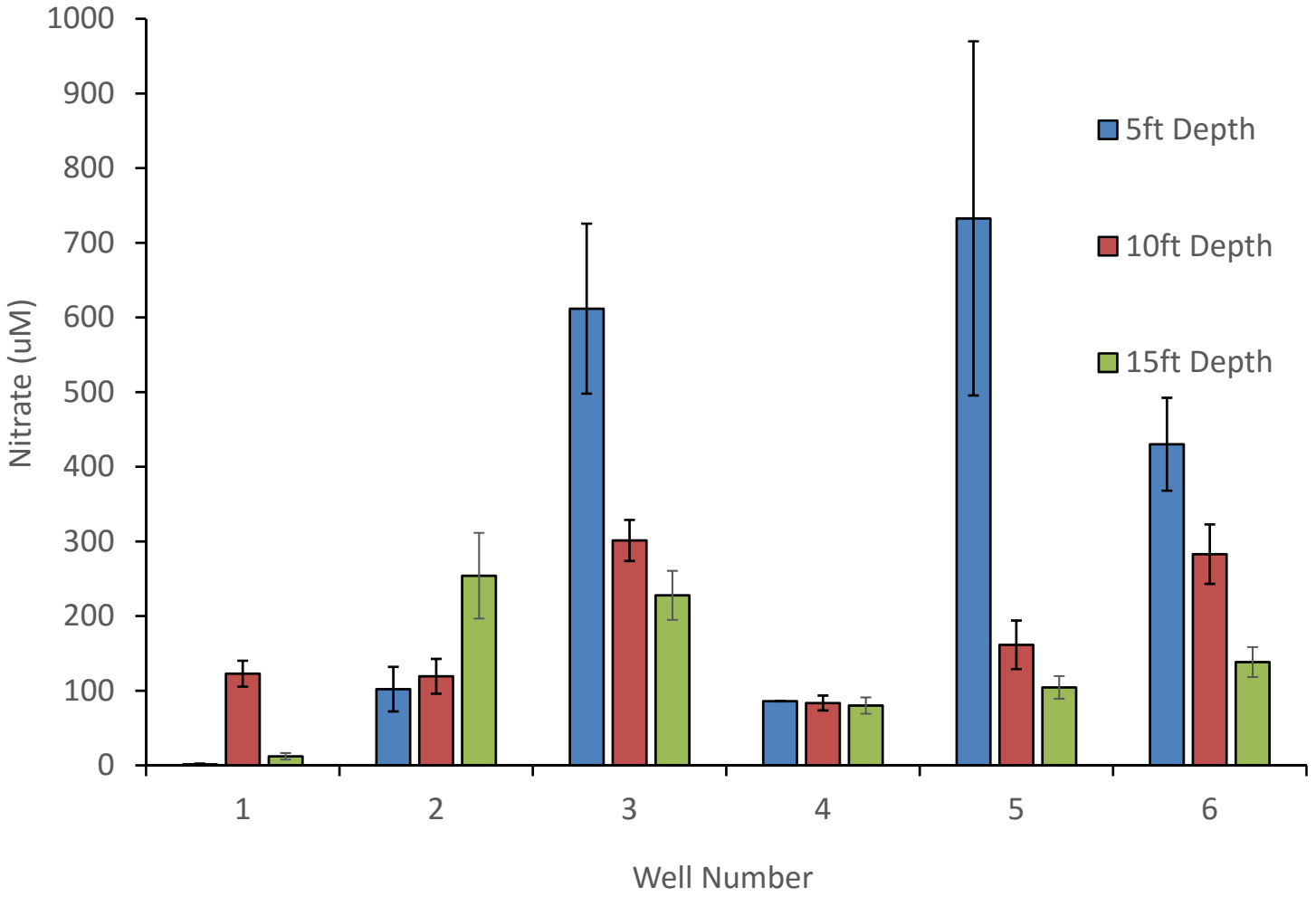
- May be most effective at the headwaters of streams and/or coves where groundwater discharge is concentrated.

Groundwater monitoring wells

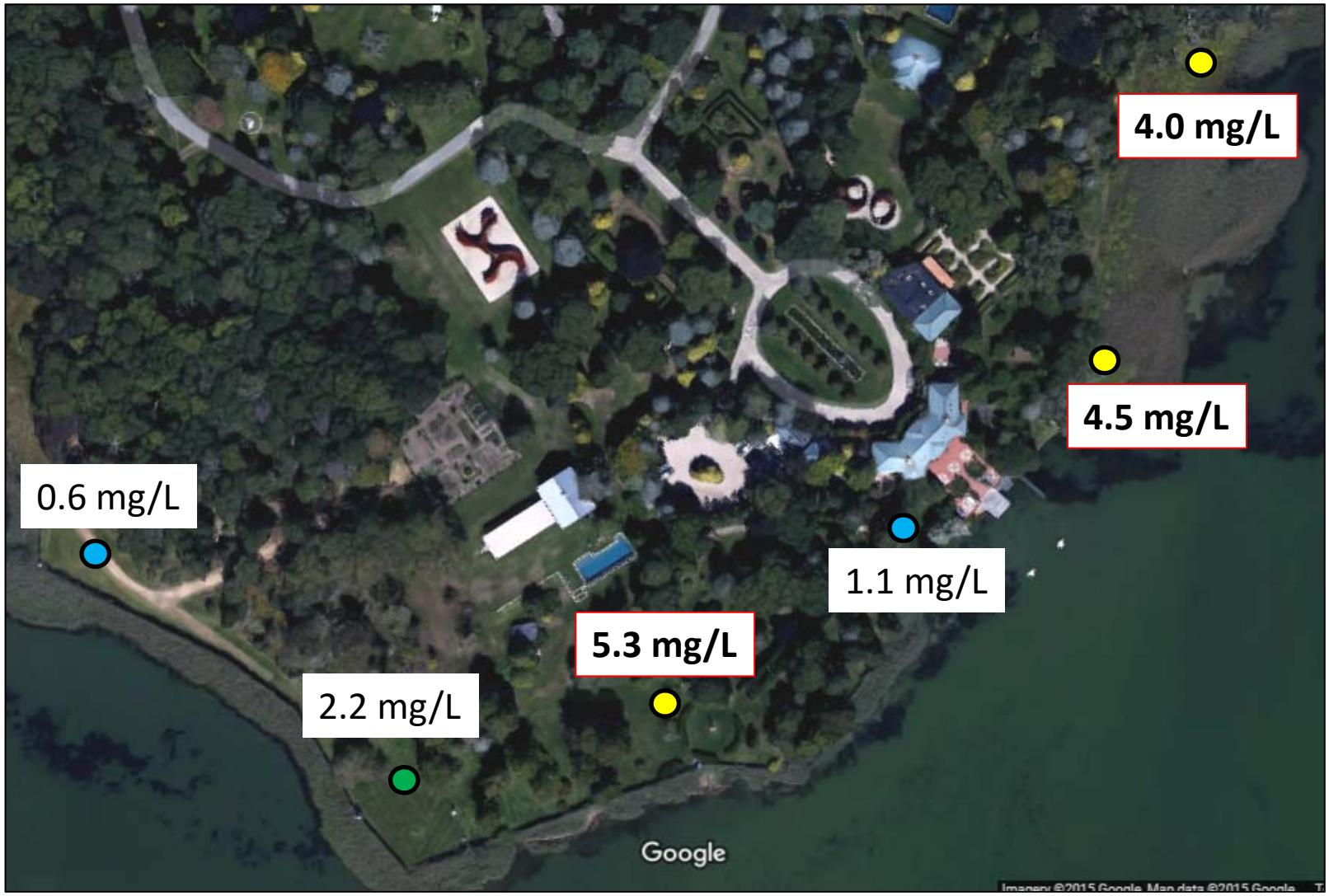


Groundwater monitoring well nitrate

-values are average of measurements January - August



Groundwater monitoring well, nitrate



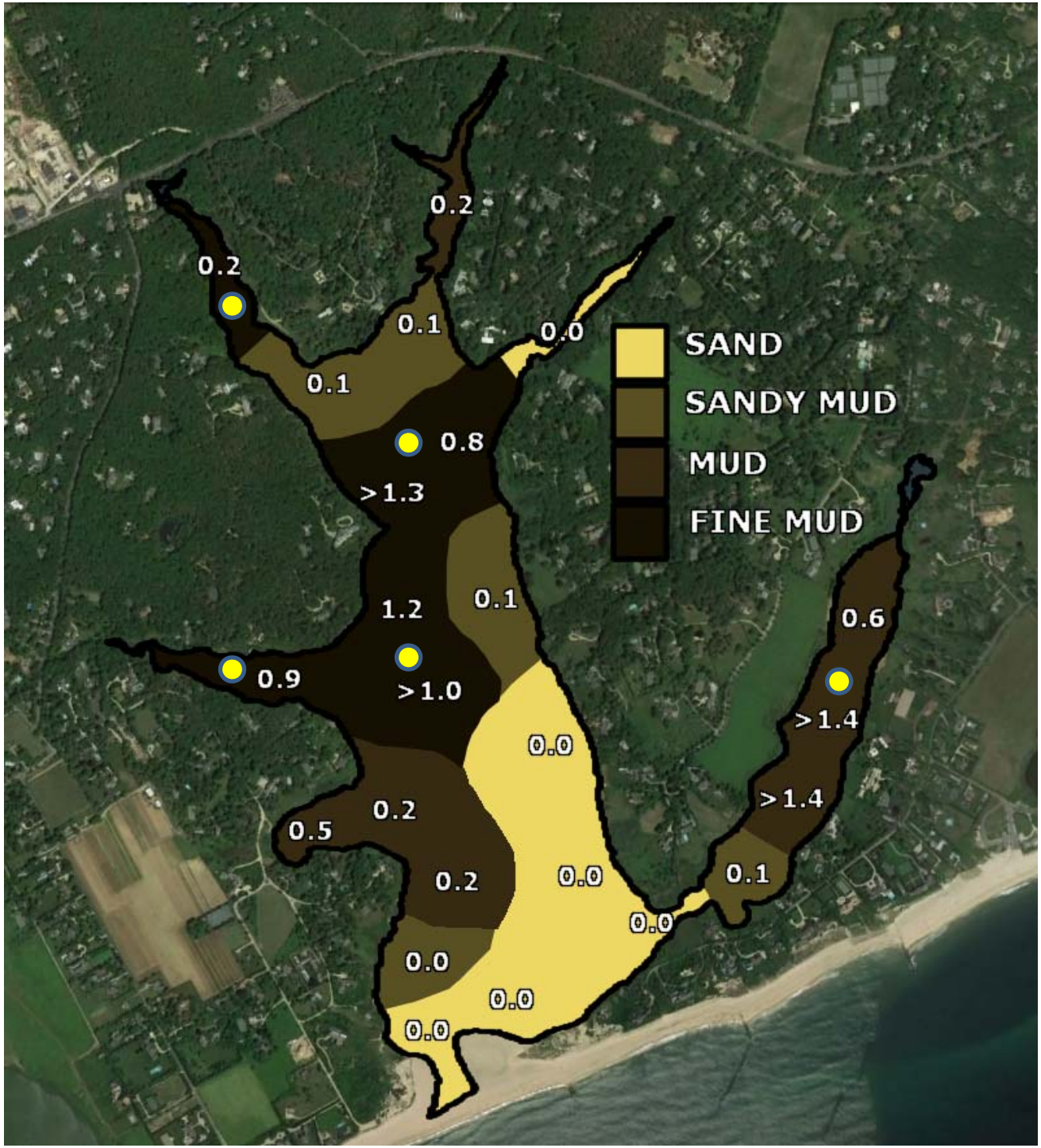
Dredging Georgica Pond

- **Removal of the thick layer of mud** across parts of the Pond could eliminate 50% of the phosphorus and 20% of the nitrogen fueling algal blooms.
- A greater depth within the Pond would provide more dilution of nutrients and could lower water temperatures.

- Deepening the passage from Georgica Cove to the Pond will allow the Cove to exchange with the Pond.
- Dredging the bar along the north end of the pond will permit better exchange to the south.

Sediment type and depth of mud in meters, Georgica Pond

- Meeting with GEI consultants suggested sediment testing for NYSDEC dredging permits
- Sediment samples collected and being analyzed for NYSDEC contaminants



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Selective suppression of harmful cyanobacteria in an entire lake with hydrogen peroxide

Hans C.P. Matthijs [a,1], Petra M. Visser [a,*,1], Bart Reeze [b], Jeroen Meeuse [c], Pieter C. Slot [a], Geert Wijn [b], Renée Talens [b], Jef Huisman [a]

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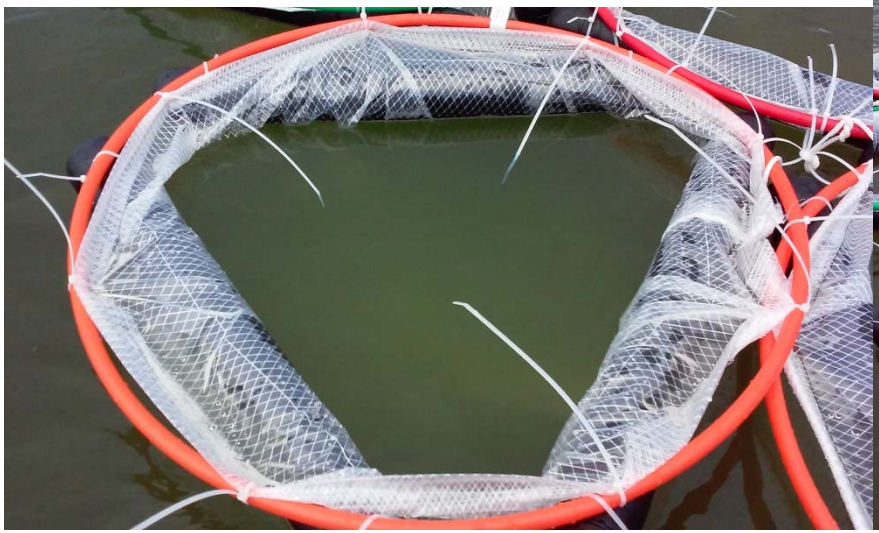
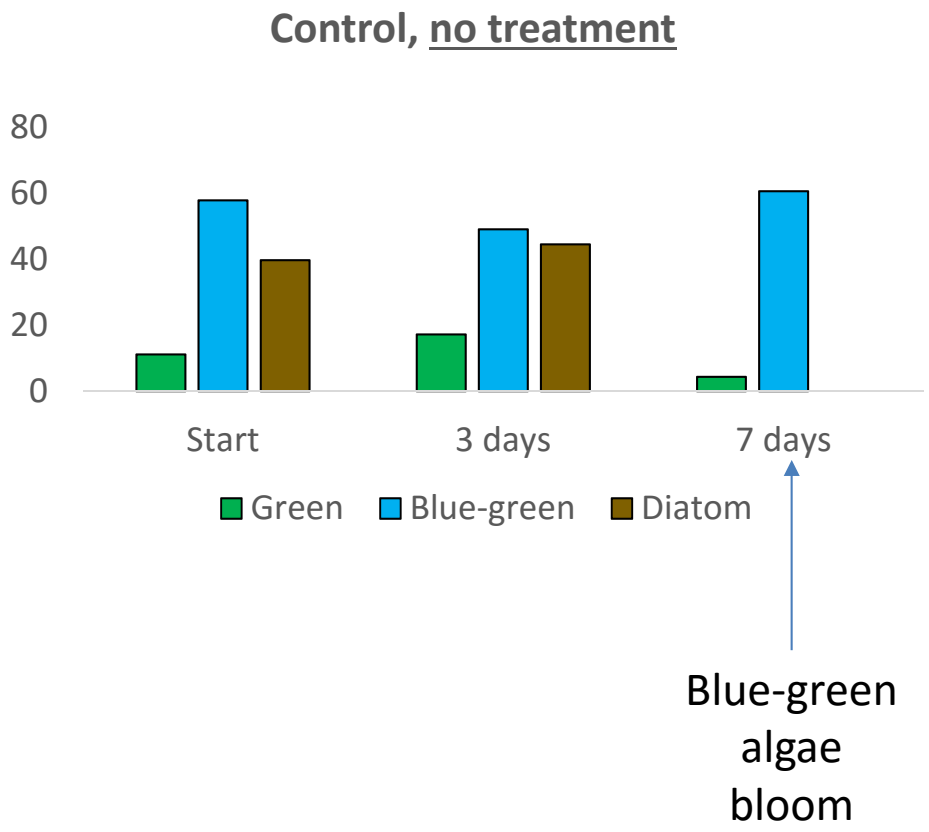
[b] ARCADIS Nederland BV, P.O. Box 673, 7300 AR Apeldoorn, The Netherlands

[c] Waterschap Hunze en Aa's, P.O. Box 195, 9640 AD Veendam, The Netherlands

Mesocosm experiments, 2016



Hydrogen peroxide experiment results



Conclusions:

- Georgica Pond suffers from algal blooms, blue-green algae, low oxygen, and fish kills promoted by excessive nitrogen and phosphorus from wastewater and sediments.
- In 2016, harvesting macroalgae may have reduced the July phosphorus and nitrogen loads by up to ~25% and ~10%.
- In 2016, blue-green algal blooms were short and mild and blue-green algae never dominated the Pond.
- In 2016, macroalgae never dominated the Pond.
- Groundwater testing has suggested indicated possible locations for permeable reactive barriers to mitigate nitrogen loading.
- Sample testing has begun to investigating the dredging of muds.
- Opening the cut regularly will help keep the Pond clean and clear.
- Hydrogen peroxide may be a useful ‘emergency measure’ for Georgica Pond in the future.
- Responsible fertilizer use is required by farms and homeowners.
- Improving the removal of nitrogen and phosphorus from wastewater is the central long term solution.

Acknowledgements:

Sincere gratitude for:
Leadership of the Friends of Georgica Pond.
Generosity of Perelman Foundation & Georgica Pond homeowners
Collaboration with The Nature Conservancy
Commitment of the East Hampton Town Trustees and Town of East Hampton

Thank you to Mark Lusty, Ryan Wallace, Jennifer Janikowiak, and Rob McCabe for field sampling, laboratory work, and data analysis support.

Thank you for your attention.