

# Common Carp (*Cyprinus carpio*) Effects on the Water Quality and Ecology of Mill Pond

Presentation In Support of  
Proposal for  
Community Preservation Funding  
Through  
The Water Quality Improvement  
Grant Program

# Synopsis of Mill Pond Management Plan and WQIPP Proposal

- Overall goal improve WQ of Mill Pond and decrease the occurrence, intensity and duration of cyanobacteria blooms.
- Focus on removal of carp...major source of phosphorus loading...seasonal timing of loading benefits cyano blooms.
- Re-establish needed littoral vegetation...provides habitat needed for game fish, increases sediment stability.
- Begin with installation of floating wetland islands...also serve as phosphorus sink.
- Eventually restore balanced fishery...bluegill and bass stocking will aid in future control of carp via predation on eggs and YOY.

# Common Carp

- *Cyprinus carpio*  
non-native,  
highly invasive  
fish
- Found in variety  
of lake and  
pond  
ecosystems



# How Do Carp Impact Lake Ecosystems?

- Uproot and disturb submerged vegetation.
- Suspend sediments reducing water clarity.
- Resuspension of sediment bound phosphorus.
- Resuspension of organic sediments impact dissolved oxygen concentrations.
- Impact and disrupt feeding, spawning and nursery habitat for various game fish.

# Ecological and WQ Impacts

## High densities of common carp linked to:

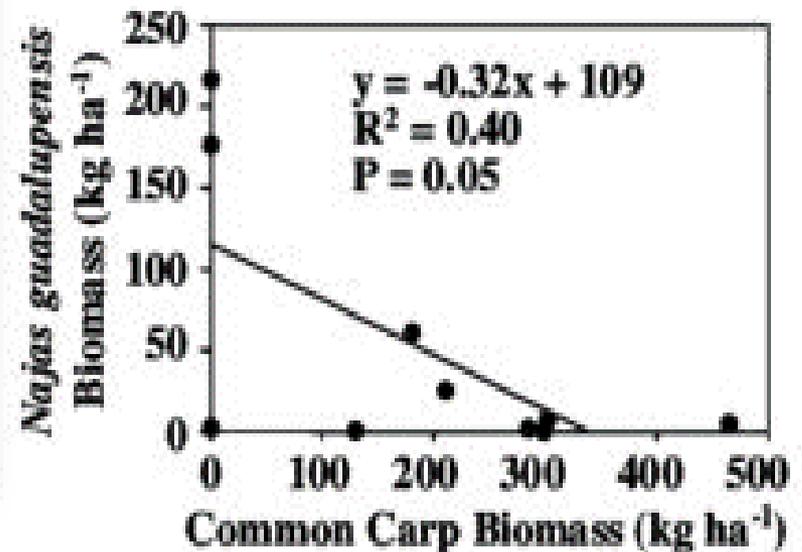
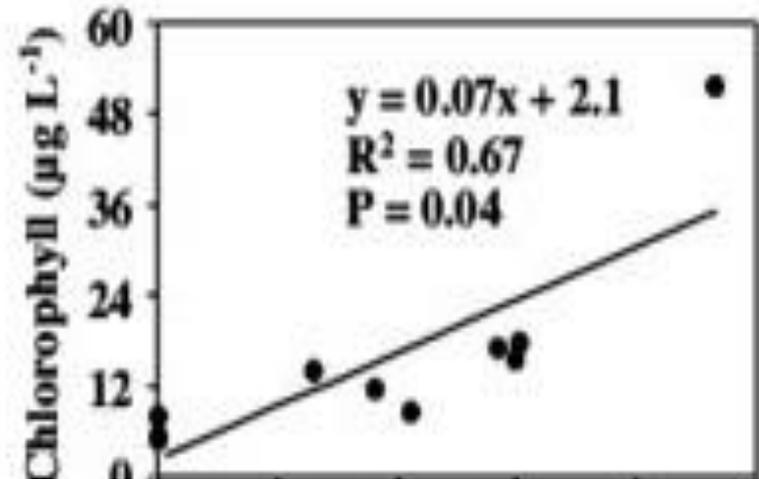
- **Added Nutrient Inputs** – What goes in one end comes out the other)
- **Foraging and Spawning Behavior** – Loss of vegetation, instability and suspension of sediment....impacts water quality, lake ecology and game fish recruitment
- **Bioturbation** – Direct nutrient loading due to resuspension of sediment
- **Alteration of Fishery** – Resulting from habitat destruction, increased turbidity and eutrophication.

# Carp Impacts Increase as Densities Increase

- Biomass significantly positively correlated with increased concentrations of...
  - Chlorophyll a, Total phosphorus, and Total nitrogen
- Biomass negatively correlated with densities of submerged aquatic vegetation biomass.

M.M. Chumchal, W.H. Nowlin, and R.W. Drenar. 2005. Biomass-dependent effects of common carp on water quality in shallow ponds. *Hydrobiologia* 545(1):271-277

# Impacts of Carp



# Ecological and WQ Impacts

Weber and Brown, 2009....

“Shallow, productive ecosystems with fine, loose sediment, and low abundance and diversity of aquatic macrophytes are most vulnerable to common carp perturbation and would experience the greatest improvements in water quality following carp”.

**Conditions documented in Mill Pond**

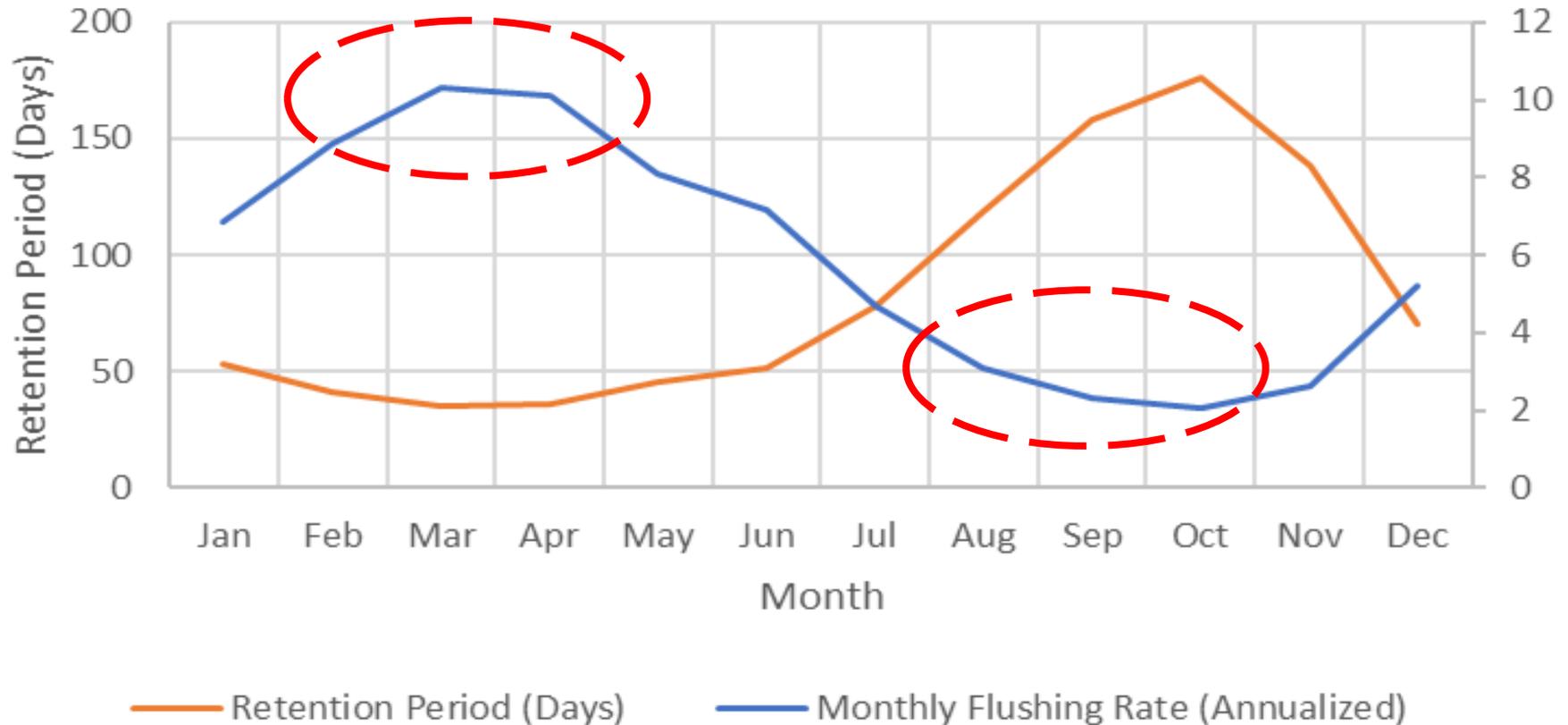
# Mill Pond

- 92 acre, shallow kettle hole pond
- Relatively minimally developed watershed
- Categorized by NYSDEC as eutrophic
- Frequently impacted by cyanobacteria blooms... 2012 – 2018 NYSDEC data confirmed blooms, some with elevated toxin levels
- Fishery - Largemouth Bass, Chain Pickerel, Bluegill, Pumpkinseed, Yellow Perch, White Perch, Brown Bullhead...large Carp population

# Summary of Princeton Hydro 2018 Data

- Lake : Watershed ratio – 23:1
- Moderately flushed system – 62 days
- GW ~ 50% of monthly inflow
- Secchi low – typically > 0.5 m
  - Water often brownish color
- No evidence of thermal stratification
- No evidence of “deep water” anoxia

## Mill Pond - Flushing Rate & Retention Time



Annualized hydraulic retention time = 62 days

Annualized flushing rate ~ 6 times / year

# Summary of Princeton Hydro 2018 Data

- TP very high - Surf<sub>m</sub> = 0.104 mg/L  
Deep<sub>m</sub> = 0.118 mg/L
- SRP low > 0.004 mg/L
- Anoxic sediment P loading not an issue
- Chlorophyll a very high - Usually > 40 mg/m<sup>3</sup>
- TSS always elevated, TSS<sub>m</sub> > 45 mg/L, surf and deep concentrations similar
- Cyano blooms common but cyanotoxin concentrations usually low (< 4µg/l)

# In-Situ Monitoring for Mill Pond, 4/24/2018

Station	DEPTH (meters)			Temp	Specific Cond.	Dissolved Oxygen		pH
	Total	Secchi	Sample	°C	mS/cm	mg/L	% Sat.	S.U.
WQ1	1.50	0.50	0.0	13.67	0.193	9.86	114.1	7.17
			0.5	12.82	0.190	10.00	93.5	7.30
			1.0	11.99	0.190	8.92	99.4	7.26
			1.4	11.73	0.187	9.68	96.1	7.23
WQ2	2.50	0.50	0.0	13.10	0.192	9.82	112.2	7.43
			0.5	13.03	0.195	9.60	109.5	7.70
			1.0	13.00	0.194	9.48	108.1	7.77
			1.5	12.95	0.194	9.44	107.5	7.80
			2.0	12.60	0.194	8.84	99.8	7.74
			2.4	12.32	0.196	8.85	99.4	7.70
WQ3	2.00	0.50	0.0	12.94	0.192	9.89	112.6	7.33
			0.5	12.78	0.195	9.70	110.1	7.43
			1.0	11.92	0.198	9.18	102.2	7.44
			1.5	11.88	0.197	8.46	94.0	7.39

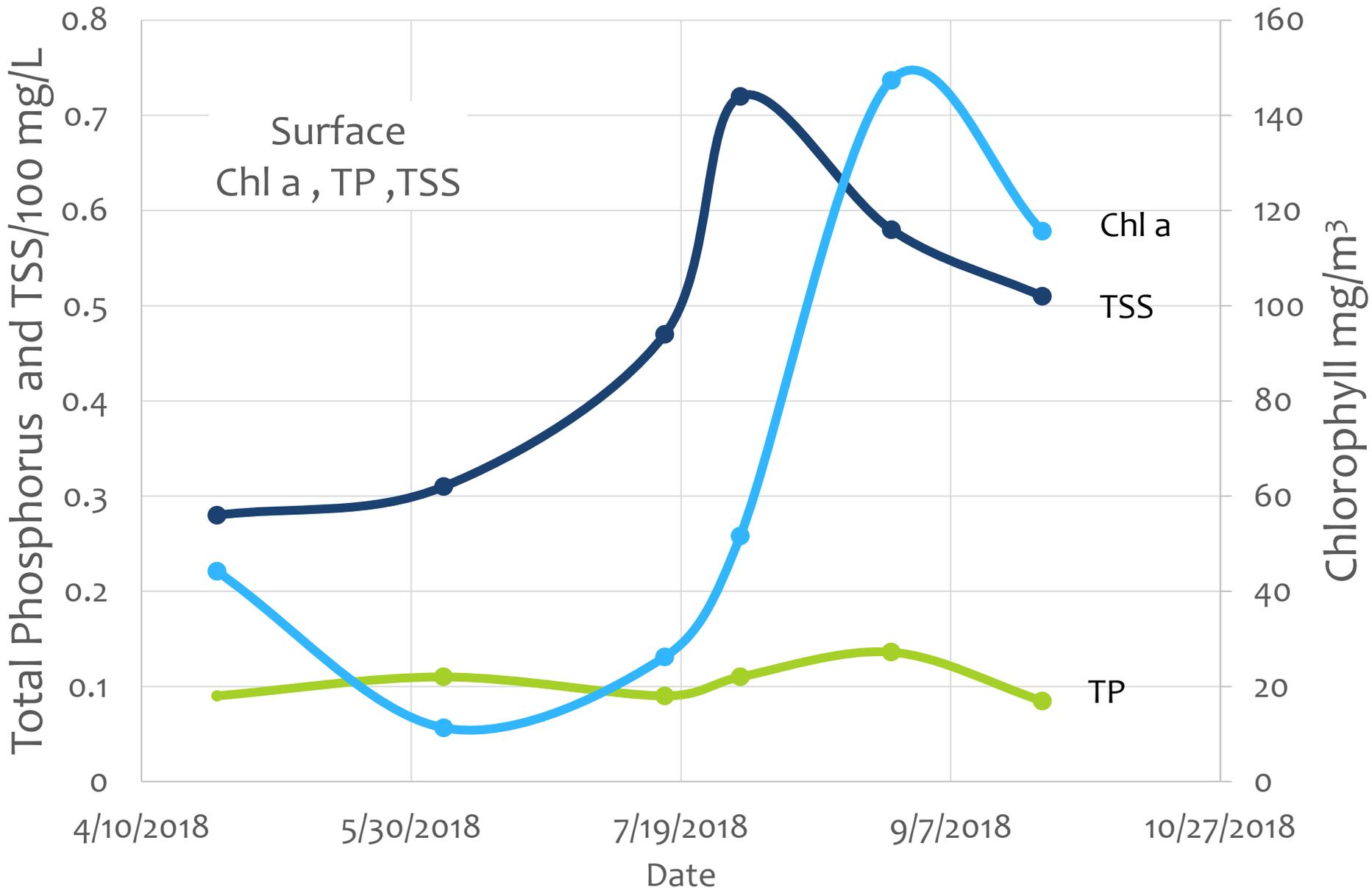
# In-Situ Monitoring for Mill Pond, 9/24/18

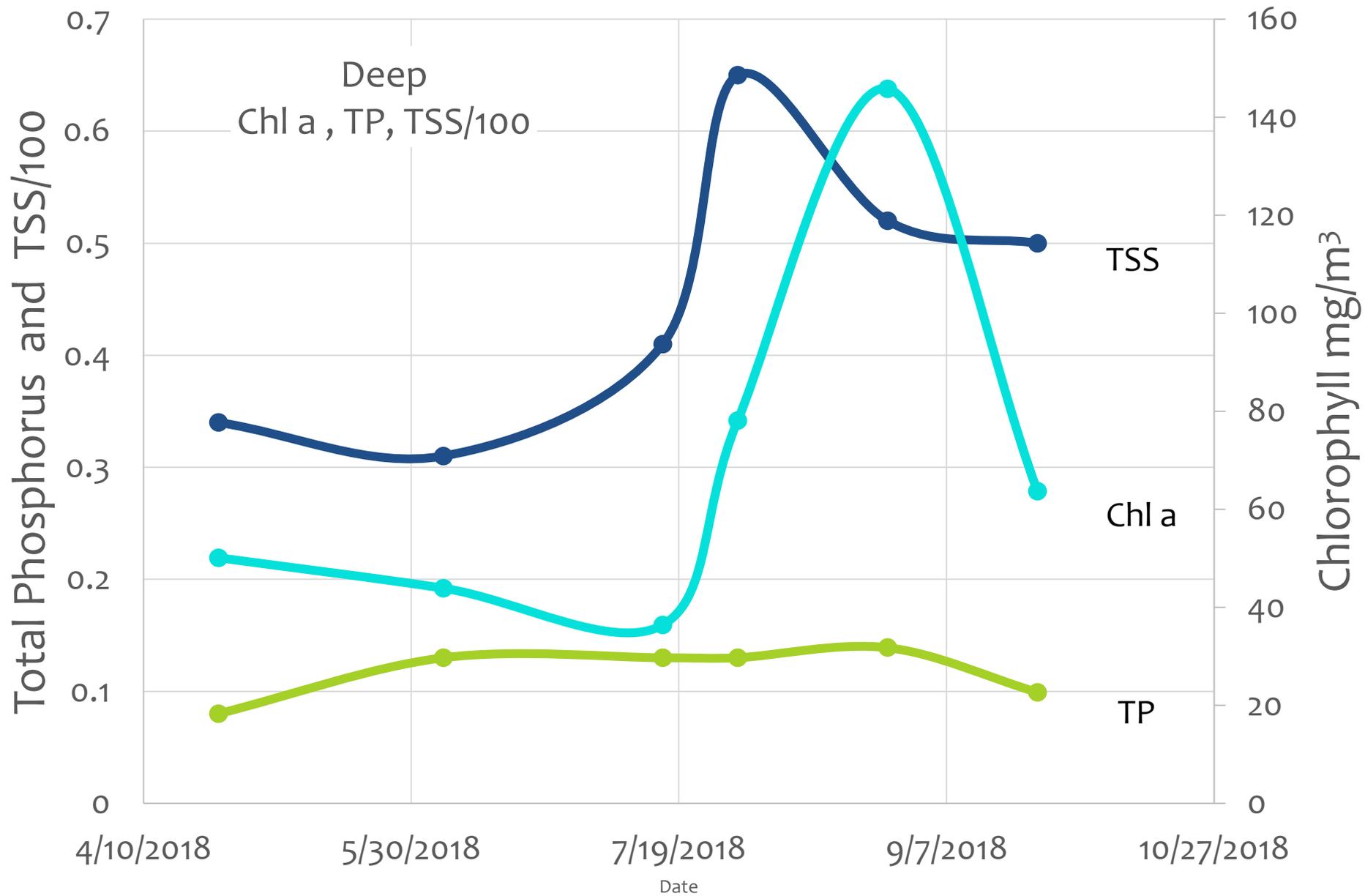
Station	DEPTH (meters)			Temp	Specific Cond.	Dissolved Oxygen		pH
	Total	Secchi	Sample	°C	mS/cm	mg/L	% Sat.	S.U.
WQ1	1.4	0.2	Surface	20.05	0.215	8.44	91.3	6.68
			0.5	19.93	0.213	8.01	86.5	6.81
			1.0	19.92	0.215	6.37	68.7	6.93
WQ2	2.4	0.3	Surface	20.47	0.217	7.55	82.4	6.62
			0.5	20.50	0.215	7.62	83.1	6.72
			1.0	20.49	0.217	7.61	83.0	6.77
			1.5	20.49	0.216	7.66	83.6	6.81
			2.0	20.49	0.216	7.52	82.4	6.88
WQ3	1.8	0.3	Surface	20.02	0.215	8.18	88.5	6.51
			0.5	20.05	0.215	7.84	84.7	6.65
			1.0	20.04	0.216	8.06	87.2	6.74
			1.5	20.01	0.215	7.93	85.8	6.77

# Water Quality Data

## Surface and Deep

Date	Chl a (mg/M <sup>3</sup> )		SRP (mg/L)		TP (mg/L)		TSS (mg/L)	
	Surface	Deep	Surface	Deep	Surface	Deep	Surface	Deep
4/24/2018	44.2	50.1	0.008	0.004	0.09	0.08	28	34
6/5/2018	11.3	43.9	0.018	0.003	0.11	0.13	31	31
7/16/2018	26.2	36.4	0.003	0.002	0.09	0.13	47	41
7/30/2018	51.6	78.1	0.003	0.001	0.11	0.13	72	65
8/27/2018	147.4	145.8	0.001	0.001	0.136	0.139	58	52
9/24/2018	115.7	63.7	0.0038	0.0021	0.0847	0.0991	51	50



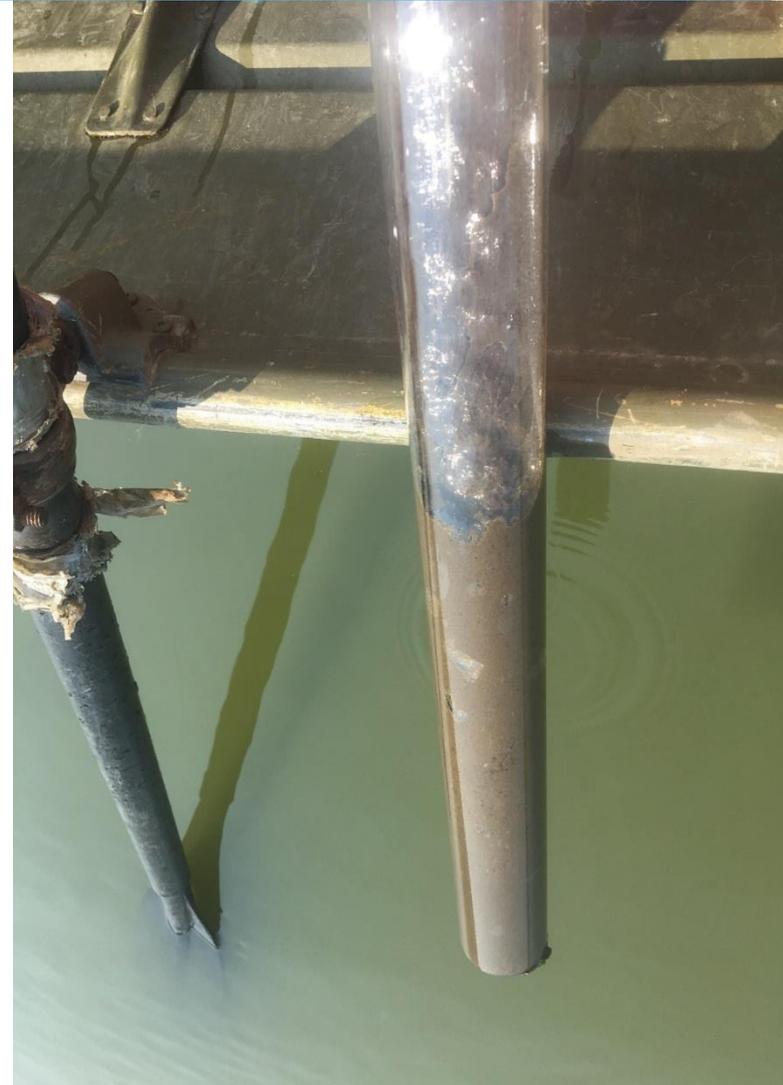


# What The Data Is Telling Us

- Lake well mixed, non-stratified and no evidence of anoxia...aeration not needed
- Lake very turbid; due to TSS and Phytoplankton (as per elevated Chl a concentrations)...clarity < 0.5 m
- Mean TP, Chl a concentrations very high, but SRP concentrations moderate

# Lake Sediment Analysis

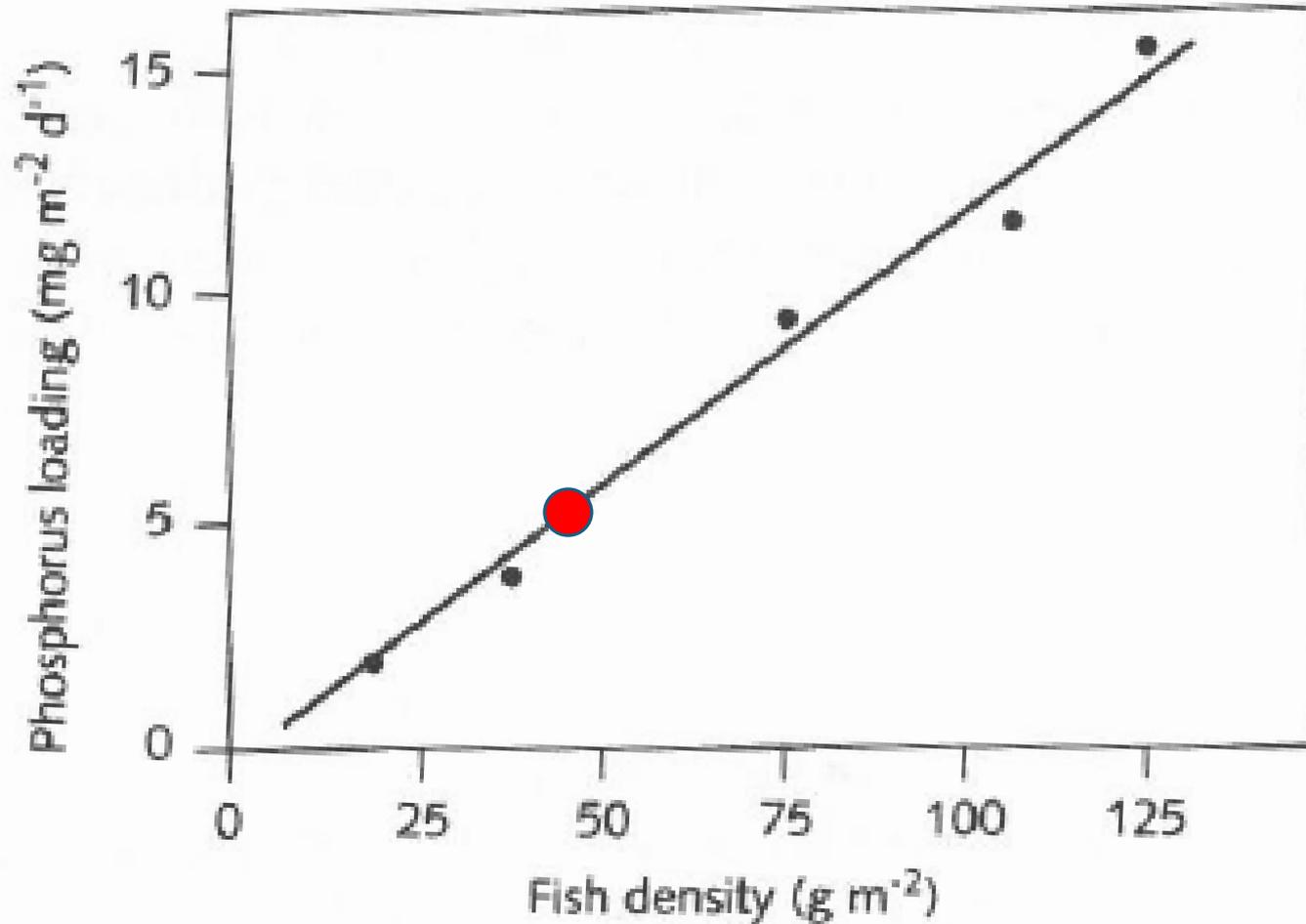
- Collected eight (8) sediment cores hand-driven to point of refusal (~ 0.5 - 1m)
- Sediments composed mostly of silts/clays, reduced organic material (Org ~30%)
- Sediment TP concs. - 542-1062 mg/kg



# Role of Carp On P Loading

- Mill Pond has a large common carp population
- 2012 over 6,000 lbs removed via netting
- Carp significantly impact water quality
  - Direct nutrient inputs (defecation)
  - Indirect nutrient inputs (bioturbation) and alteration of littoral plant community)
- Carp responsible for lack of littoral vegetation and persistent turbidity of the lake

# Carp Bioturbation Impacts, Lamarra, 1974



# Role of Carp On P Loading

- Computed P Load due to carp bioturbation only
  - Loading rate 5 mg/m<sup>2</sup>/day
  - Lake bottom area 372,000 m<sup>2</sup>
  - Loading period 245 days
  - Computed load 455.7 kg/yr
  - Adjusted by 50% to account for settling
- Total P load = 227.85 kg/yr

# Modeled External/Internal TP Load

TP Load	Load (kg/yr)	% Load
Source		
Land Use (SW Runoff)	200.4	33.75
Animals	8.6	1.44
Stream Bank	2.0	0.33
Groundwater	32.8	5.52
Septic	67.2	11.32
Internal - Oxic	26.8	4.43
Internal – Carp (bioturbation)	227.85	38.39
Internal - Geese	27.99	4.71
Total		100.0%

# What The Data Is Telling Us

- External P load high 200.4 kg/yr (33.75% of total)
- Septic P load moderate and manageable 67.2kg/yr ( 11.3% total load)
- Internal sediment P load under oxic conditions is low (<4.43%)
- Carp related P loading is high 227.85 kg/yr (38.39% of total load)

# Management Recommendations

- Focus on manageable sources of P
    - Stormwater runoff
    - Septic
    - Carp
  - No need to aerate lake, not stratified and internal sediment load low
  - Data do not support need for nutrient inactivation (alum or alum surrogate treatment of lake sediments)
- 
- Target carp removal as primary restoration effort

# Why Focus on Carp Removal

- Supported by field and modeled data
- P load timing relative to septic and stormwater loading
  - Flushing rate
  - Seasonality of load
- Easier to implement and more cost effective than stormwater management
- WQ improvement quicker than septic management
- Easier to document benefits relative to septic management and stormwater management
- Has worked before at Mill Pond and other lakes

# Carp Removal Options

- Gill Nets
- Electroshocking
- Recreational anglers
- Bow anglers
- Baited box nets



# Baited Box Nets



Photo Courtesy of Carp Solutions - <http://carpsolutionsmn.com>

# Advantages of Baited Box Nets

- Fish come to you!
- Highly selective; by-catch minimal.
- Not size selective.
- High catch per unit effort.
- Relatively cost effective.



# Status of Carp Removal Permit

Pursuant to Environmental Conservation Law Section 11-0517, The Trustees of the Town of Southampton are granted permission to contract to remove carp, koi, and goldfish removed from Mill Pond (Lake Nowedonah) in Water Mill:

1. Removal operations may take place whenever practical
2. Gear used for removal is limited to:
  - 6" or > stretched mesh gill nets
  - 3" or > stretched mesh seine nets < 400' long
3. Carp, koi, and goldfish caught in this operation may not be returned alive or dead and may be disposed of by any legal means
4. Fish removed data shall be submitted to the DEC Region 1 Fisheries Unit on a quarterly basis within 30 days of the end of each quarter.

**This permit shall remain in force through December 31, 2023, as long as, all of the above conditions are met. Failure to comply with any of the above conditions will result in the immediate revocation of the permit.**

# Status of Fish Survey Permit

- Permit submitted to DEC Albany in early May
- Awaiting approval
- Permit based on use of combination of fixed and active collection equipment to assess the composition, density and robustness of game and forage fish community (excluding invasive species)
- Data to be used to assist post-carp removal fish stocking efforts

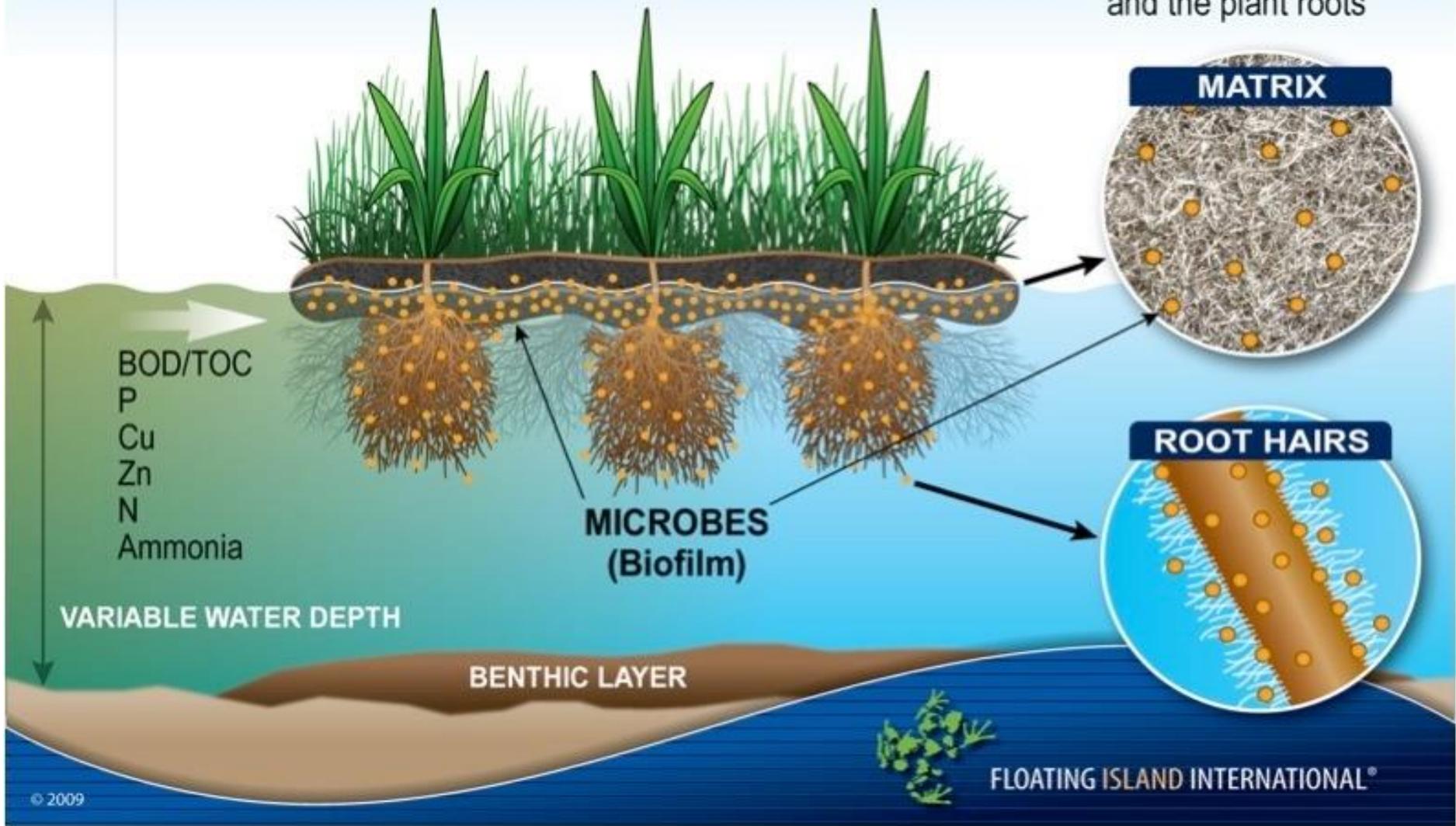
# Floating Wetland Islands

- Provide habitat for fish and other aquatic organisms.
- Help mitigate wave erosion impacts.
- Assimilate nutrients that fuel algae blooms.
- Rapid growth and not subject to disruption by carp or sediment disturbances.



# Floating Treatment Wetlands (FTWs)

Biofilm covers the island and the plant roots



**MATRIX**

**ROOT HAIRS**

**MICROBES  
(Biofilm)**

BOD/TOC  
P  
Cu  
Zn  
N  
Ammonia

VARIABLE WATER DEPTH

BENTHIC LAYER

FLOATING ISLAND INTERNATIONAL®

# Typical Installation



# Summary

- Common carp invasive fish species; disrupt fishery, impact water quality linked to HABs.
- Mill Pond data supports active removal effort.
- NYSDEC has issued a carp removal permit that is good through 2023.
- Baited box nets are a very cost-effective removal option.
- FWIs first step to restoring littoral vegetation.

# Proposed Schedule of Activity

- Carp removal permit in hand...initiate carp removal efforts using trap nets (petition for mod to permit).
- Use local fishermen to accept carp for bait (new restrictions on herring catch increases desirability of carp as alternative).
- Conduct fishery survey and assess existing fishery ...use data to formulate post-carp stocking plan.
- Install FWIs, use to “kick start” re-establishment of Mill Pond’s littoral vegetation.
- Continue to support efforts to reduce SW and Septic loading to Mill Pond.

# Thank You....

