FOSTER'S POND

Aquatic Management Program
10-Year Summary

April 29, 2014

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ACT President

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Overview of Presentation…

- Foster's Pond condition in 2004
- Development of a weed treatment program
- Fanwort management
- Other invasive management
- Water quality monitoring results
- Algae management
- Where do we go from here

Foster's Pond in August 2004

<u>POND AREA</u>: 125 acres

<u>AVERAGE DEPTH</u>: less than 7 feet

<u>FANWORT COVER</u>: moderate to high biomass; found at 87% of data points locations; lake wide cover estimated at 53%

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MANAGEMENT TECHNIQUES

Different Approaches

- Physical/Manual
- Mechanical
- Chemical
- Biological

Determining Which One to Use

- Program goals and objectives
- Accurate plant identification
- Environmental constraints
- Social acceptability
- Cost

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FACTORS FOR HERBICIDE SELECTION…

- Target species
- Size & configuration of treatment area
- Selectivity desired or required
- Water uses
- Flow considerations
- Timing
- Cost

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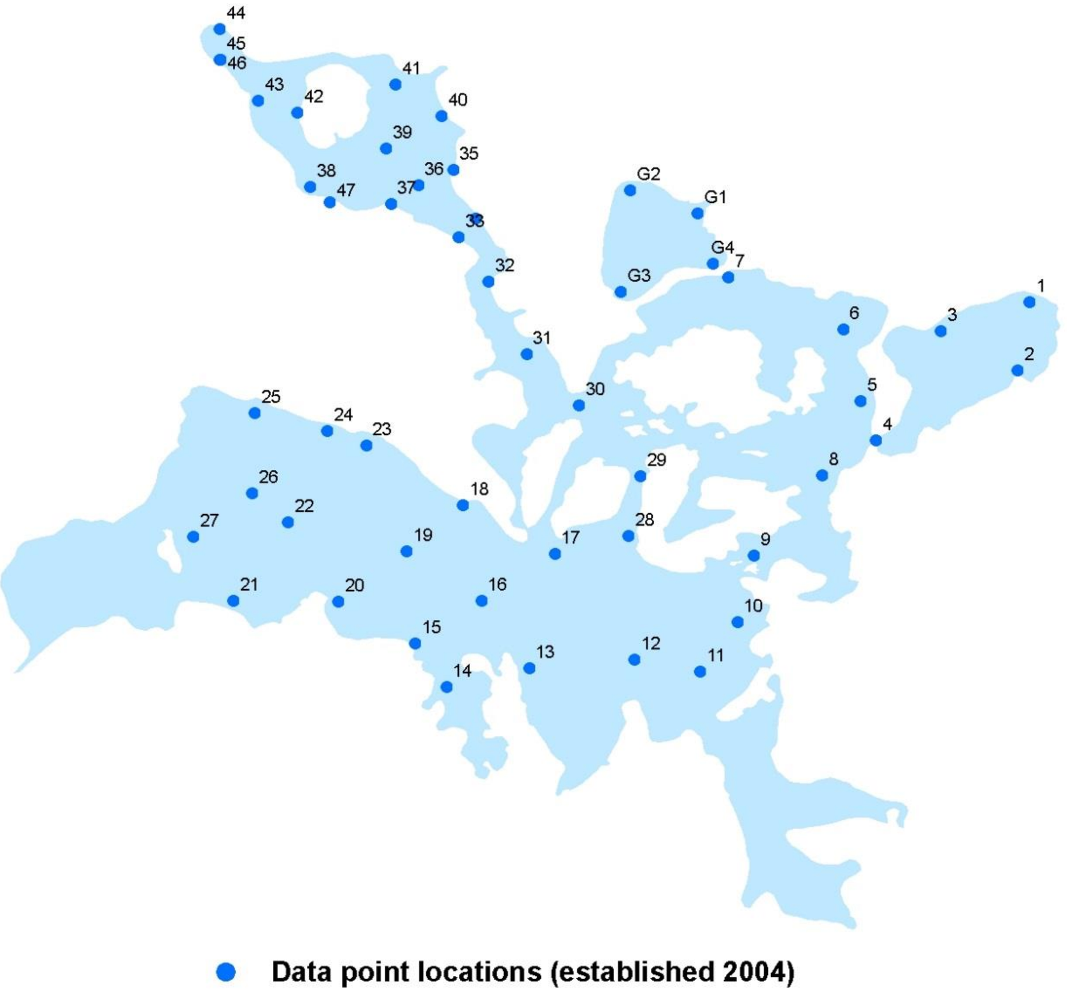
SONAR Herbicide

- active ingredient: **Fluridone**
- manufacturer: **SePRO Corporation**
- Characteristics
  - Systemic mode of action / growth inhibitor
  - Used for submersed and floating plants
  - Liquid and granular formulations
  - Favorable toxicology
  - Excellent control of fanwort; the only aquatic herbicide registered in 2005 that controlled fanwort
- **TREATMENT PROGRAM:** Sonar (liquid) herbicide applied to whole-lake; 3 separate applications to maintain >60 days of herbicide concentration-exposure-time

Monitoring and Maintenance

- Routine surveys
- Identify other invasives – 3 submersed now found
- Spot-treatments
- Modify approaches



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2006

- Glenwood Road Basin / Dug Pond
- Brazilian elodea (*Egeria densa)*
- Sonar herbicide treatment

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2007

- Partial-lake Sonar treatment
- Sonar pellet formulation
- Limno-barriers

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2008 & 2009

- Surveys – by ACT in 2008 and by Geosyntec in 2009
- Similar findings
- Increasing plant and fanwort cover in 2009
- Presence of Spiny Naiad (*Najas minor)*

2009 Foster's Pond Aquatic Vegetation Survey and Water Quality Monitoring Report

October 15, 2009

Table 1: Aquatic Vegetation Data Summary

Year	Estimated % Total Plant Cover	Estimated % Fanwort Cover	Biomass Index	Species Richness Index
2004	78.9	54.5	2.9	3.6
2005	25.5	0.1	1.4	1.7
2008	15.9	0.9	1.6	1.7
2009	34.2	6.1	1.6	5.5

Prepared For:

Foster's Pond Corporation

Prepared By:

Geosyntec consultants
engineers | scientists | innovators

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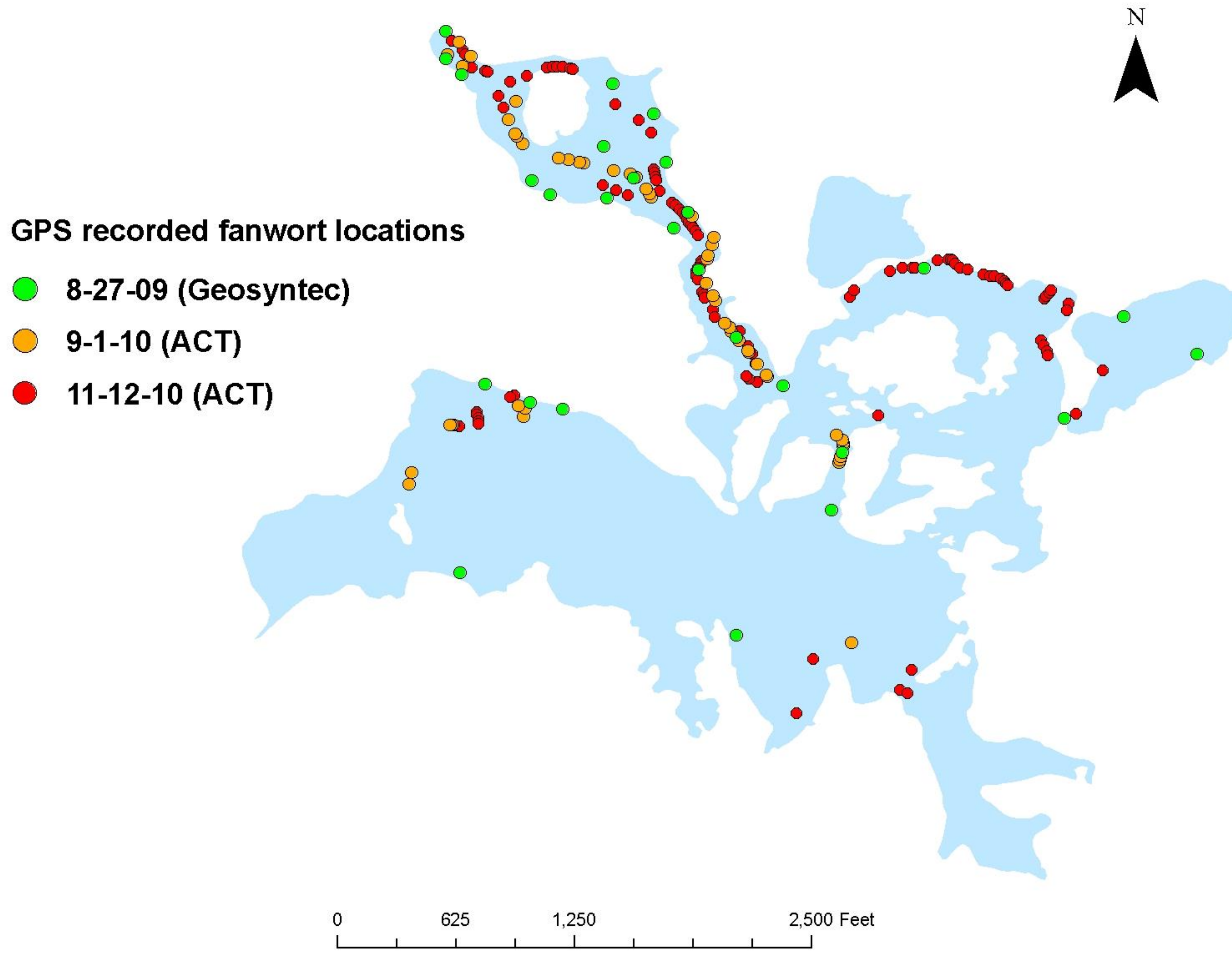
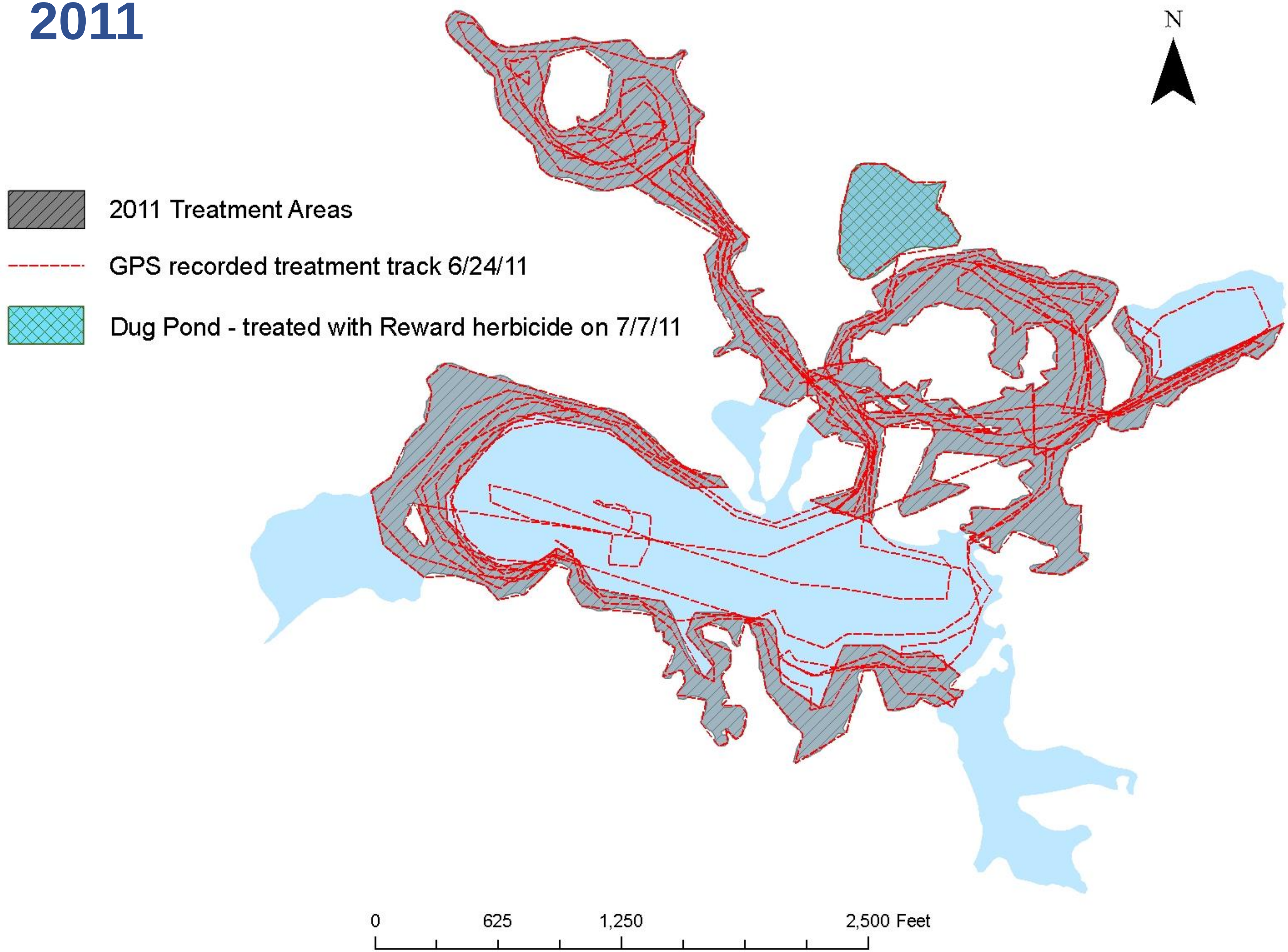
2010

- Spiny Naiad spot-treatment
- Reward (diquat) herbicide fast acting, contact herbicide, good for control of annual plant


N
GPS recorded fanwort locations
8-27-09 (Geosyntec)
9-1-10 (ACT)
11-12-10 (ACT)
0
625
1,250
2,500 Feet

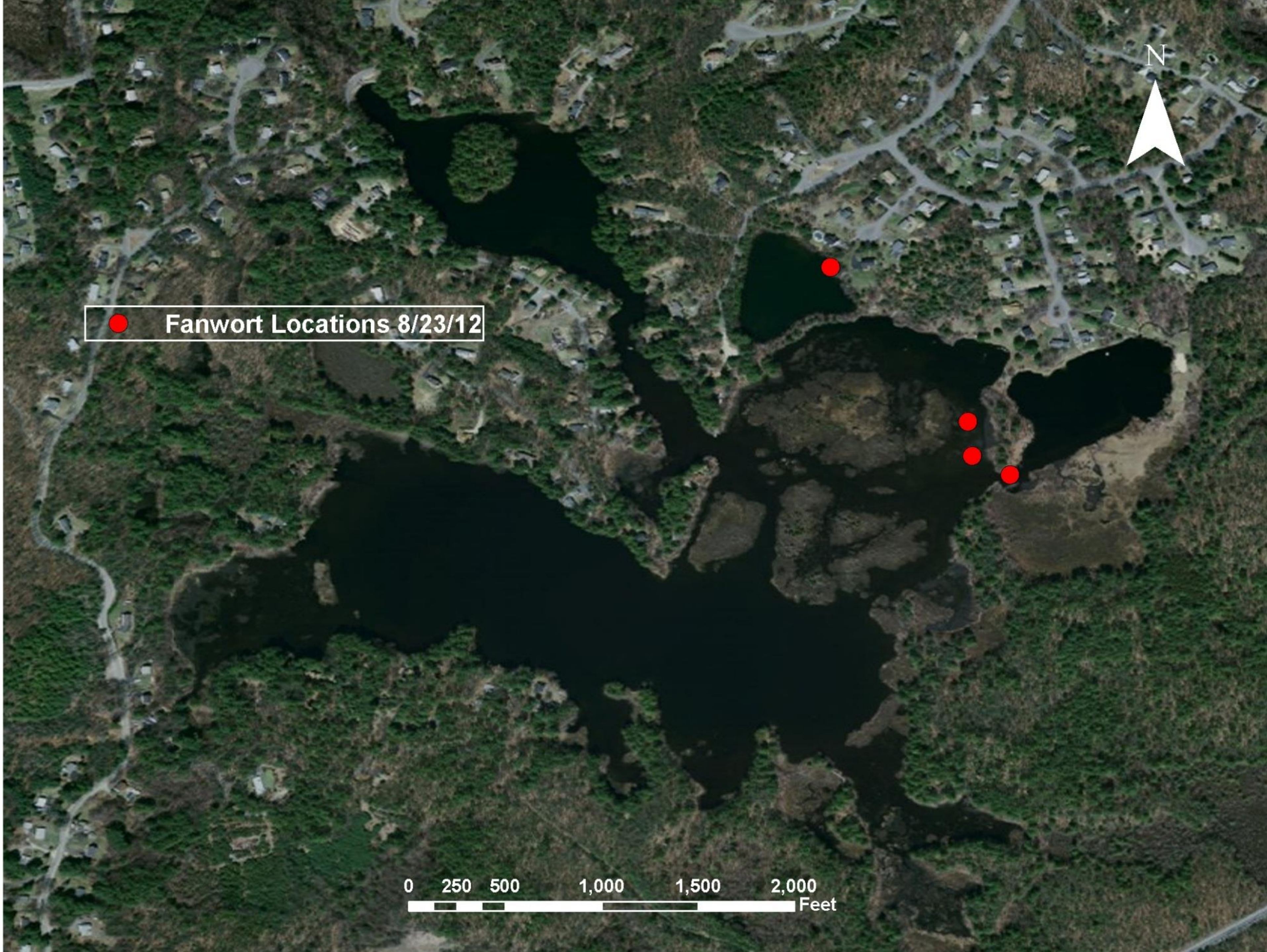
2011


N
2011 Treatment Areas
GPS recorded treatment track 6/24/11
Dug Pond - treated with Reward herbicide on 7/7/11
0
625
1,250
2,500 Feet

2012

Table 1: Aquatic Vegetation Data Summary

Year	Estimated % Total Plant Cover	Estimated % Fanwort Cover	Biomass Index	Species Richness Index
2004	78.9	54.5	2.9	3.6
2005[1]	25.5	0.1	1.4	1.7
2008	15.9	0.9	1.6	1.7
2009	34.2	6.1	1.6	5.5
2011[1]	19.0	0	1.2	1.4
2012	21.2	0.1	1.3	1.6



N
Fanwort Locations 8/23/12
0
250
500
1,000
1,500
2,000
Feet

Algal Bloom – what happened?

- Cyanobacteria or bluegreen algae
- Present for a long time in Foster's Pond
- Causes of blooms
- Advisory & Risks
- What can be done

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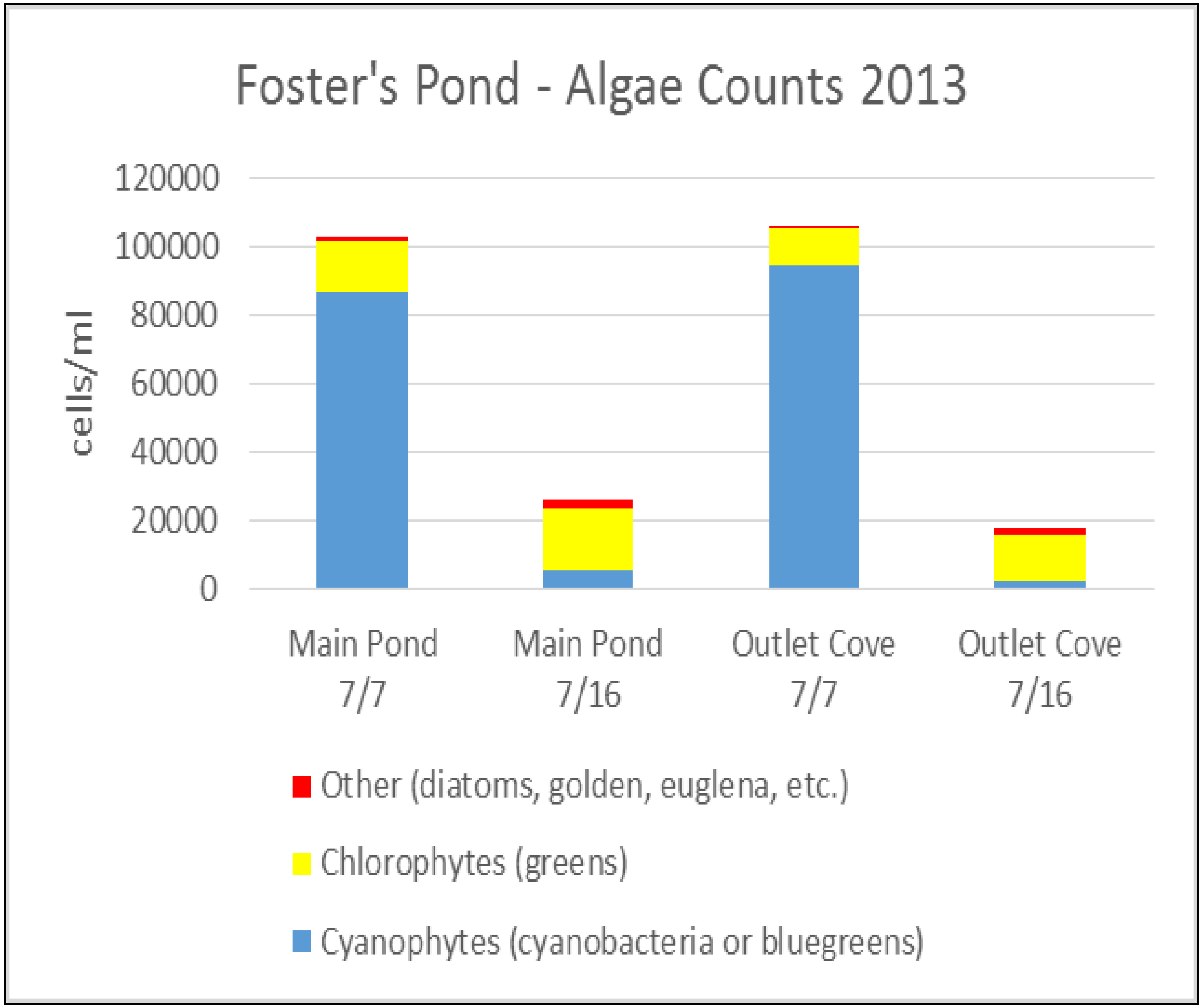
2012 Water quality monitoring

- Replicated previous WQ sampling
- Phosphorus elevated which fuels algae growth
- Cyanobacteria bloom most evident in Main Pond and Outlet Cove

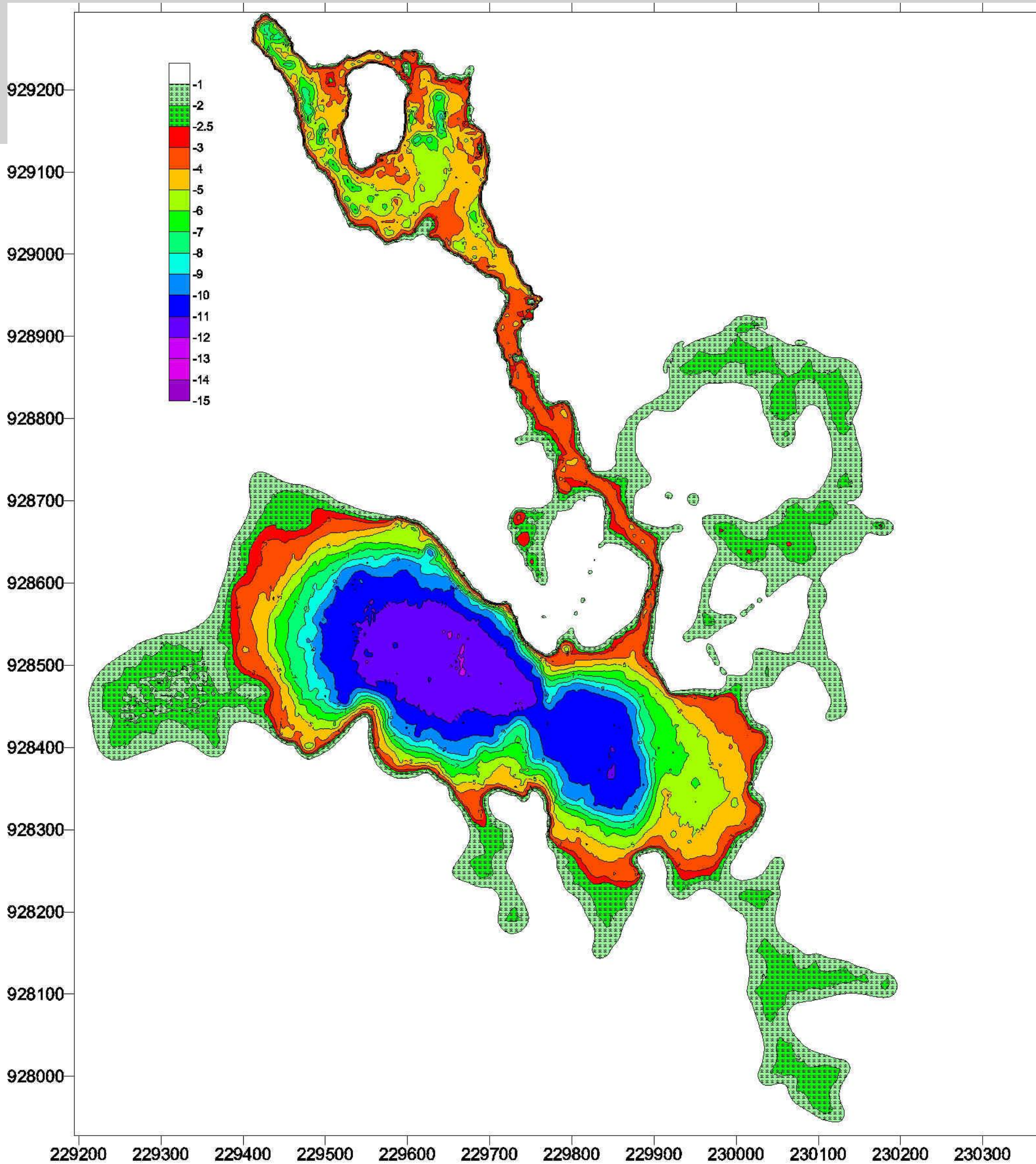
2013 Algae Management



- Water clarity monitored by FPC
- Samples collected and analyzed
- Copper sulfate algaecide applied to half the pond on 7/12/13
- 90% reduction in cyanobacteria in 4 days

Issues

- Elevated nutrients
- Pond history and formation
- Shallow depth and bottom type
- Watershed inputs
- Invasive plants – that nutrient management can't fix



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Next steps?

1. **Maintain control of fanwort and other invasive plants**
2. **Prevent bloom conditions of cyanobacteria from developing**
3. **Investigate longer term improvements in water quality and overall condition of the pond**

POTENTIAL IMPACTS OF EXOTIC OR INVASIVE PLANTS

FISH, WILDLIFE & NATIVE PLANTS

- **Displacement of native plants**
- **Displacement of endangered, threatened or rare aquatic plants**
- **Habitat loss for fish & wildlife**
- **Change in spawning site availability**
- **Change in fish distribution**
- **Reduction in feeding success of predatory fish**
- **Reduction of open-water**

WATER QUALITY

- **Temperature & oxygen fluctuations**
- **Increased phosphorus (nutrient) loading**
- **Alteration in plant and algae communities**
- **Accelerated eutrophication rates**

Source: A report from the Milfoil Study Committee on the Use of Aquatic Herbicides to Control Eurasian Watermilfoil in Vermont. VTDEC, March 1993

POTENTIAL IMPACTS OF EXOTIC OR INVASIVE PLANTS (continued)

RECREATION

- Risk of swimmer entanglement
- Reduced access for boating & fishing
- Reduced aesthetics

LOCAL COMMERCE & REAL ESTATE

- Reduced property taxes
- Declining property values
- Renters fail to return for a second season
- Slowed business for marinas, etc.
- Declining attendance at lakefront beaches and parks

Source: A report from the Milfoil Study Committee on the Use of Aquatic Herbicides to Control Eurasian Watermilfoil in Vermont. VTDEC, March 1993

INVASIVE AQUATIC PLANTS

- Eurasian Watermilfoil
- Variable Watermilfoil
- Fanwort
- Water Chestnut
- Curlyleaf Pondweed
- Common Reed / Phragmites
- Purple Loosestrife
- Hydrilla
- Spiny naiad
- Southern naiad
- Parrot feather
- Brazilian waterweed
- Hybrid milfoils
- Cyanobacteria; toxic bluegreen algae

What is a herbicide?

Approximately 300 registered herbicides in the US, but less than 15 are registered for aquatic use

Registered aquatic herbicides available in the 1990's

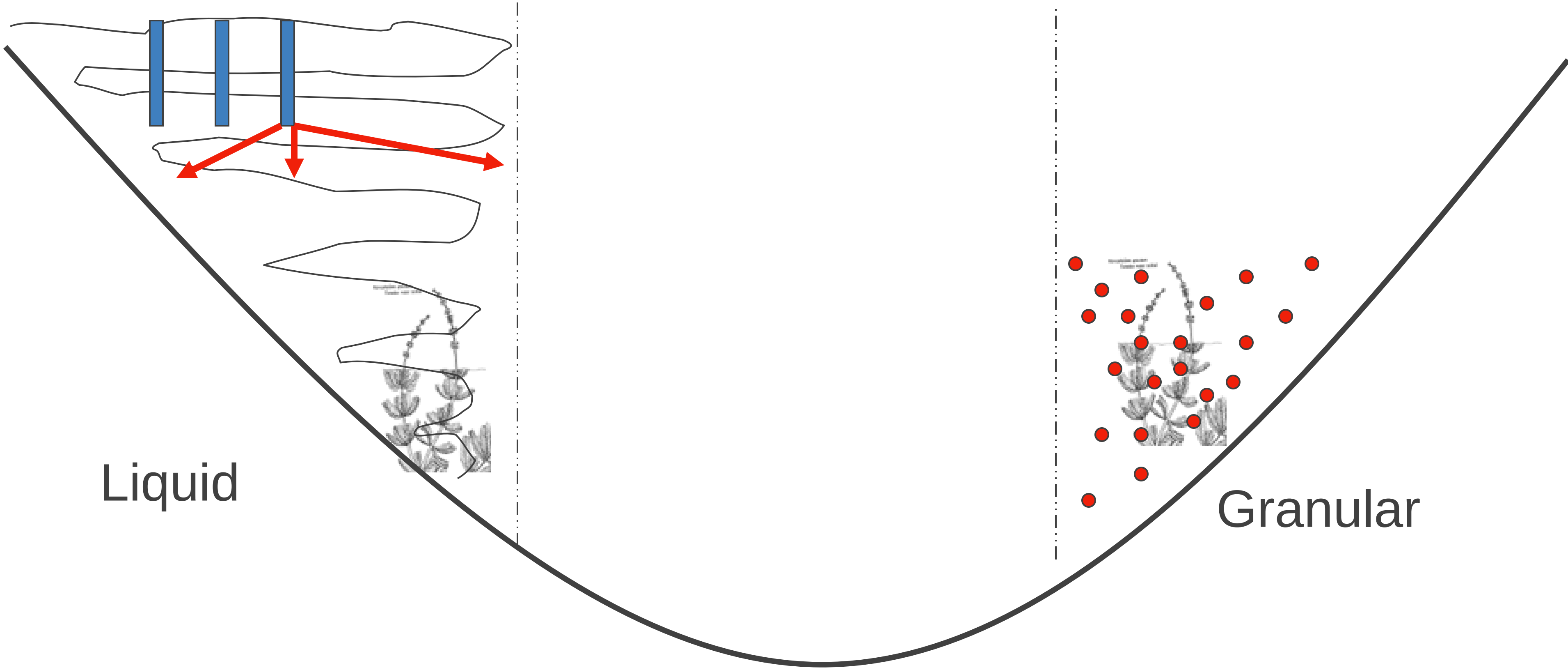
Compound	Year Registered	Mode of Action
2,4-D Ester	1959	Systemic – auxin mimic
2,4-D Amine	1976	
Copper	1950's	Contact – phs – membrane
Diquat	1962	Contact – PSII – membrane
Endothall	1960	Contact – Resp. – membrane
Glyphosate	1982	Systemic – protein synthesis
Fluridone	1986	Systemic – Enzyme inhibitor

Aquatic herbicides registered since 2002

Compound	Year Registered	Mode of Action
Triclopyr	2002	Systemic – auxin mimic
Imazapyr	2003	Systemic – ALS inhibitor
Peroxide	2003 (1980s)	Contact - algaecide
Carfentrazone	2004	Contact – Enzyme- membrane
Penoxulam	2007	Systemic – ALS inhibitor
Imazamox	2008	Systemic – ALS inhibitor
Flumioxazin	2010	Contact – protox
Bis-pyrobac	2012	Systemic – ALS inhibitor
Topramezone	2013 expected	Systemic – HPPD inhibitor

Source: USACE, ERDC

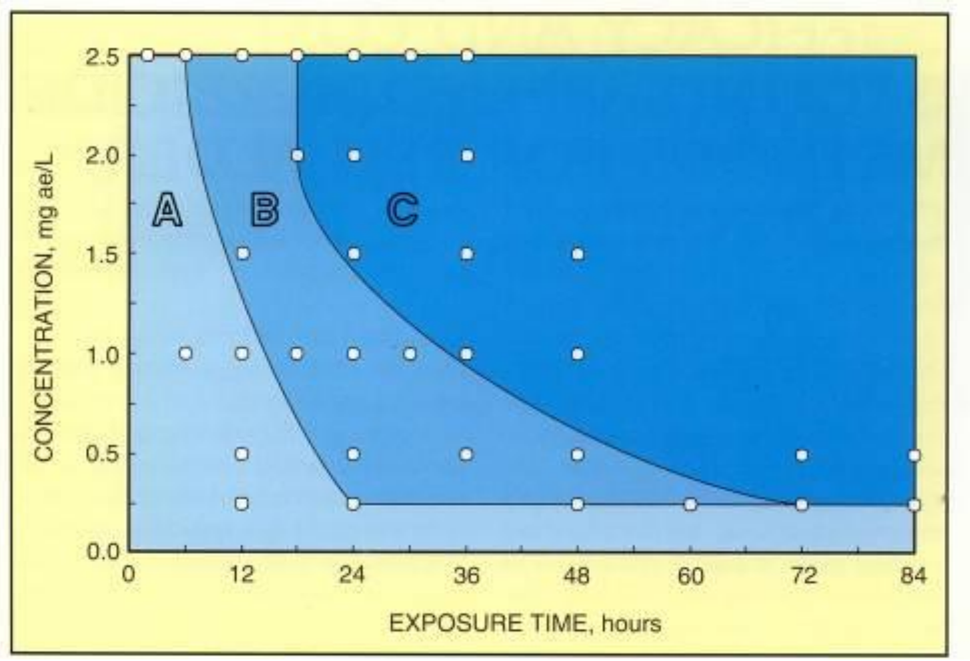
Different Formulations



Graphics courtesy of SePRO

Concentration Exposure Time (CET)

Source: US Army Engineers – ERDC



Untreated

1 WAT

4 WAT

Control Predictions

A: 0 - 70 % (regrowth likely)

B: 70 - 85 % (regrowth potential subject to site conditions)

C: >85 % (limited regrowth potential)

Clipper®

- active ingredient: **Flumioxazin**
- manufacturer: **Valent U.S.A. Corporation**
- Characteristics
  - Contact herbicide – rapid mode of action
  - Targets submersed and floating plants and some filamentous algae
  - Prefers low pH water
  - Fanwort (*Cabomba caroliniana)* control


Pre-Treatment
5/17/12
ALUMACRAFT


Post-Treatment
6/11/12

Summary – Invasive Aquatic Plant Control

- 8 new active ingredients registered by EPA for aquatic use since 2003 and more are on the way
- Rotate chemistries
- Use new products, new formulations and new approaches
- Manage invasive species using an integrated approach

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Nutrient Management

manage the PROBLEM
not the pest

Why Manage Algae?

Poor water clarity

Taste & Odor

Aesthetics

Recreational impairment

Diurnal Oxygen Fluctuations

Cyanobacteria Toxins (HAB's)

Nuisance Algae Control

Nuisance algae conditions are triggered by excessive nutrients – usually phosphorus

Control Algae (Treat the symptoms)

- Copper products, alternative algaecides
- Aeration

Control Nutrients (Treat the source)

- Increase N:P ratio / reduce favorability for cyanos
- Watershed management
- In-Lake Phosphorus Reduction

Why is Watershed Management Sometimes Not Enough?

- May take many years to make a difference.
- Difficult/Expensive to implement
- May not be feasible to lower nutrient concentrations below critical threshold.
- Contributions of internal recycling

Methods of In-Lake Phosphorus Reduction

- As an alternative to copper treatments until watershed management efforts come to fruition.

- Address ***internal recycling*** when it's a significant component of nutrient load.

Alum Treatment - What is Alum?

- Aluminum Sulfate
- Used extensively in the drinking water industry.
- Is not a herbicide or algaecide, but a chemical precipitant/coagulant that binds with phosphorus rendering it biologically unavailable.

Limitations of alum

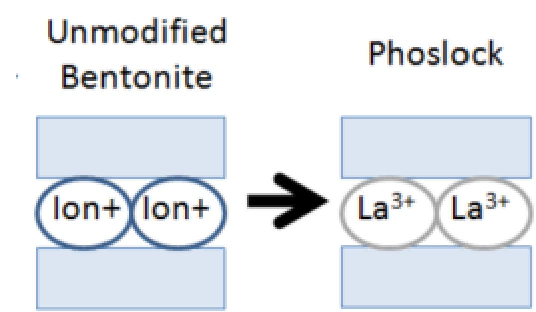
- Reaction causes drop in pH

- Must be buffered in soft/low-alkalinity water

- Even with buffering, there are still limitations for smaller and shallow lakes, so only phosphorus-**Precipitation** can occur and not phosphorus-**Inactivation** of the sediment

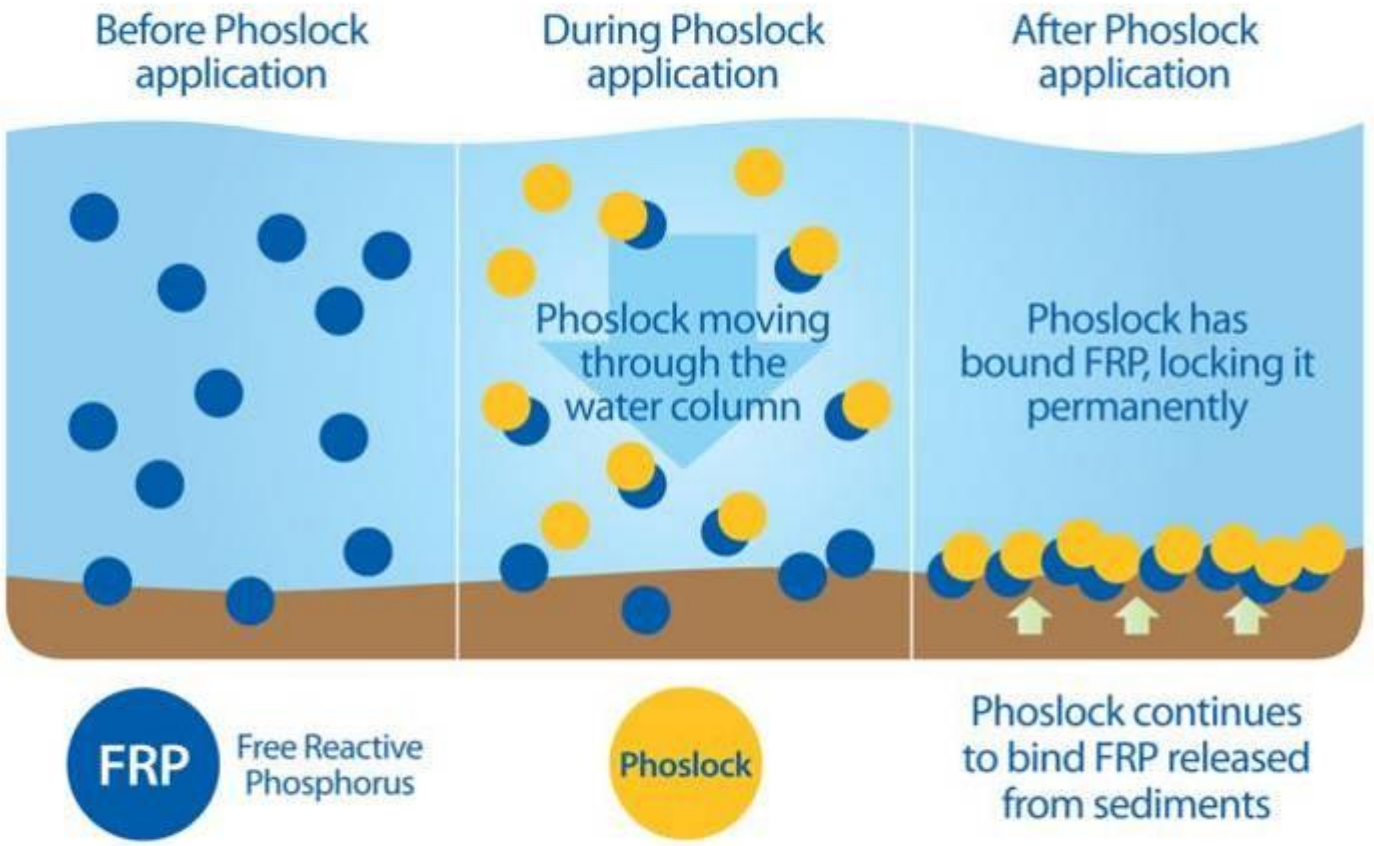
What is Phoslock?

- A patented technology which effectively binds and removes phosphorus
- Consists of two naturally occurring components found in soil
- Lanthanum embedded inside modified bentonite clay layers
- Stable and non-toxic technology



How Phoslock Removes Phosphorus

Removes Free Reactive Phosphorus (FRP)



Overview of Phosphorus Inactivation

- Precipitation/Recovery vs. Inactivation/Reset (Low vs. High Dose)
- Dose Determination (Multiple Methods)
- Dose Verification/Pilot Treatment
- Full-Scale Implementation
- Treatment Monitoring
- Post-Treatment Monitoring

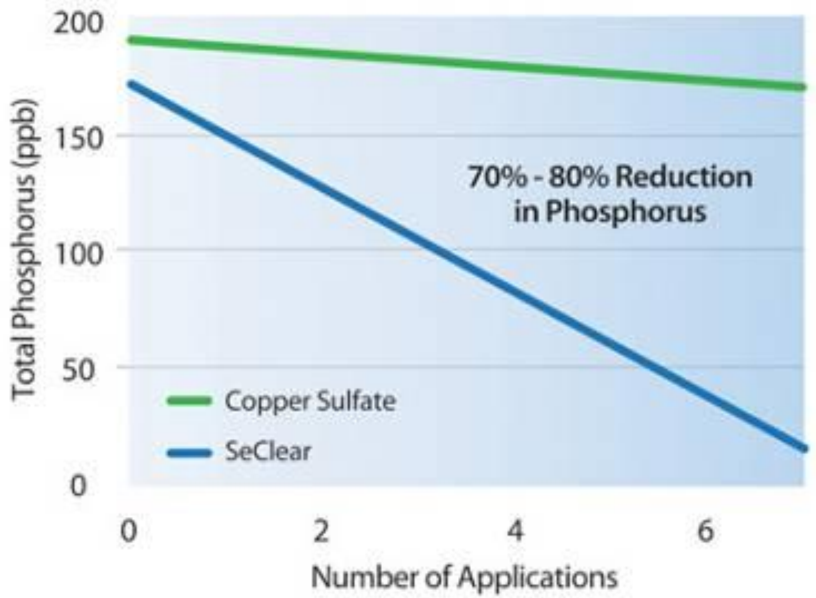
Alum Treatments

- Significant reduction of sediment phosphorus release (>90%)
- Improved water clarity
- No effects on mussels

Phoslock Applications

- Phoslock slurry injected or surface applied
- Tank mix granule with H2O, constant agitation
- Even coverage to maximize performance

SeClear® – Algaecide & Water Quality Enhancer



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7/28/2007
N
Google earth
1995
Imagery Date: 7/28/2007 42°36'29.81" N 71°08'13.99" W elev 79 ft eye alt 5837 ft

Summary – Algae Control & Nutrient Management

- There is excessive phosphorus in Foster's Pond
- Internal recycling vs external loading needs to be identified
- Algaecide treatments control the symptom
- Phosphorus removal can target the cause
- Alum or Phoslock can be considered for phosphorus removal
- SeClear is an option for maintenance treatments

ONGOING MANAGEMENT WILL BE NEEDED TO CONTROL NUISANCE WEEDS AND ALGAE

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Important dates in the regulation of aquatic herbicides

- 1910 – Federal Insecticide Act
- 1947 – FIFRA administered by USDA
- 1962 – “Silent Spring” by Rachel Carson
- 1970 – EPA created
- 1972 – Federal Environmental Pesticide Control Act
- 1988 – FIFRA amended to require re-registration
- 1996 – Food Quality Protection Act amended both FIFRA and FFDCA requires EPA to reevaluate all tolerances for pesticides and inerts
- 2008 – EPA completed reregistration of all products registered prior to 1984; 15-year renewal cycle


04/27/2010