

The Aptly Named Mystic Lake: Strange Happenings but Active Management



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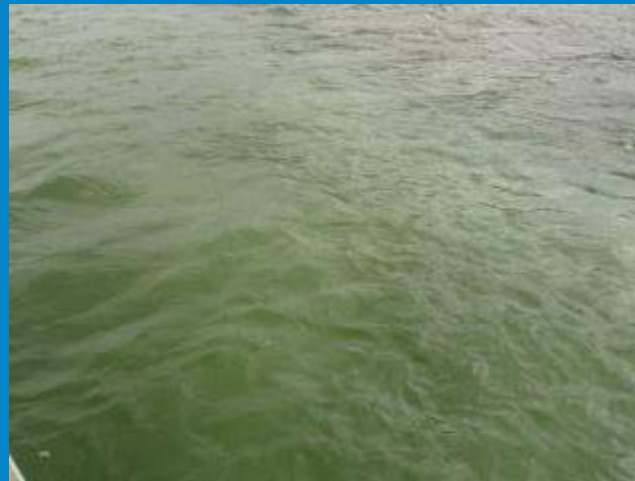
Background

- Indian Ponds: 3 kettlehole ponds in Barnstable on Cape Cod
- Mystic and Middle considered pristine 15 years ago
- Hamblin impacted by duck farm from 1st half of 20th century, severe cyano-blooms. Treated with aluminum in 1995, clarity high for last 15 years.
- Mystic and Middle have declined, with severe cyano-blooms over last few years. Trigger(s) for recent decline not obvious
- Regulatory inertia



Background

- Blooms of *Aphanizomenon*, *Anabaena* and *Planktothrix* in 2009 and 2010
- Benthic mats of Cyanos as well
- Major mussel die off in 2009, more in 2010
- “Lethargy” of surviving mussels
- Nerve toxin suspected



Related Features and Issues



High iron in deep water



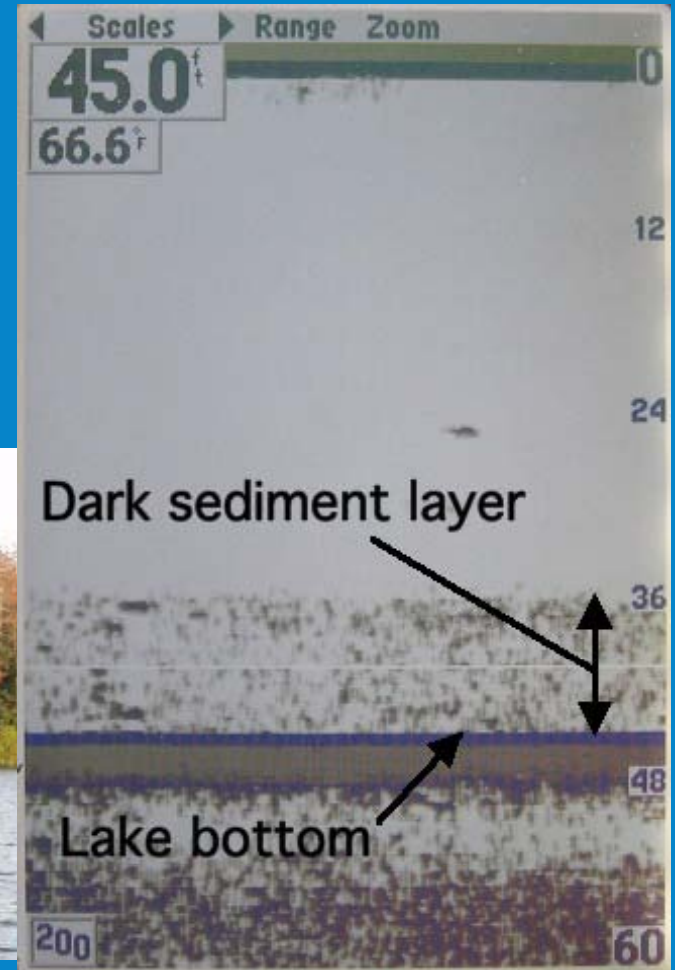
Organic muck



Dead trees



Mussel shell erosion



Deep suspended sediment layer

Is there some connection here?

Data Review



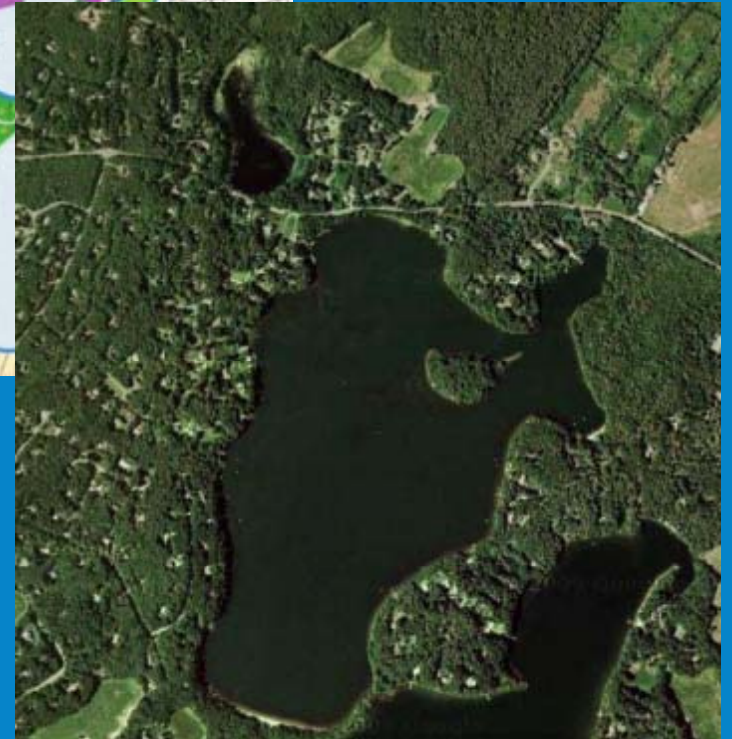
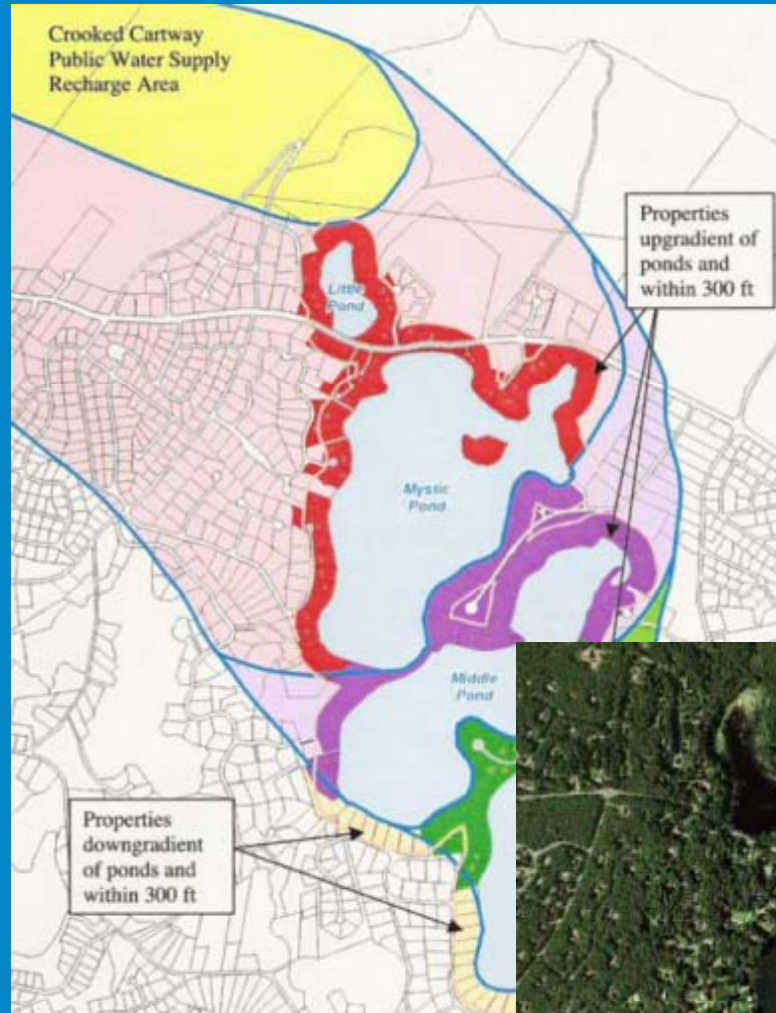
- Lake layer interactions – major difference in thermocline depth and oxygen status between 2008 and 2009
- Deep algal layer in 2008, rose into upper waters in 2009
- Increasing alkalinity since at least 2004

Dissolved Oxygen			Chlorophyll a		
Depth (m)	8/19/2008	8/24/2009	Depth (m)	8/19/2008	8/24/2009
0.5	8.1	9.3	0	2.4	31.8
1	8.3	9.3	1		
2	8.3	9.2	2		
3	8.3	9.0	3	1.7	40.6
4	8.3	8.4	4		
5	8.2	0.2	5		
6	8.3	0.1	6		7.9
7	8.8	0.1	7		
8	8.7	0.1	8		
9	0.2	0.1	9	146.3	10.7
10	0.1	0.1	10		
11	0.1	0.1	11		3.7
12	0.1	0.1	12		
13	0.1	0.1	13	2.4	

	Alkalinity (mg/L)				
	2004	2007	2008	2009	2010
Mean 0-8 m	6	12	14	20	19
Mean >10 m	17	13	33	44	44

Background

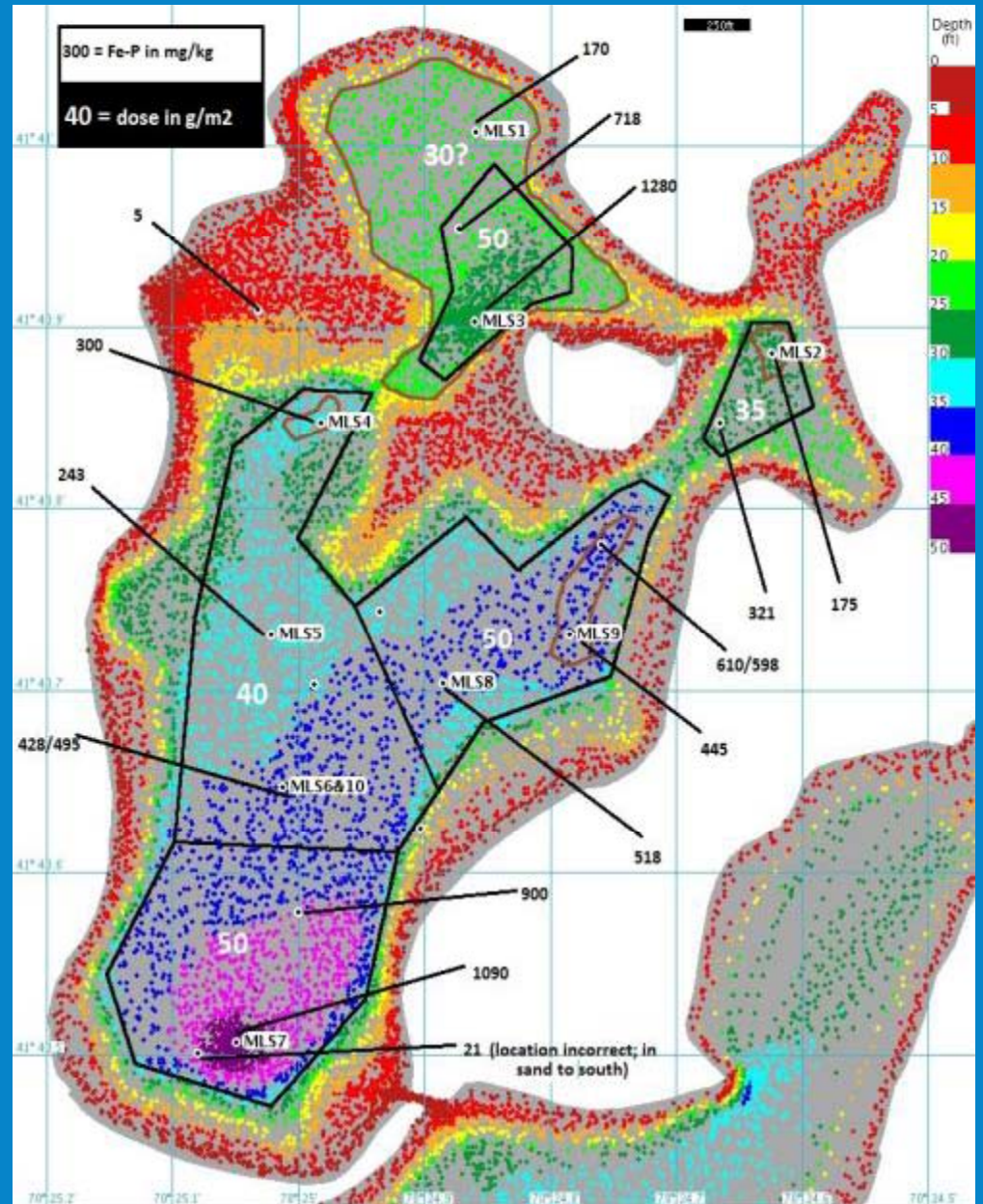
- No major land use changes in 3 decades, reduced influence from agriculture
- N inputs from development may be significant, but nature of blooms suggests P overload
- Internal loading of P implicated in algal blooms



Treatment Prep



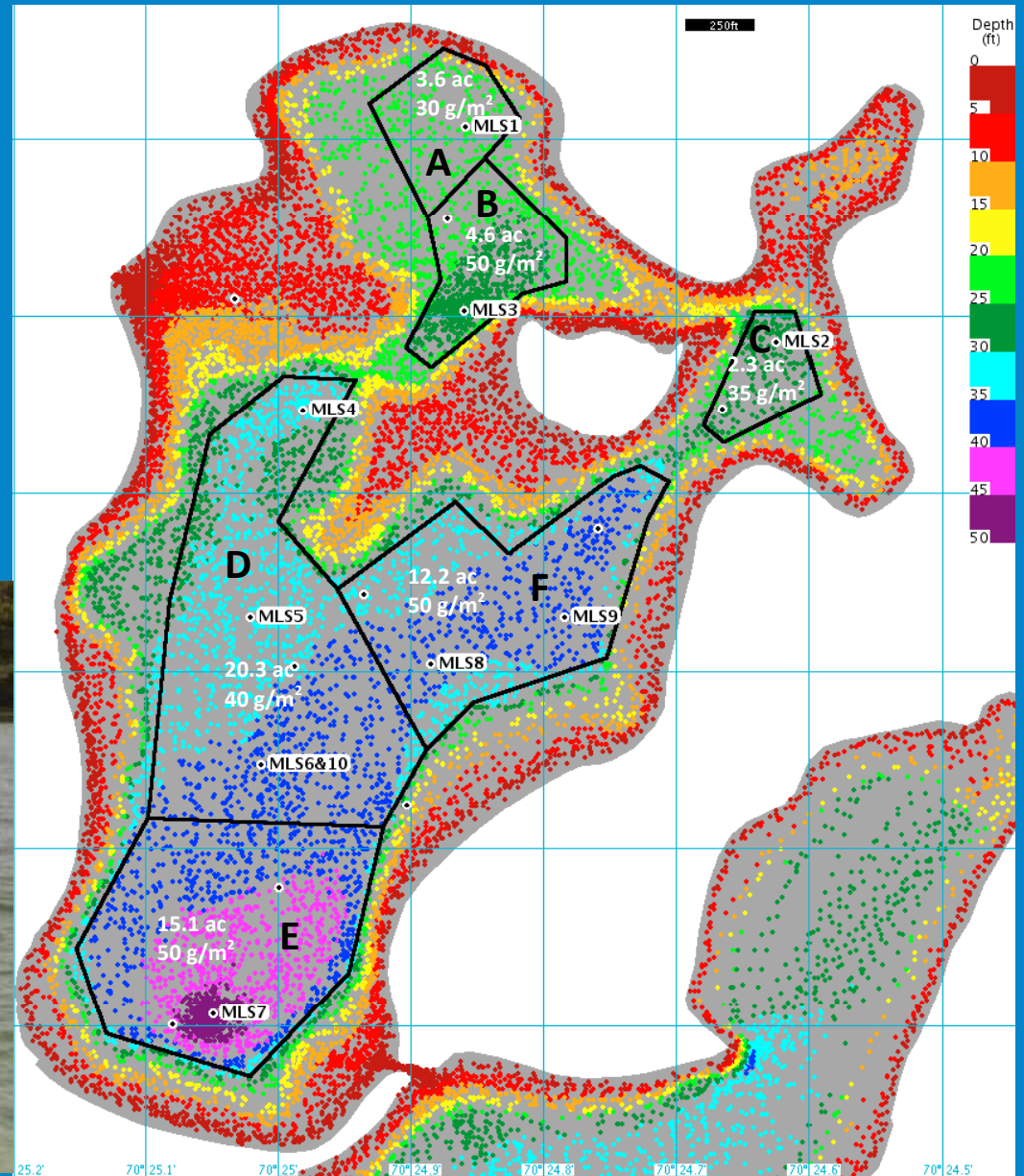
- Available sediment P tested, values in target areas range from 170 to 1280 mg/kg
- Aluminum doses of 30 to 50 g/m² set for 6 target zones covering about 60 acres
- Includes area at north end that is between 20 and 25 ft deep, suitable mussel habitat, to assess impacts of treatment on mussels



Treatment



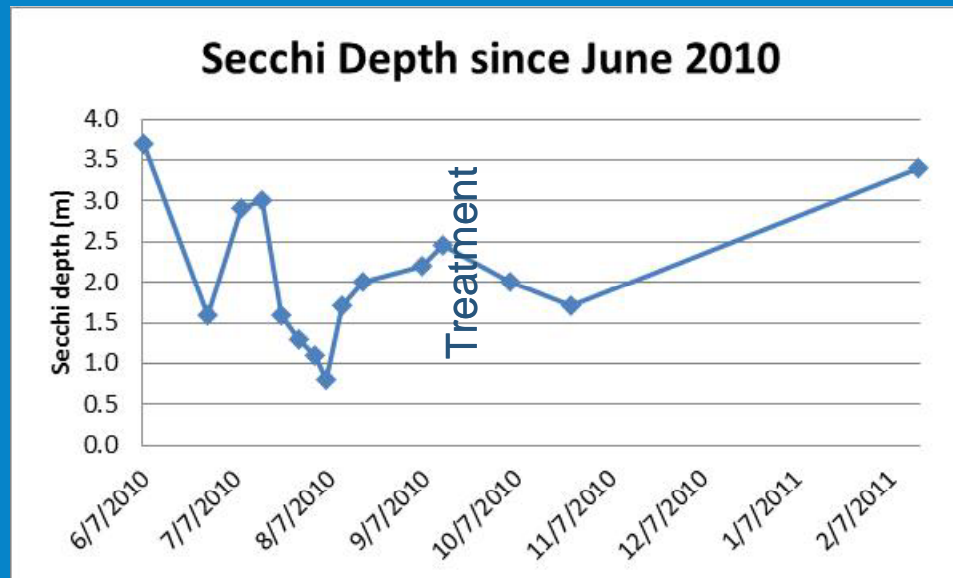
- Performed by ACT in late Sept/early Oct 2010
- 21,002 gal alum, 10,553 gal aluminate applied
- No apparent mortality to fish or mussels after extensive monitoring



Post-Treatment Prognosis



- No immediate improvement in clarity
- Fall algae mainly chlorophytes, not cyanobacteria; diatoms and greens in winter
- Phosphorus data indicate major reduction near bottom, slower shift in average P over whole lake
- Treatment did not harm biota, but success of fall P inactivation is not determinable until the next summer



Lessons Learned



- All actions, including doing nothing, have consequences. Not acting can be worse than acting with incomplete information. Not permitting an action may not prevent harm.
- Aquatic systems are not static. A system in fine condition this year may not stay that way, even without any obvious stressors.
- Adequate data, analyzed and interpreted quickly, is a great asset in management programs