

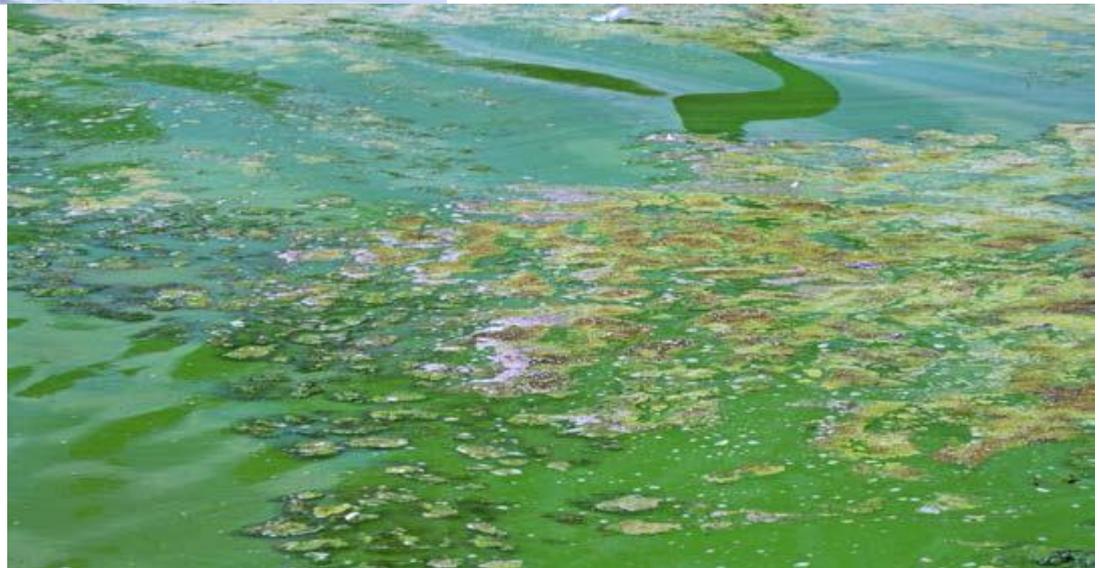
Blue-Green Algae: Pretty Name, Big Trouble



Tom Stiles, KDHE-BOW
2015 Kansas Environmental Conference
August 20, 2015

08.17.2015 09:56

Blue-Green Algae = Cyanobacteria



Defining Cyanobacteria

**Structurally like Bacteria
(Unicellular, no Nucleus)**

**Functionally like Algae
(Aquatic, Photosynthetic)**



Not Everything Green is Cyanobacteria

Duckweed - *Lemna*

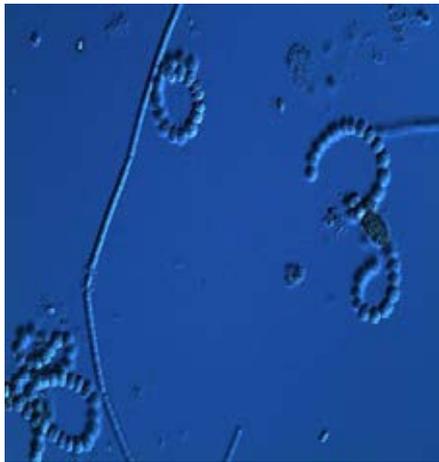


Green Algae Washed Ashore



The Big Three: Annie, Fanny and Mike

Anabaena



Aphanizomenon



Microcystis



And this Persistent Bugger: Planktothrix (Oscillatoria)



Ok, What's the Big Deal?

Aesthetics for Starters Puts the Wreck in Recreation



The Bigger Deal is Public Health: Cyanos Produce Toxins

- ◆ Over 100 forms of Microcystin – hepatotoxin, predominant toxin
- ◆ Cylindrospermopsin – hepatotoxin
- ◆ Numerous Anatoxins – neurotoxin
- ◆ Saxitoxins – chiefly marine, but can be produced by freshwater cyanobacteria
- ◆ All have dermatotoxic effects on individuals with varying sensitivities; many cause gastrointestinal distress
- ◆ Microcystin and Cylindrospermopsin can be analyzed with ELISA kits
- ◆ Specific forms and other toxins need to be analyzed through Liquid Chromatography/Mass Spectrometry

So Many Weapons

Cyanobacteria	Hepatotoxins		Neurotoxins		Dermatotoxins
	Cylindrosprum	Microcystin	Anatoxin	Saxitoxin	Dermatotoxins
<i>Anabaena</i>	X	X	X	X	X
<i>Aphanizomenon</i>	X		X	X	X
<i>Microcystis</i>		X			X
<i>Planktothrix</i>		X	X	X	X

What's Safe? What's Harmful?

- ◆ World Health Organization – Microcystin LR
 - Finished Drinking Water for a Lifetime: 1 µg/L
 - Recreation Low Risk: 4 µg/L or 20K cells/ml
 - Recreation High Risk: 20 µg/L or 100K cells/ml
- ◆ EPA Public Health Advisory under SDWA
 - Microcystin in drinking water
 - 0.3 µg/L for preschoolers;
 - 1.6 µg/L for older children & adults
 - Cylindrospermopsin in drinking water
 - 0.7 µg/L for preschoolers
 - 3.0 µg/L for older children & adults
 - Working on anatoxin and recreation values

KDHE Thresholds

- ◆ Recreation (modeled after NWS tornado alerts)
 - HAB Watch: > 4 $\mu\text{g/L}$ or 80K/ml cell counts
 - HAB Warning: > 20 $\mu\text{g/L}$ or 250K/ml cell counts
 - Recommended Closure: > 2000 $\mu\text{g/L}$ or 10M/ml cell counts

- ◆ Public Water Supply (follow WHO & EPA guidelines)
 - Microcystin & Cylindrospermopsin
 - Has not been an issue for PWS
 - Treatment with activated carbon has been effective
 - Cyanotoxins not prevalent in river systems

WATCH

Harmful Algae May Be Present

Blue-Green Algae May Be Harmful To Humans & Animals



Keep Pets & Livestock Away From The Water

- Use caution when contacting lake water and wash with clean water afterward
- Avoid areas of algae accumulation
- Don't let people/pets eat dried algae or drink untreated lake water
- Clean fish well and discard guts

In case of harmful algae contact, call doctor/veterinarian if people/animals have nausea, vomiting, diarrhea, rash, irritated eyes, seizures, breathing problems or other unexplained illness



For more information:
Scan this code or visit
kdheks.gov/algae-illness

Report new algae-blooms to
Kansas Department of Health and
Environment:
www.kdheks.gov/algae-illness
or call
785-296-1664

Report possible algae-bloom illness
to Kansas Department of Health
and Environment:
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or call
877-427-7317

Posted by:

Posted on:

Kansas Dept. of Health and Environment 1000 SW Jackson, Topeka, Kansas 66612, 785-296-1500 www.kdheks.gov

WARNING

Harmful Algae Present

People & Animals May Get Sick



**Avoid Water Contact
Such As
Swimming & Wading**



**Avoid Water Skiing
or
Jet Skiing**



**Keep Pets &
Livestock Away
From Water**

- Avoid areas of algae accumulation
- Clean fish well and discard guts
- Don't let people/pets eat dried algae or drink untreated lake water
- If people/pets contact lake water- wash with clean water as soon as possible

In case of harmful algae contact, call doctor/
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DANGER

BEACH CLOSED

Harmful Algae Present

People & Animals May Get Sick



STAY OFF BEACH

In case of harmful algae contact, call doctor/
veterinarian if people/animals have nausea, vomiting,
diarrhea, rash, irritated eyes, seizures, breathing
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DANGER

LAKE CLOSED

Harmful Algae Present

People & Animals May Get Sick



KEEP OUT OF LAKE

In case of harmful algae contact, call doctor/
veterinarian if people/animals have nausea, vomiting,
diarrhea, rash, irritated eyes, seizures, breathing
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The First Step: The Jar Test



Refrigerate Overnight & Observe

Clear, No BGA



Ring @ Top, BGA Present



A Routine Week

- ◆ Monday: Investigate reported blooms and collect samples; overnight send samples to Topeka
- ◆ Tuesday: Receive samples, preserve with Lugol's and freeze portion overnight to lyse cells
- ◆ Wednesday: Count cells and run ELISA tests for microcystin and cylindrospermopsin; enter results in data management system
- ◆ Thursday: Complete remaining analyses; internally distribute results; stakeholder call in afternoon to decide status of lake going into weekend; update public information
- ◆ Friday: Schedule lakes for Monday sampling

Biggest Issue: Blooms Move

Vertical Migration or Wind Movement of Surface Accumulations May Rapidly Change the Spatial Distribution of Cyanobacteria

**Rock Creek Lake, Iowa
2006 Beach Closure Event**



**Beach Area
Monday
July 31**



Photos Courtesy of IA DNR



Photo Courtesy of IA DNR

**Beach Area
Thursday
August 3**

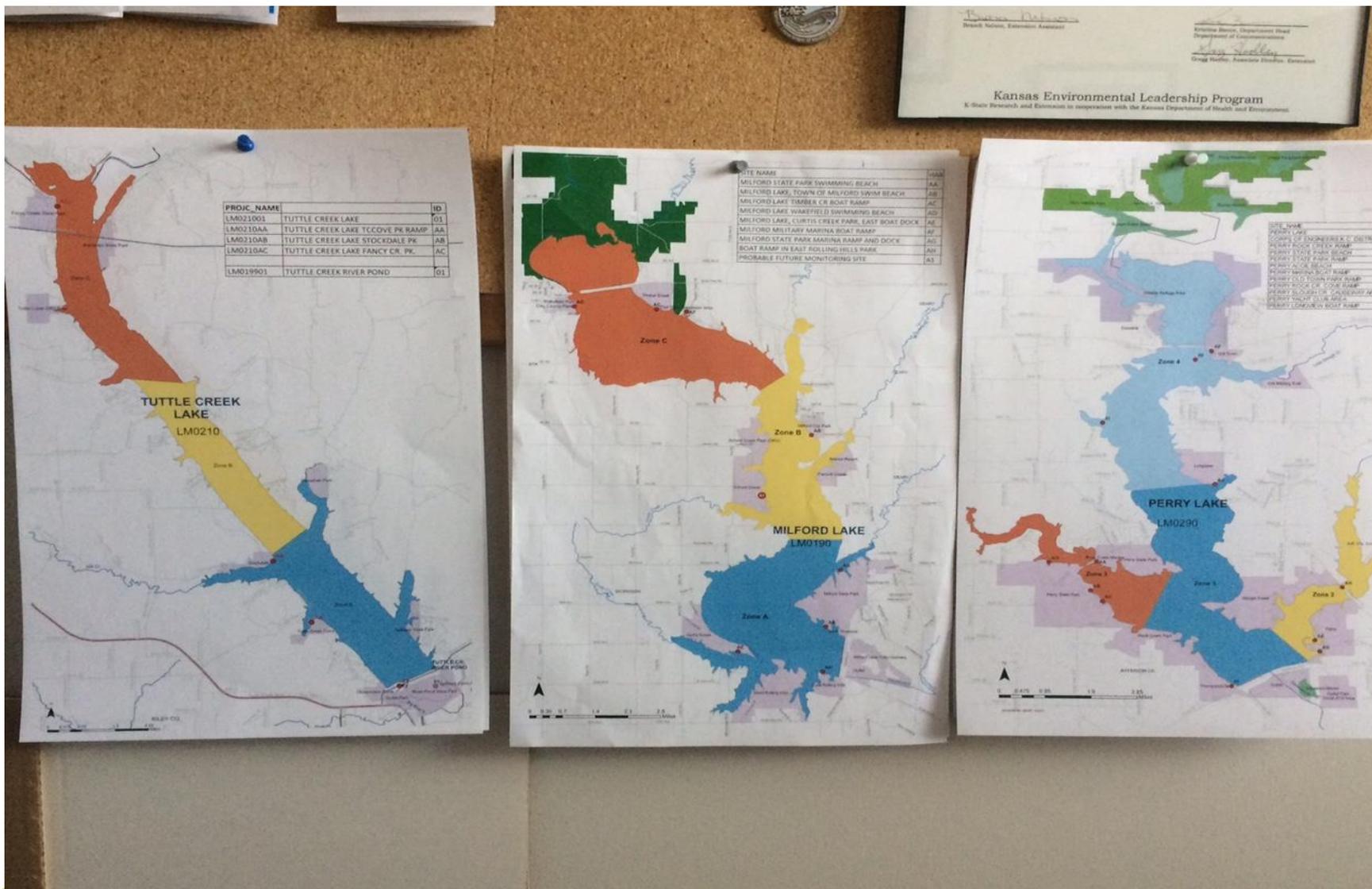


**Boat Ramps
Friday
August 11**

Mitigating the Bloom Dynamics

- ◆ Treat most lakes as solitary unit: whole lake is assigned status regardless of location of bloom
- ◆ Recognize that while blooms may move, they may leave toxins behind
- ◆ Messaging is keyed toward public awareness and some assumption of risk
 - Watch: swim and boat as you please, but have your head on a swivel
 - Warning: beaches should be closed, but boating and fishing out in lake still ok, with caution
 - Closure: bloom is overwhelming and not only should you not be in it, you shouldn't be near it (spray, mist, odors)
- ◆ Local managers have discretion to post/preclude beaches and ramps as they see fit
- ◆ Certain lakes can be zoned

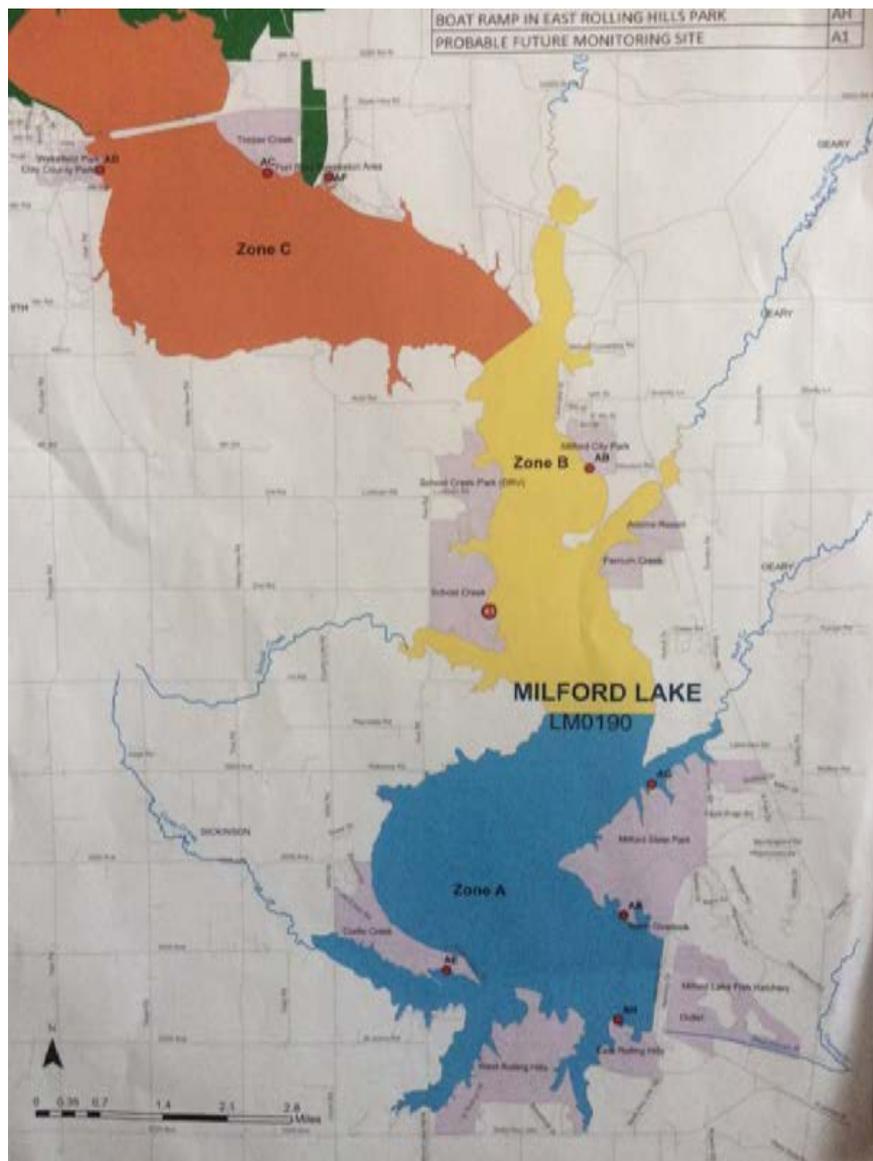
Lake Zones are Quasi-Independent



Debra DeLeon
 Kansas State Department of Health
 Department of Environmental Health Services
 Environmental Health Services
 Greg Miller, Associate Director, Extension

Kansas Environmental Leadership Program
 K-State Research and Extension in cooperation with the Kansas Department of Health and Environment

Milford Lake has been Poster Child of Kansas BGA



Our Mission: To Protect and Improve the Health and Environment of all Kansans

This Year, Got thru Cabela's Walleye Tournament, the State HS Championship & Fourth of July, and then...

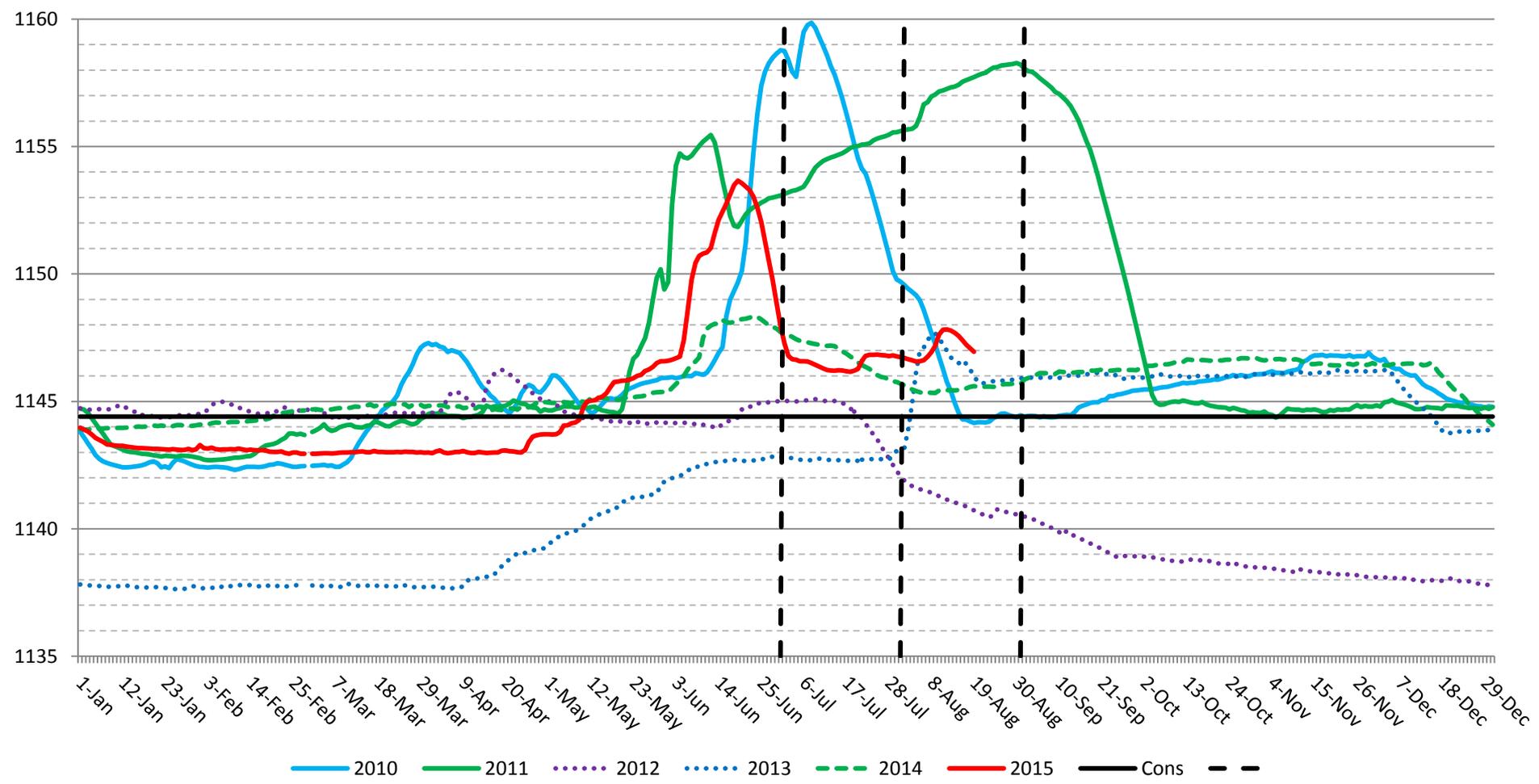


2015 Milford Lake Conditions (Cell Counts/Microcystin)

Zone	A		B	C	
Site	State Park Beach	Thunderbird Marina	Milford Beach	Timber Creek Ramp	Wakefield
July 13	612K/30	7K/0.5	456K/5	77M/6000	40K/0.5
July 20	833K/15	9K/0.5	268K/5	2M/140	1.7M/30
July 27	144K/4	32K/1	559K/6	4.9M/300	3.6M/30
Aug 3	412K/6	31K/0.5	138K/6	1.3M/25	696K/20
Aug 10	9K/0.5	333K/20	177K/6	8K/0.5	568K/45
Aug 17	75K/3	63K/0.5	340K/10	3.1M/150	743K/50

Water Levels Influence Bloom Formation

Milford Lake 2010-2015 Daily Elevations

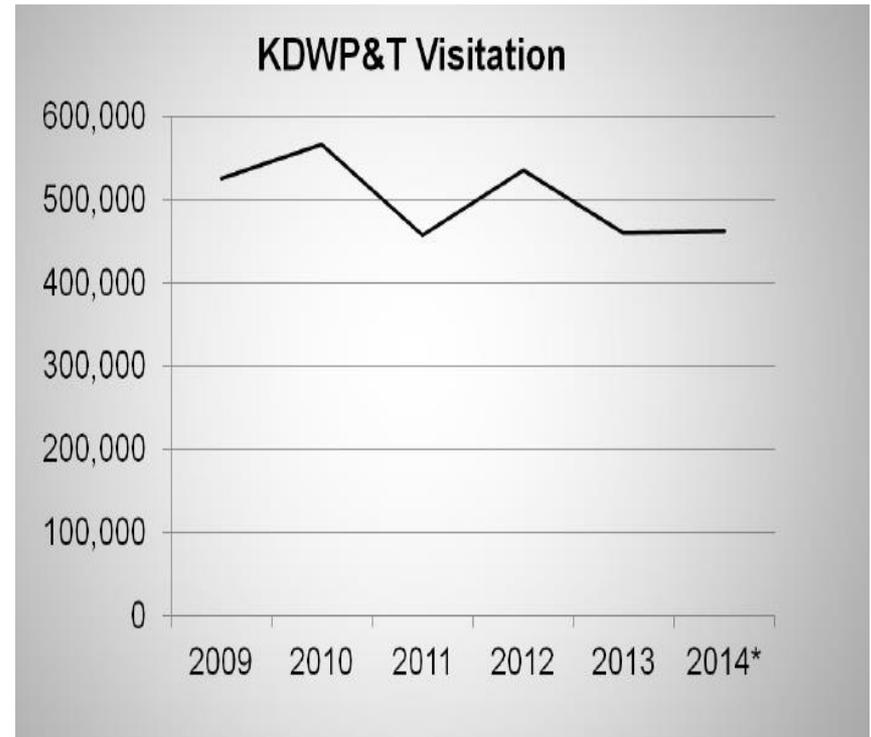
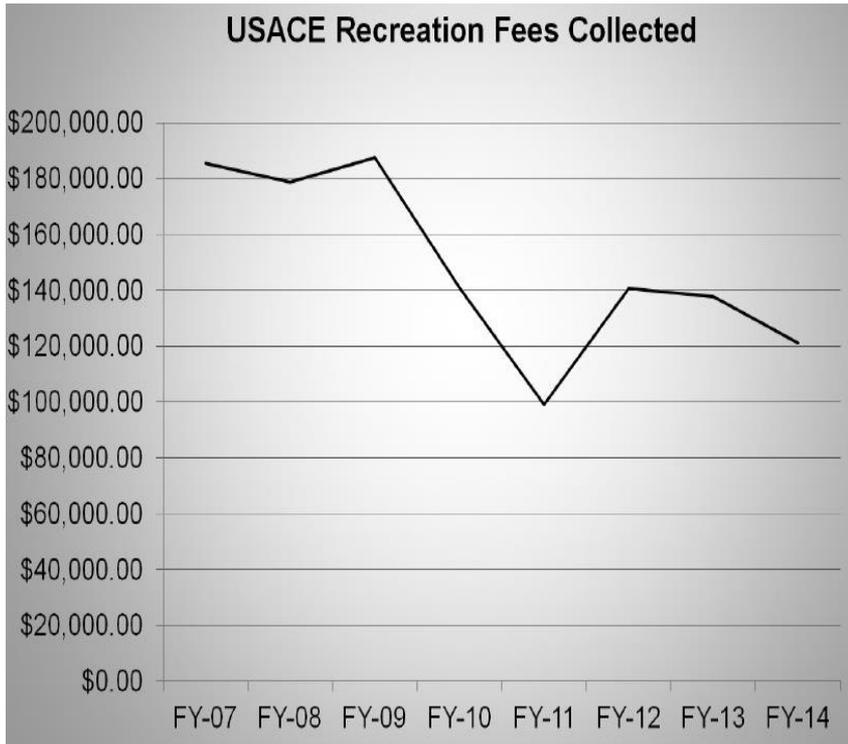


Bloom Frequency and Persistence Varies

Year	Milford	Marion
2015	42 days and counting	35 days
2014	133 days	48 days
2013	28 days	42 days
2012	35 days	77 days
2011	87 days	35 days

Marion blooms tend to start in June and finish by the end of July; Milford blooms have started in June except this year and 2011 and run into Autumn. New KDHE thresholds would drop the numbers somewhat for past years.

And Recreation has Suffered



And for some towns, property values have been hurt, too

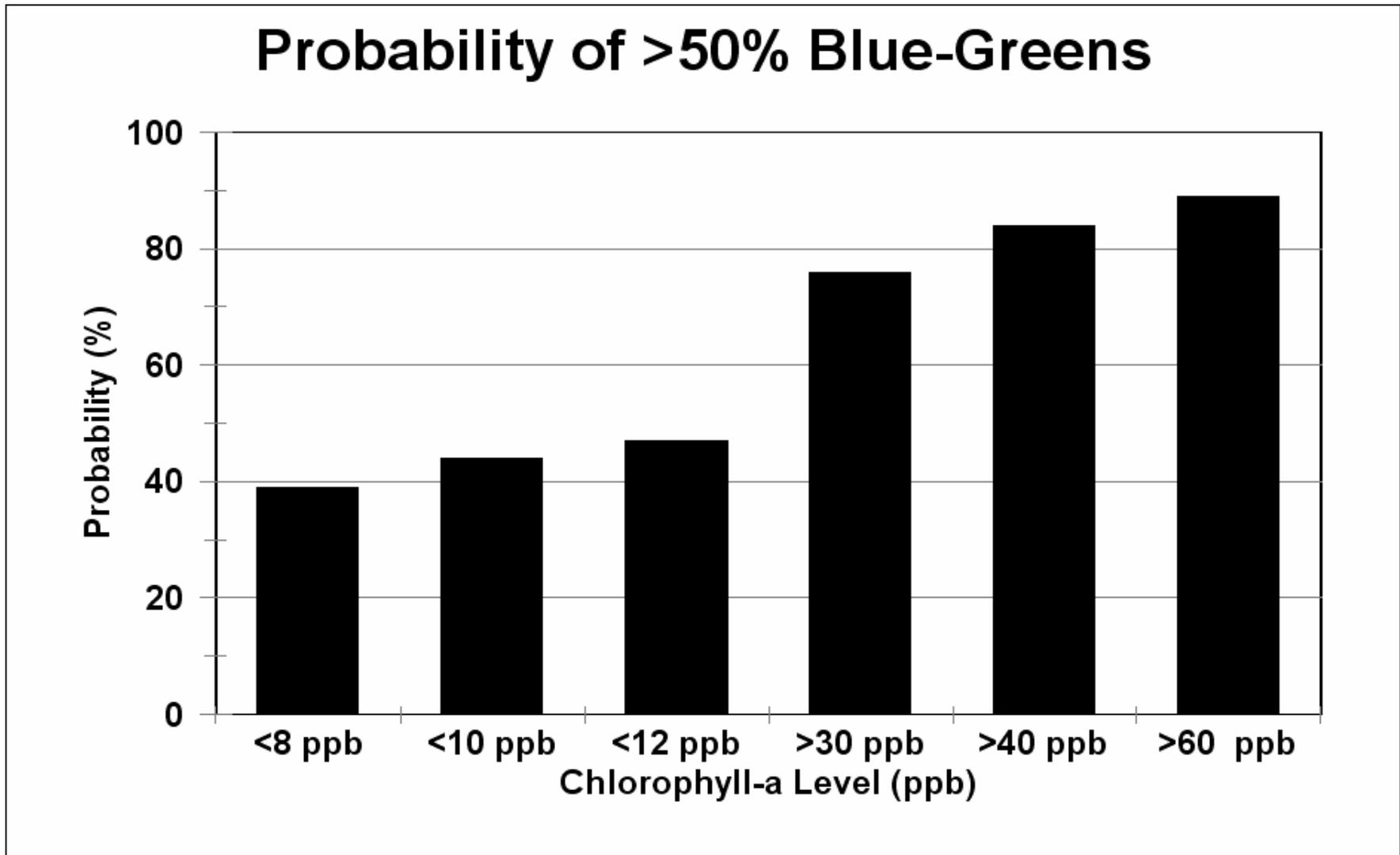
This has been building for some time

Table 7. Algal Communities observed in Milford Lake during KDHE sampling years.

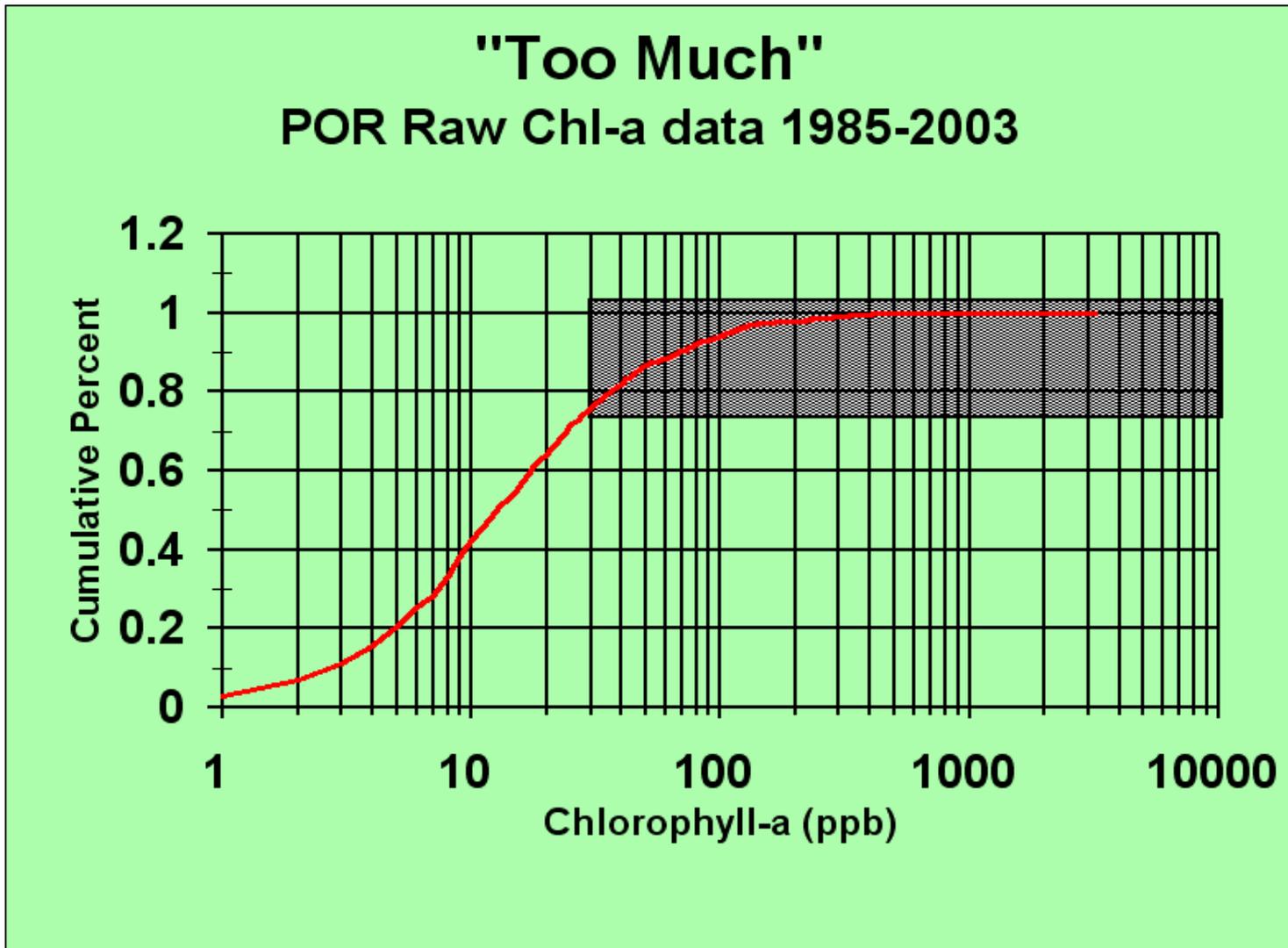
Sampling Date	TSI Chl-a	Total Count (cells/ml)	Percent Composition			
			Green	Blue Green	Diatom	Other
1991	55	12400	18	74	8	<1
1994	41.6	1450	65	0	0	35
1996	48.2	2898	15	76	7	2
1997	51.1	7277	10	82	8	<1
1998	56.8	9041	34	50	3	13
2000	51.7	4914	35	59	5	1
2003	57.5	24224	16	83	<1	<1
2006	51.2	23342	<1	99	<1	0
2009	67.4	151893	3	96	1	0
2012	72.0	233730	1	92	0	6



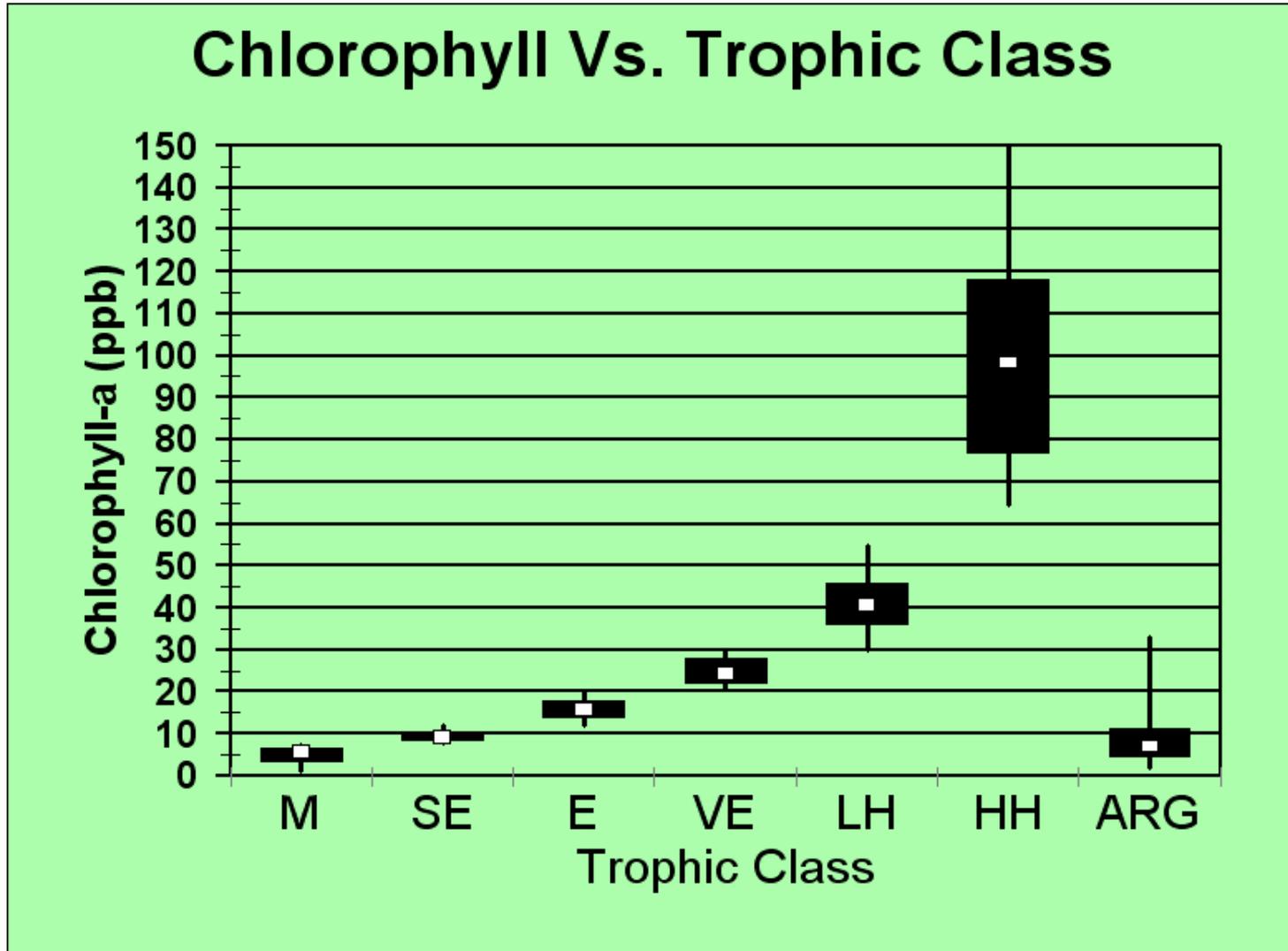
Increased Trophic State Invites BGA



Once we're past 20 ppb chl a...

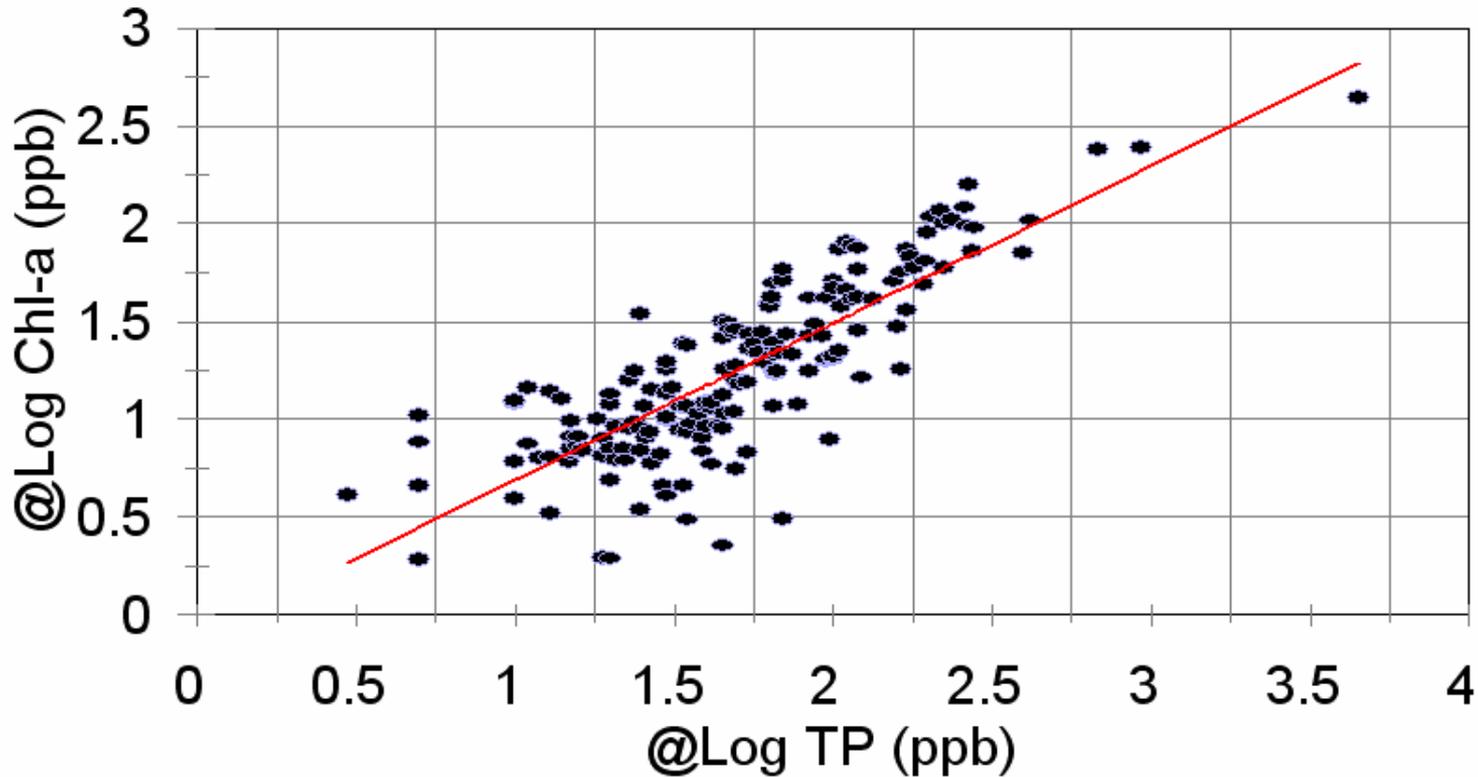


Very Eutrophic & Hypereutrophic Lakes Vulnerable

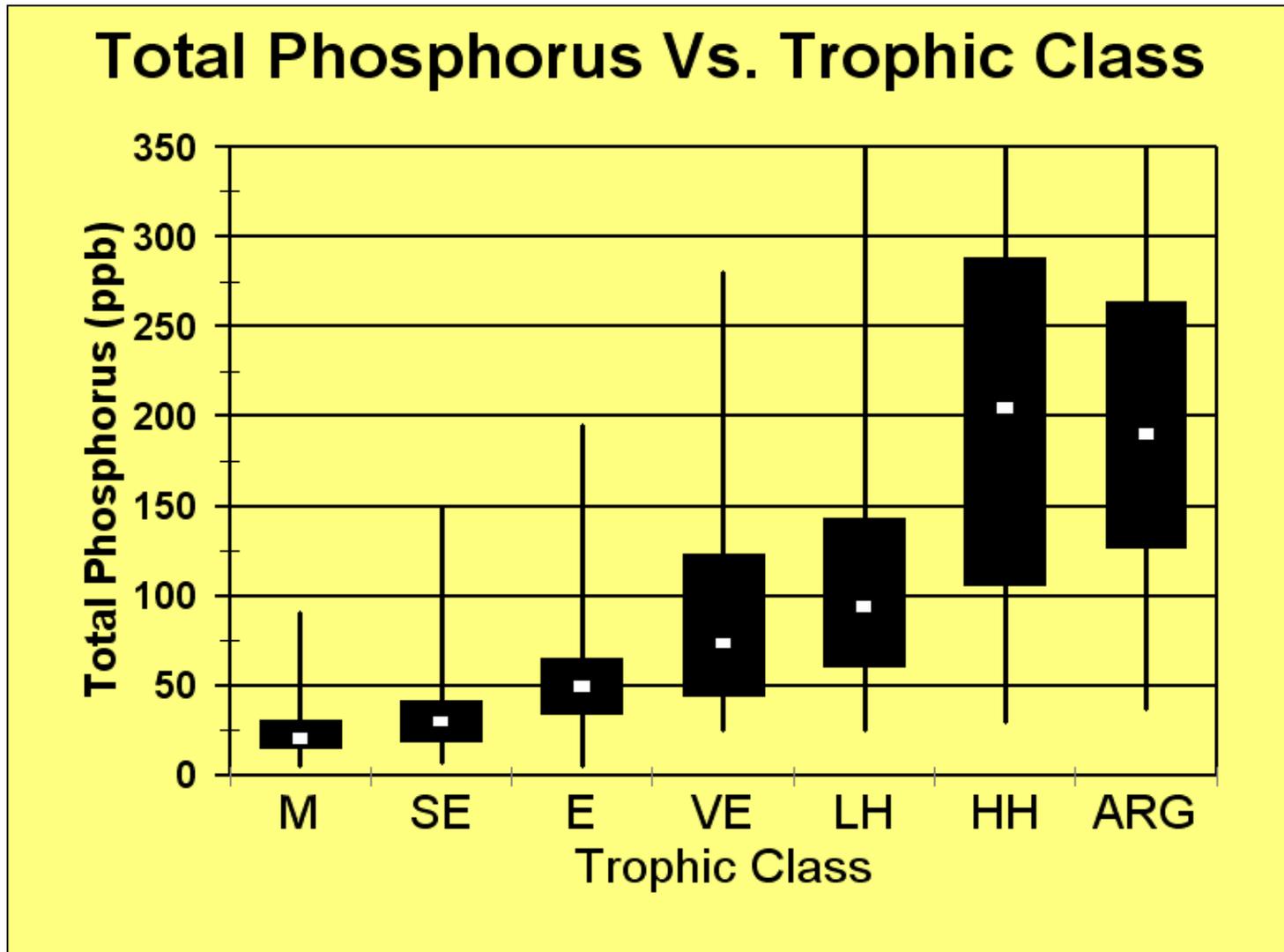


Algae are tied to Nutrients

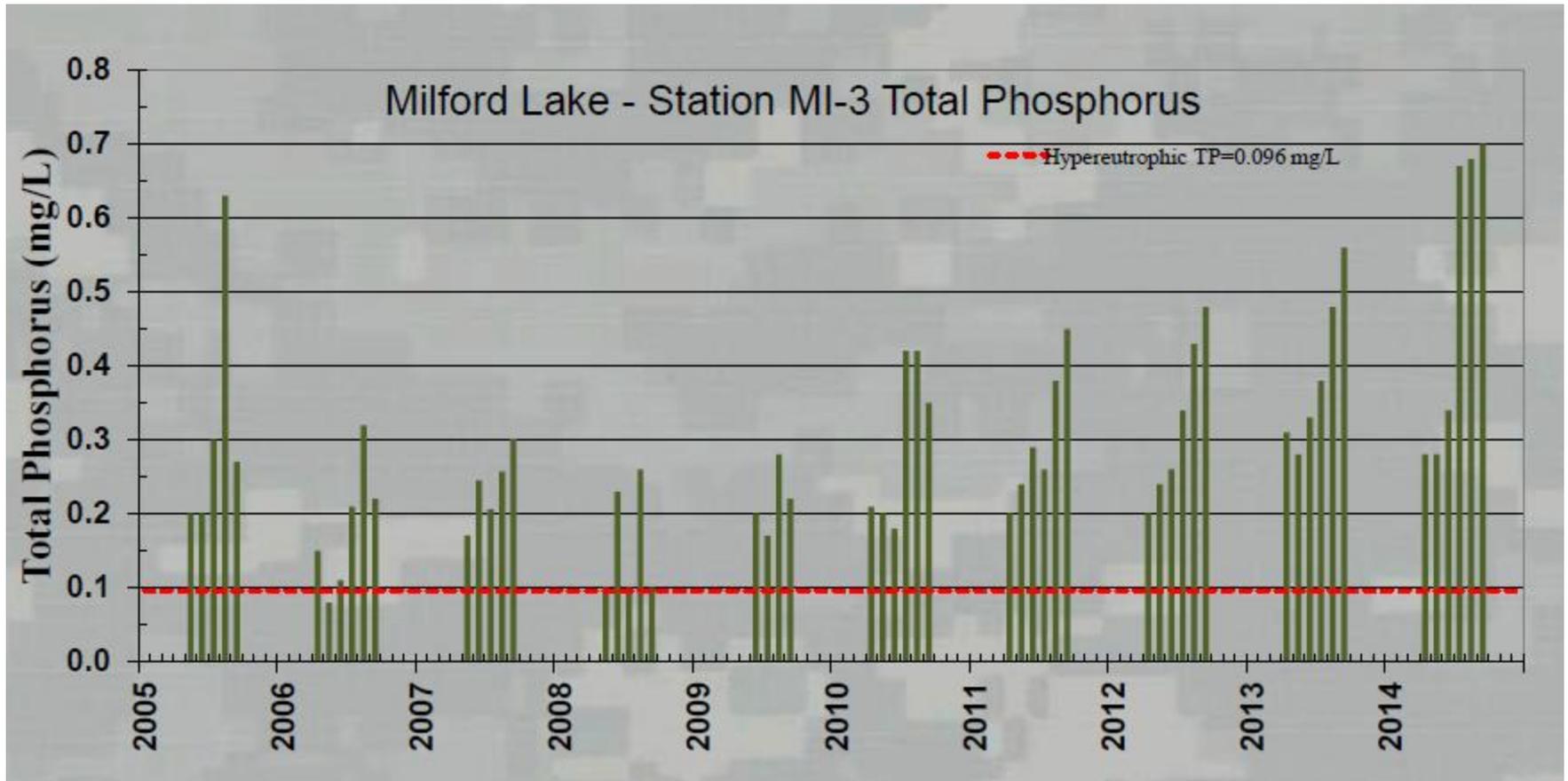
Chlorophyll-a Vs. TP



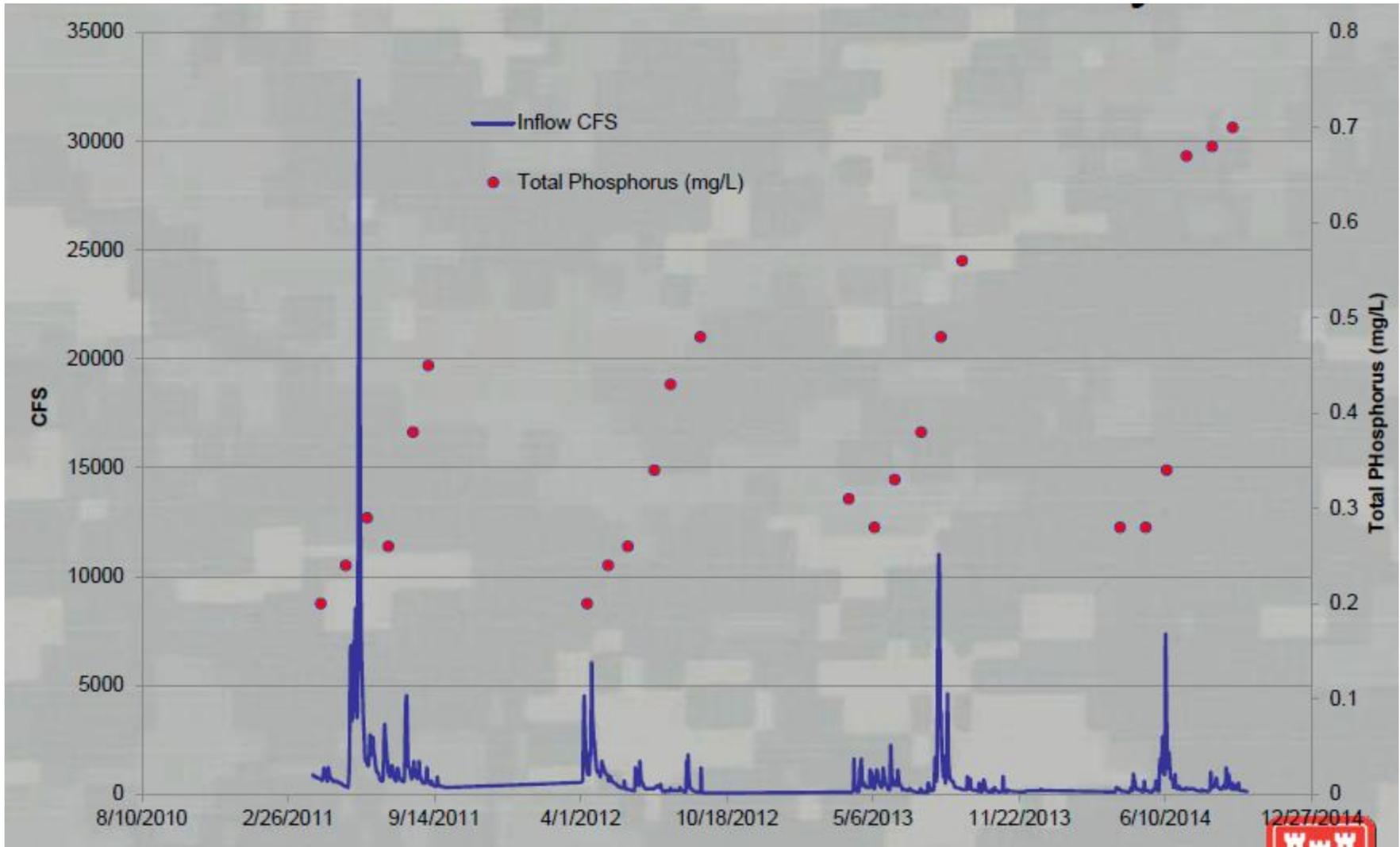
In-lake TP over 50 ppb Problematic



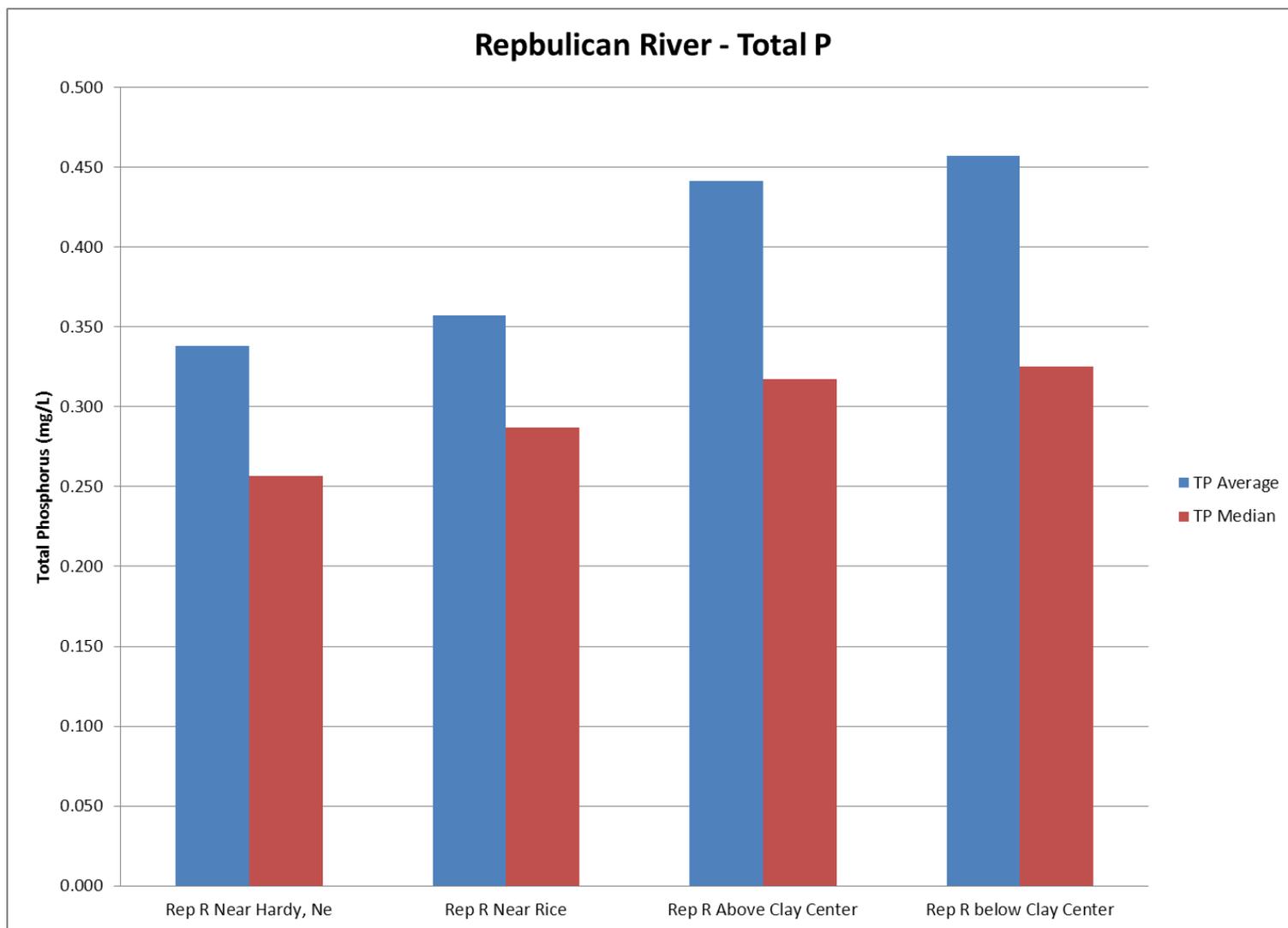
Milford is always over 50 ppb & it's on the rise



Phosphorus increases late in season



Geographically, the Republican comes into KS warm & gets hotter



Takes more than muddy water to knock out a bloom



Reduction of Nutrient Inputs is a big job

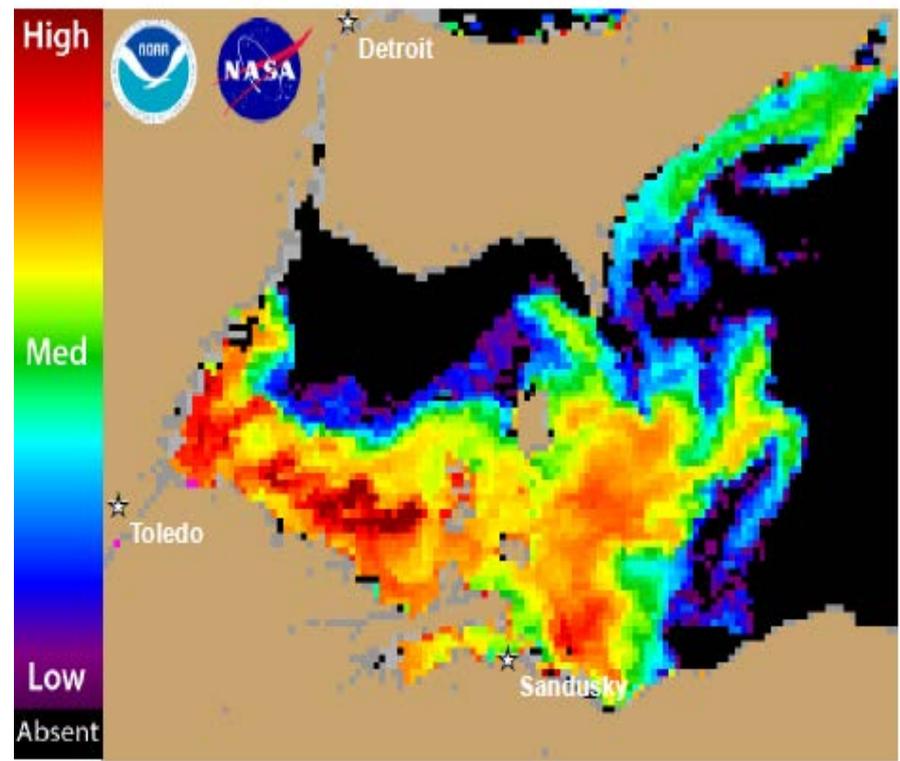
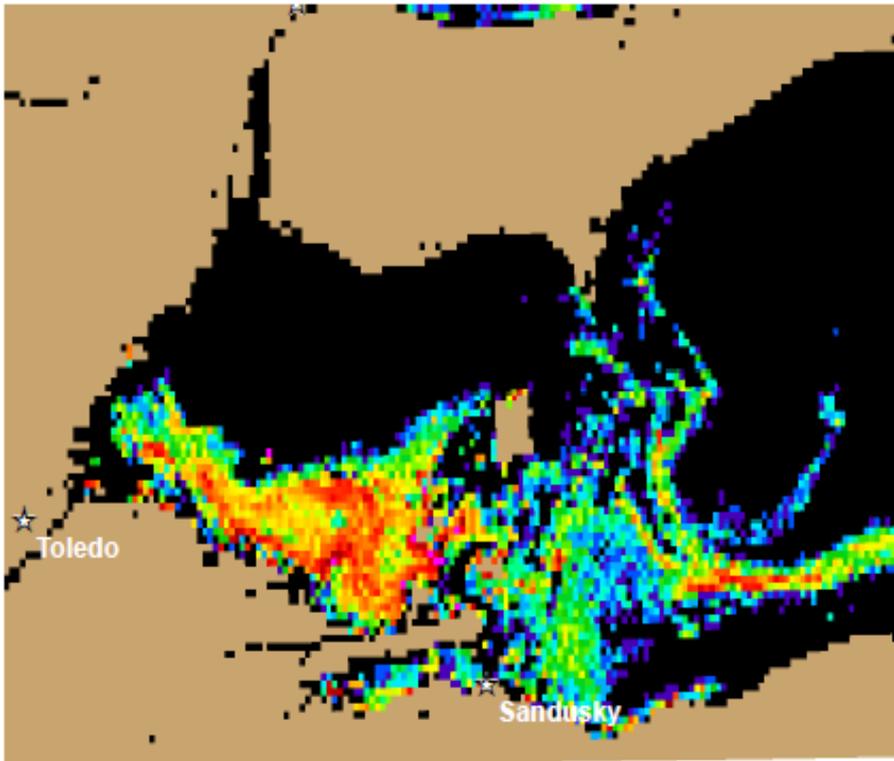
Table 11. Milford Lake current average condition and TMDL based on BATHTUB

Lake Inflow	Current Average Condition	TMDL	Percent Reduction
TP – Annual Load (lbs/year)	1,216,912	148,341	88%
TP – Daily Load (lbs/day)	6335	772.19	88%
TP – Lake Concentration (µg/L)	287	83.3	71%
TN – Annual Load (lbs/year)	4,875,835	674,882	86%
TN – Daily Load (lbs/day)	20,706	2866	86%
TN – Lake Concentration (µg/L)	1722	427.8	75%

Table 19. Milford Lake TMDL

Description	Allocations (lbs/year)	Allocations (lbs/day)
Phosphorus Atmospheric Load Allocation	1388.9	7.23
Phosphorus Nonpoint Source Load Allocations	116,897.6	646.04
Phosphorus Wasteload Allocation	15,220.5	41.7
Phosphorus Margin of Safety	14,834.1	77.22
Phosphorus TMDL	148,341.2	772.19*

NASA & NOAA August 15 HAB Prediction and August 16 Actual Conditions on Lake Erie



Questions?



Tom Stiles, Watershed Planning, Monitoring &
Assessment Section, KDHE

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785-296-6170