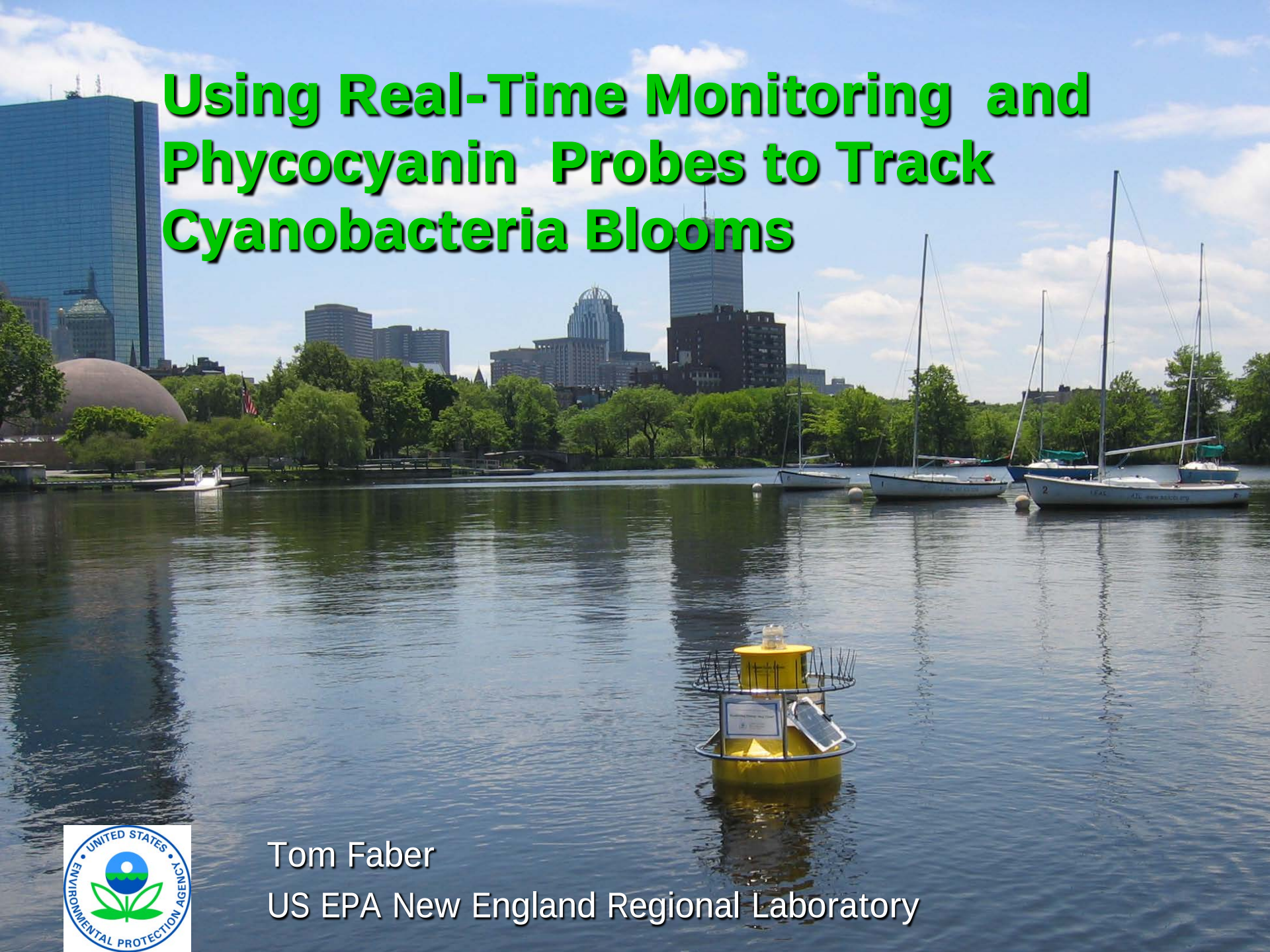


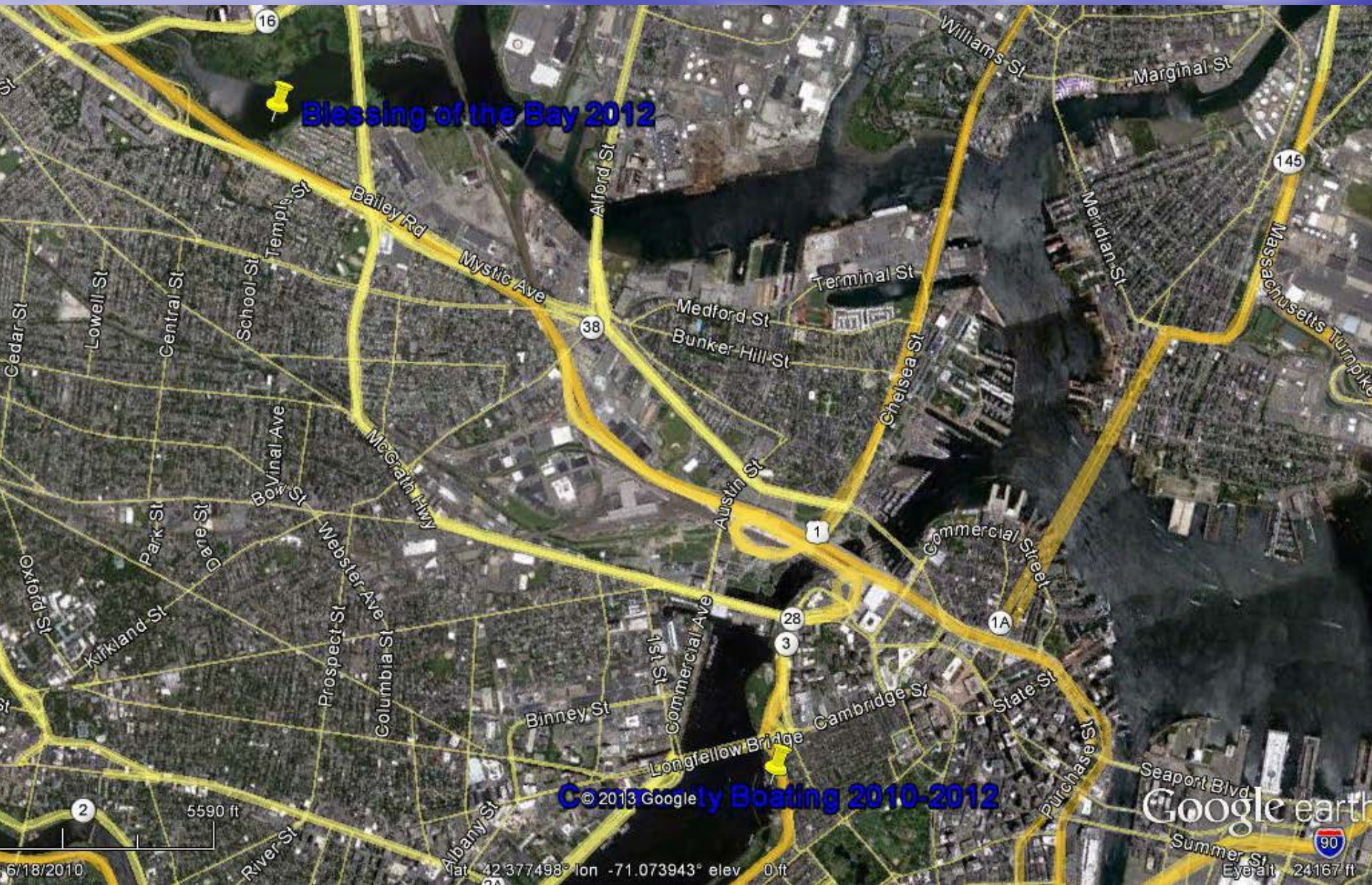
Using Real-Time Monitoring and Phycocyanin Probes to Track Cyanobacteria Blooms

Tom Faber
US EPA New England Regional Laboratory

Measuring Cyanobacteria

- EPA buoy monitoring program
- Cyanobacteria cell counts differences
- Using probes for measuring phycocyanin
- Probes and calibrating options

Monitoring Locations



Background

- Monitoring locations were selected for
  - High recreational use
  - Historic algal blooms
- Coincide with other monitoring
- Data available real-time to project partners through a password protected website
- Monitoring began in 2010

Charles and Mystic River Real-Time Monitoring
EPA New England Regional Laboratory

Environmental Protection Agency (EPA) has established monitoring buoys in the Charles and Mystic Watersheds. These buoys collect and transmit water quality data that is available to the public. EPA has established these buoys to help with the tracking of cyanobacteria blooms and water quality conditions.

Note: **All water quality measurements are collected 1 meter below the water's surface**

Last Sonde verification: **Charles 9/12/12** **Mystic 9/12/12**

Click here

Project Partners:

Community Boating Inc. Boston

CRWA

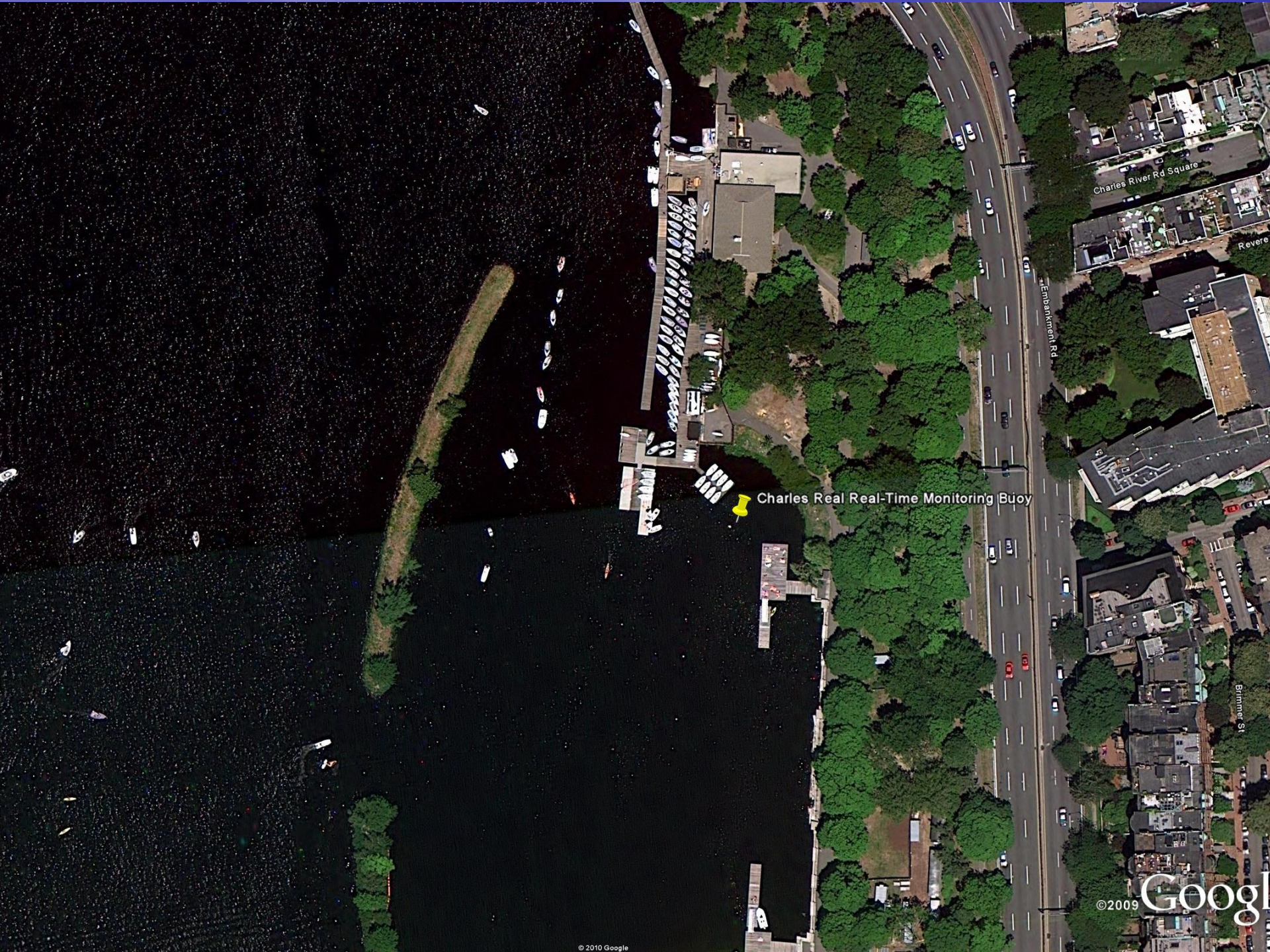
dcr

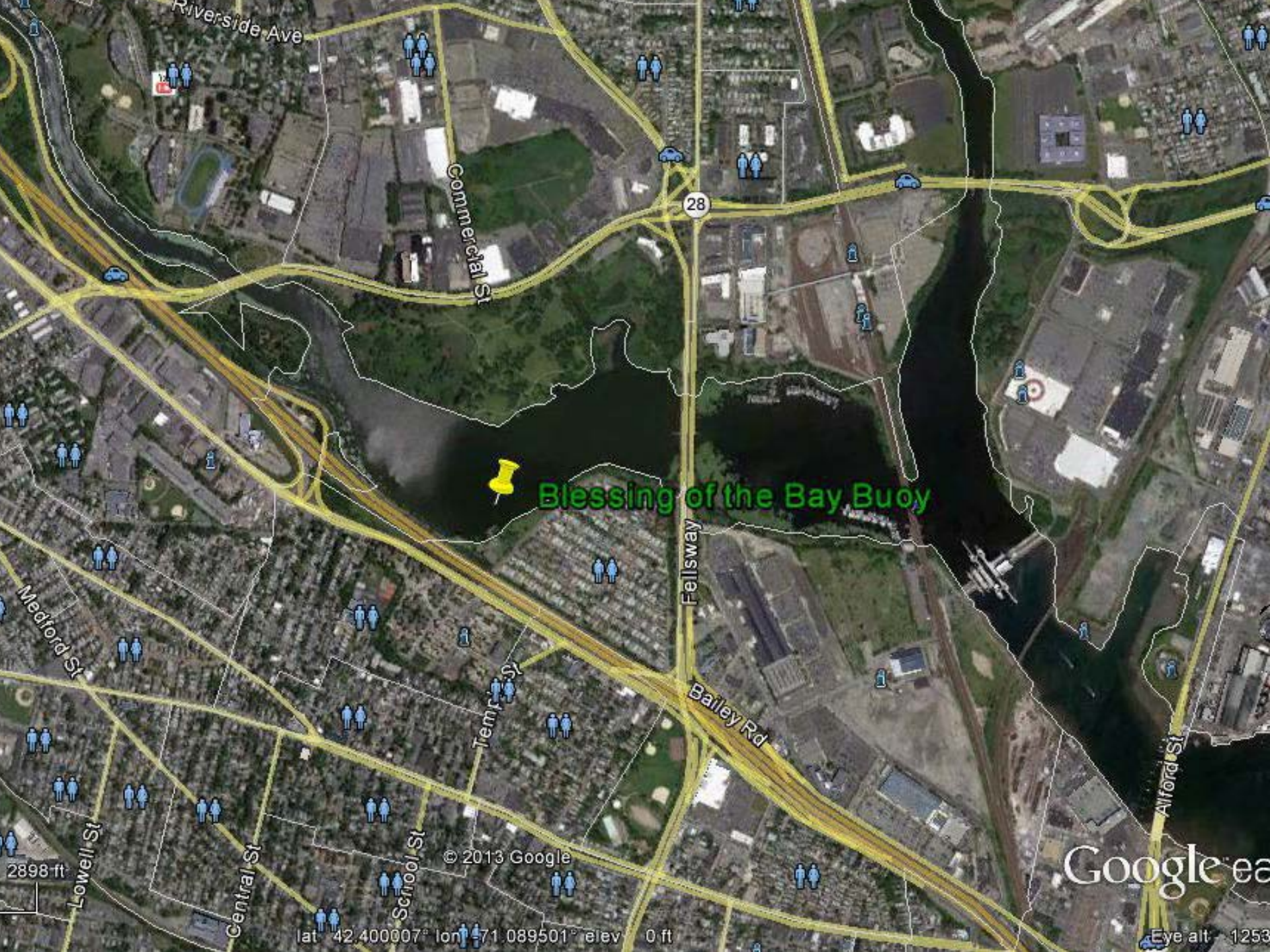
Somerville, MA
Mayor Joseph A. Curtatone

MyRWA
Mystic River Watershed Association
your community • your watershed

Commonwealth of Massachusetts Department of Public Health

Disclaimer:
The data presented on this website is considered preliminary data and may be subject to future revision or qualifiers. The data from this site is transmitted directly from the instrument with no or little review. Inaccuracies may be presented because instrument malfunction or physical changes at buoy location.


Charles River Rd Square
Revere
Embankment Rd
Charles Real Real-Time Monitoring Buoy
Brimmer St
©2009 Google
© 2010 Google

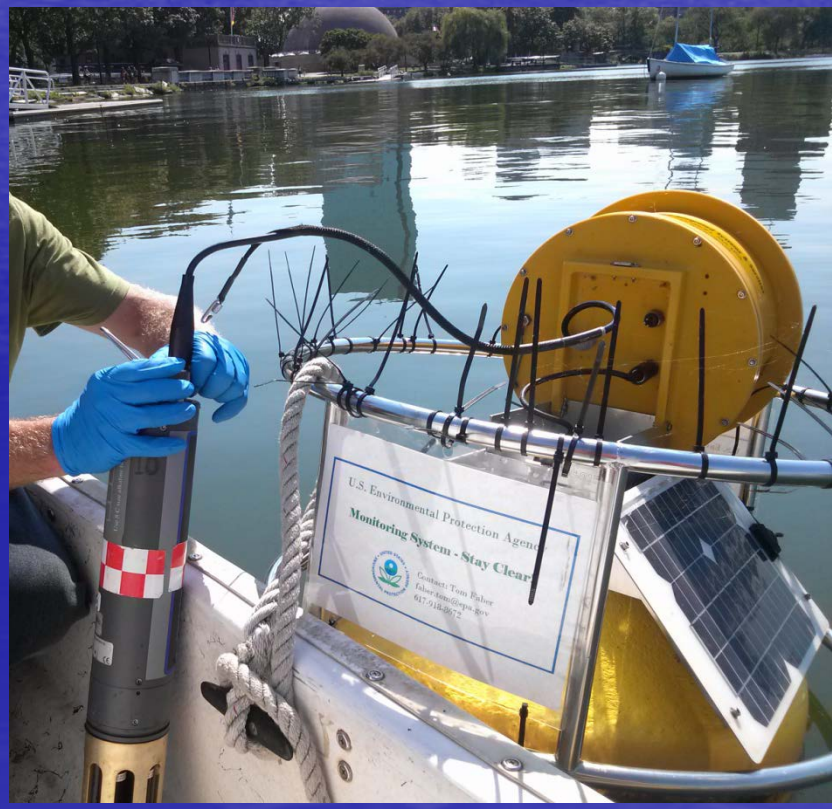

Riverside Ave
Commercial St
28
Blessing of the Bay Buoy
Fellsway
Medford St
Temple St
Bailey Rd
Alford St
Lowell St
Central St
School St
© 2013 Google
2898 ft
lat 42.400007° lon -71.089501° elev 0 ft
Eye alt 1253


U.S. Environmental Protection Agency
Monitoring System - Stay Clear!

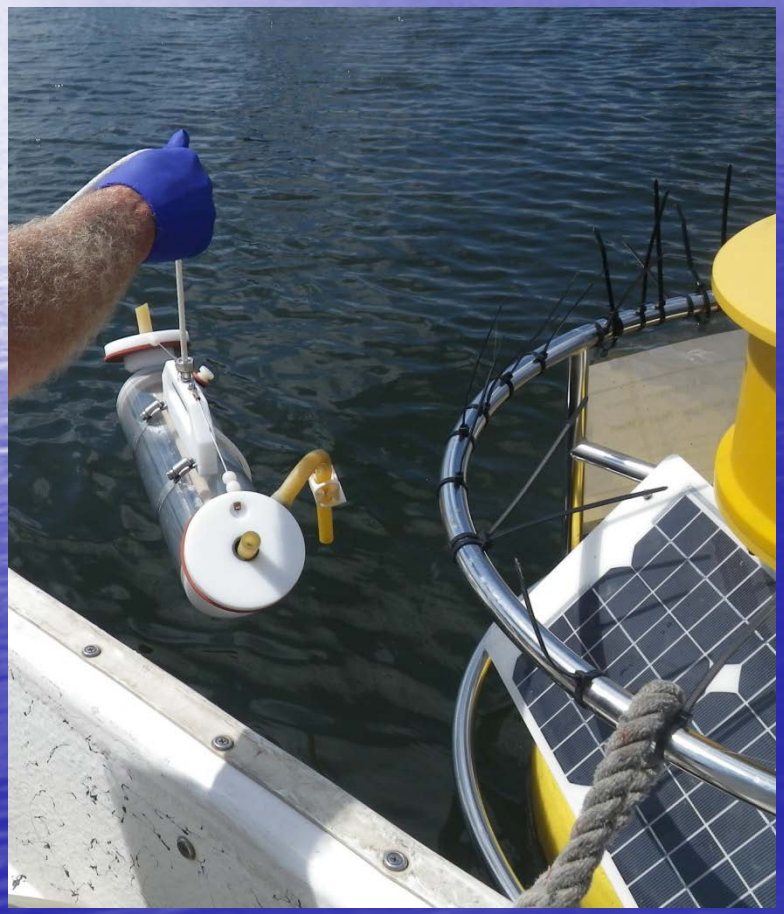
Buoy measures water quality conditions and helps to track cyanobacteria blooms

Sonde Measurements

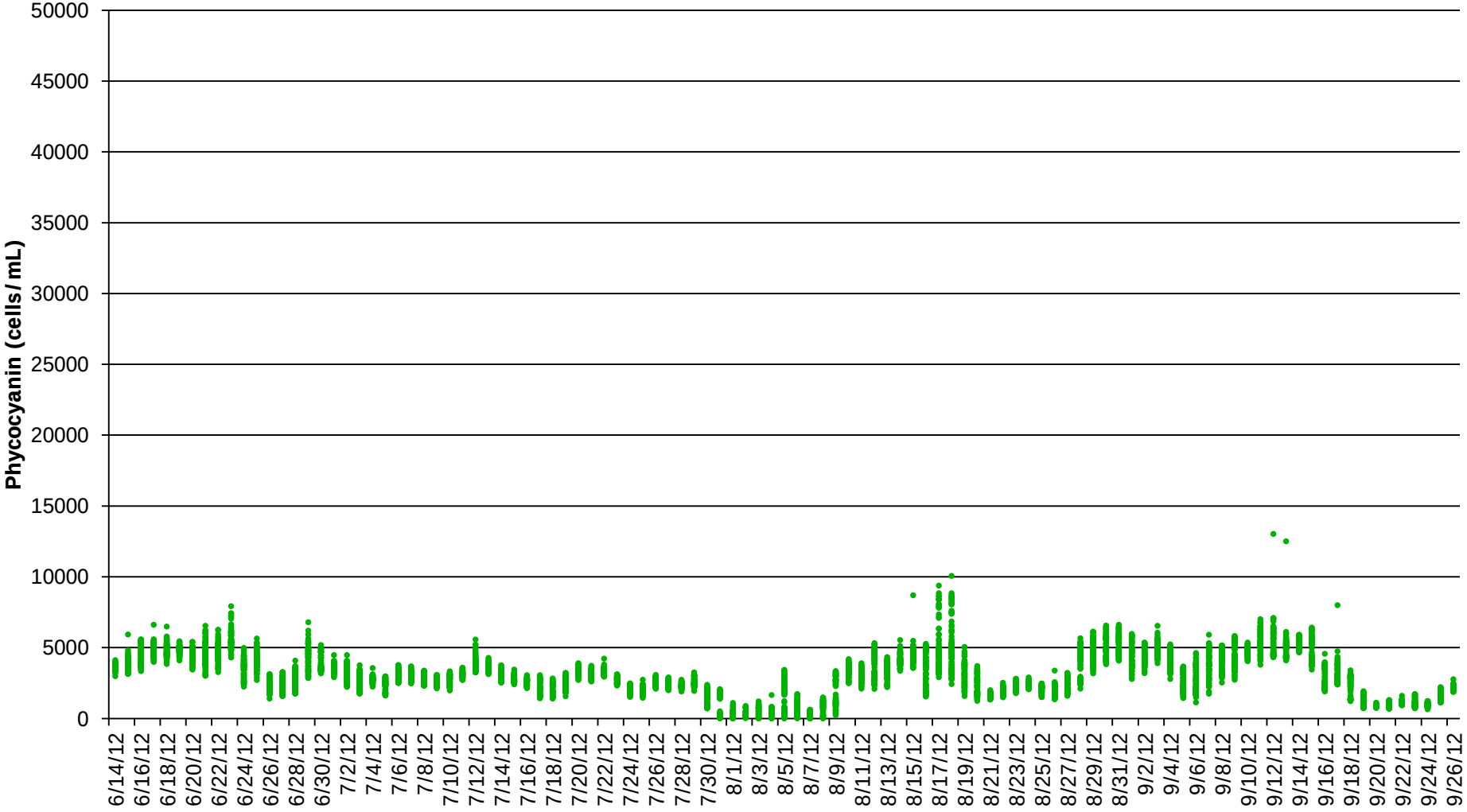
- Recorded every 15 minutes
- Measurements collected at 1 meter depth
- Probes checked and recalibrated ~ every 2 weeks
- Parameters
  - Temperature
  - Conductivity
  - pH
  - Dissolved Oxygen
  - Turbidity
  - Chlorophyll
  - Phycocyanin



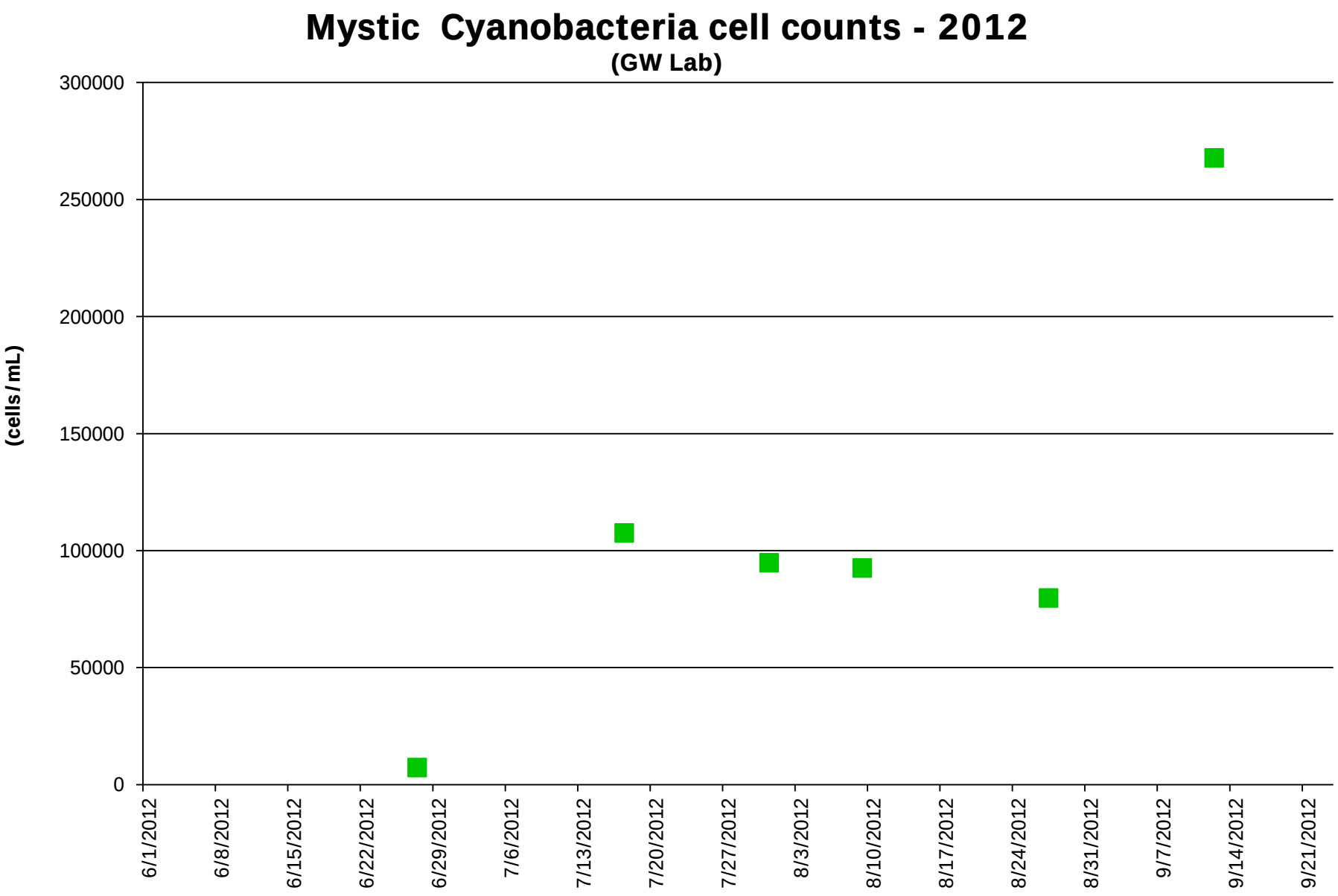
Field samples collected and processed for Chlorophyll a and Phycocyanin to correct and evaluate data

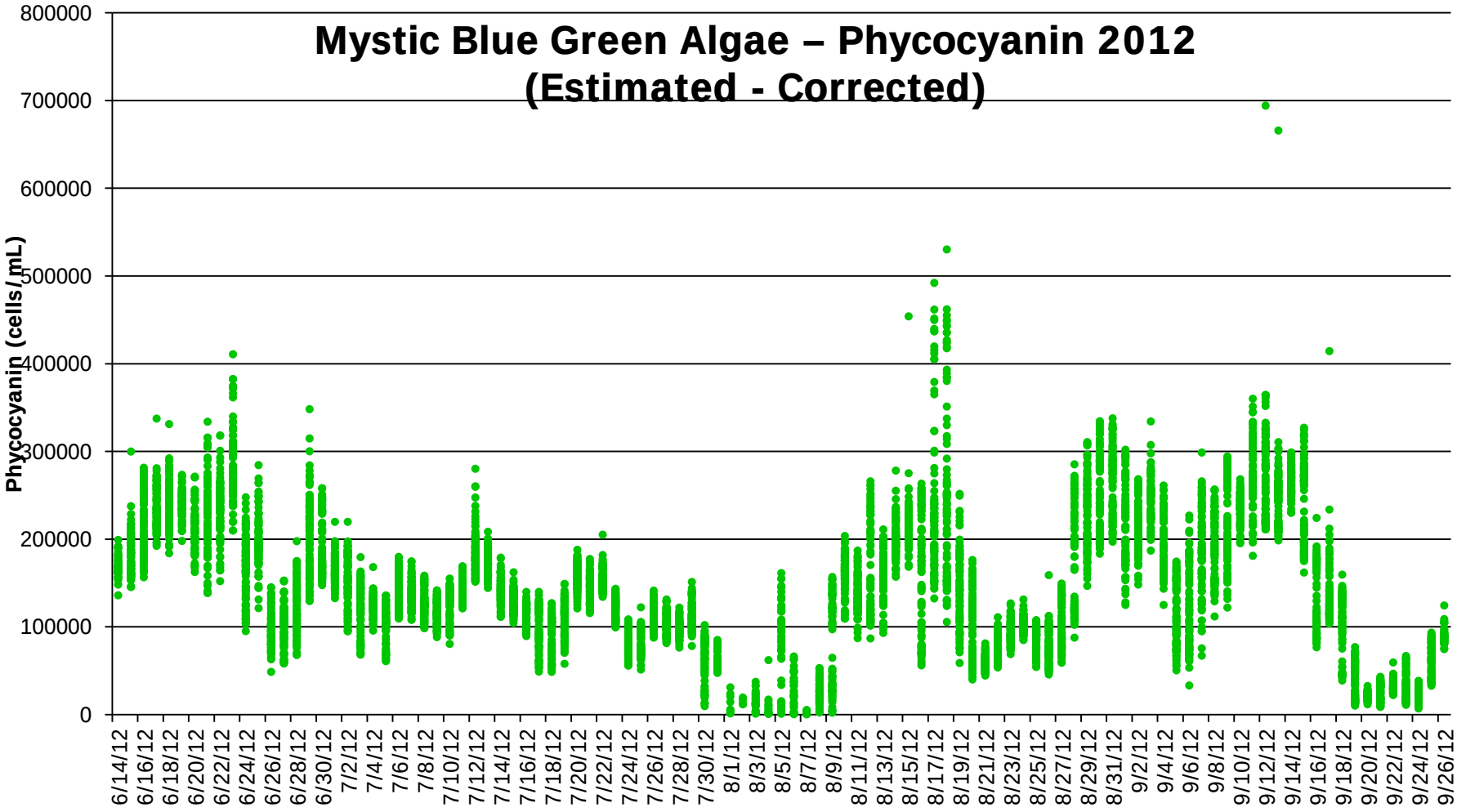


Mystic Blue Green Algae – Phycocyanin 2012 (Uncorrected)

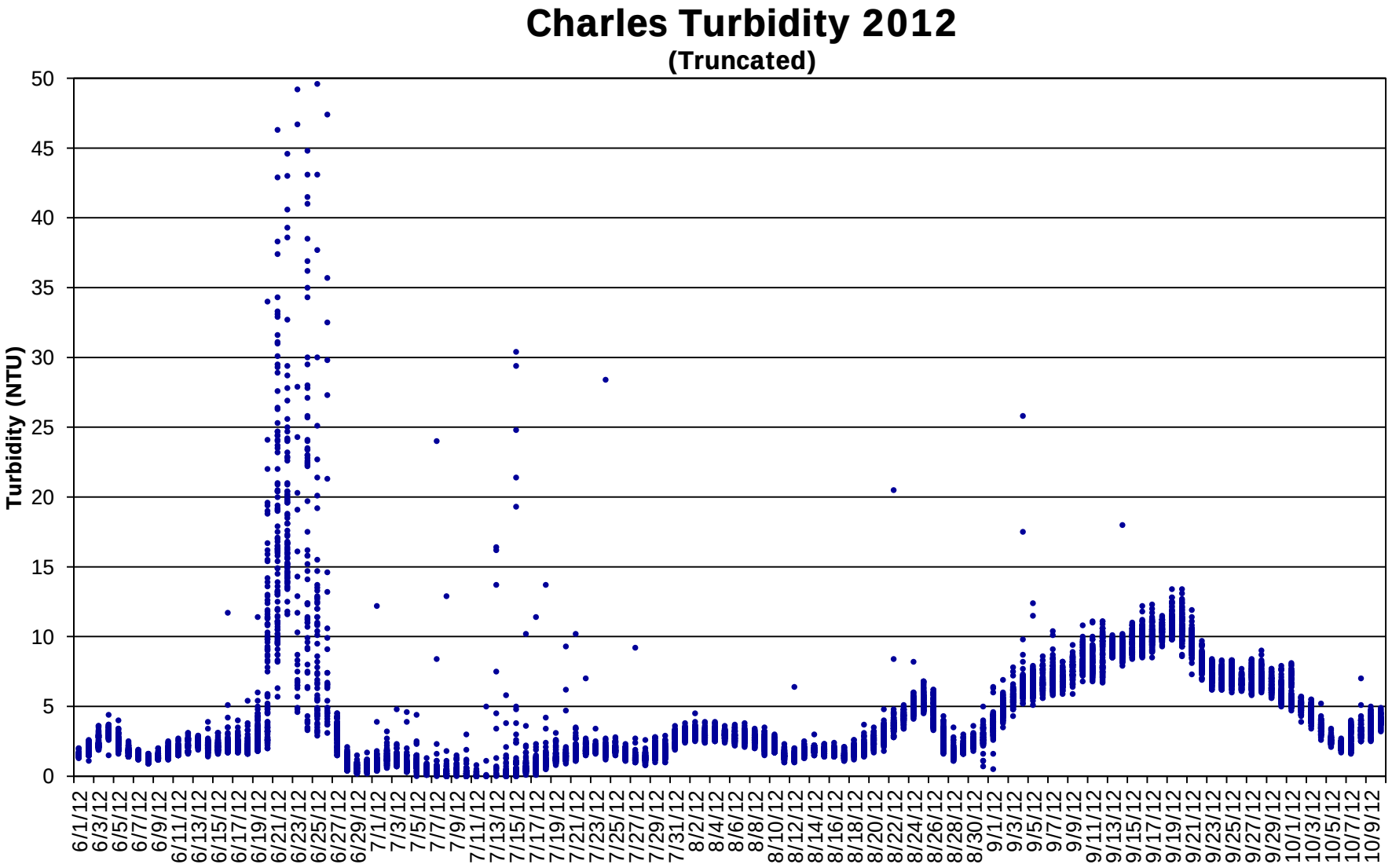


Note: Two high points truncated


Mystic Cyanobacteria cell counts - 2012
(GW Lab)
(cells/mL)
300000
250000
200000
150000
100000
50000
0
6/1/2012
6/8/2012
6/15/2012
6/22/2012
6/29/2012
7/6/2012
7/13/2012
7/20/2012
7/27/2012
8/3/2012
8/10/2012
8/17/2012
8/24/2012
8/31/2012
9/7/2012
9/14/2012
9/21/2012



Note: two Points truncated


Charles Turbidity 2012
(Truncated)
Turbidity (NTU)
50
45
40
35
30
25
20
15
10
5
0
6/1/12
6/3/12
6/5/12
6/7/12
6/9/12
6/11/12
6/13/12
6/15/12
6/17/12
6/19/12
6/21/12
6/23/12
6/25/12
6/27/12
6/29/12
7/1/12
7/3/12
7/5/12
7/7/12
7/9/12
7/11/12
7/13/12
7/15/12
7/17/12
7/19/12
7/21/12
7/23/12
7/25/12
7/27/12
7/29/12
7/31/12
8/2/12
8/4/12
8/6/12
8/8/12
8/10/12
8/12/12
8/14/12
8/16/12
8/18/12
8/20/12
8/22/12
8/24/12
8/26/12
8/28/12
8/30/12
9/1/12
9/3/12
9/5/12
9/7/12
9/9/12
9/11/12
9/13/12
9/15/12
9/17/12
9/19/12
9/21/12
9/23/12
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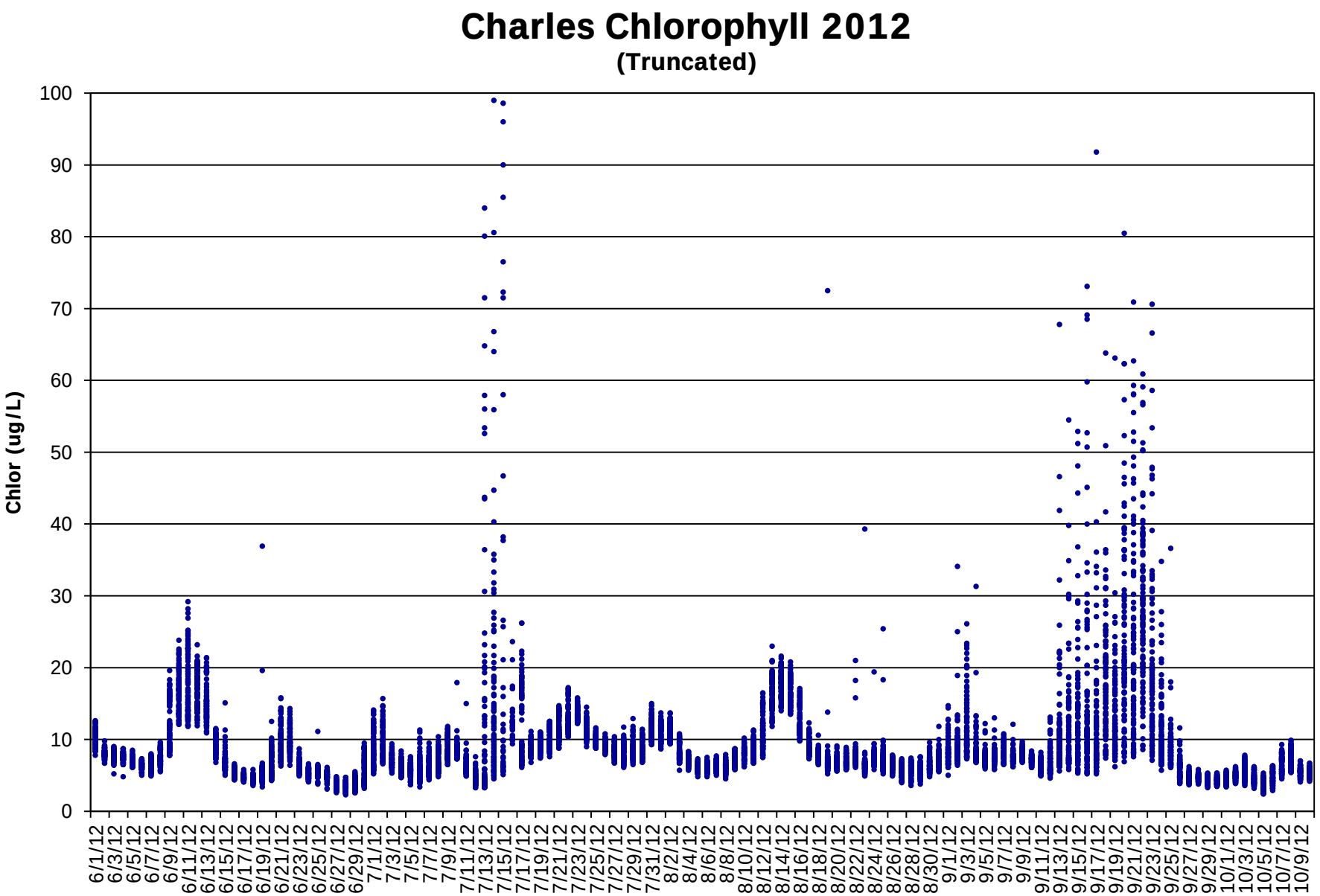
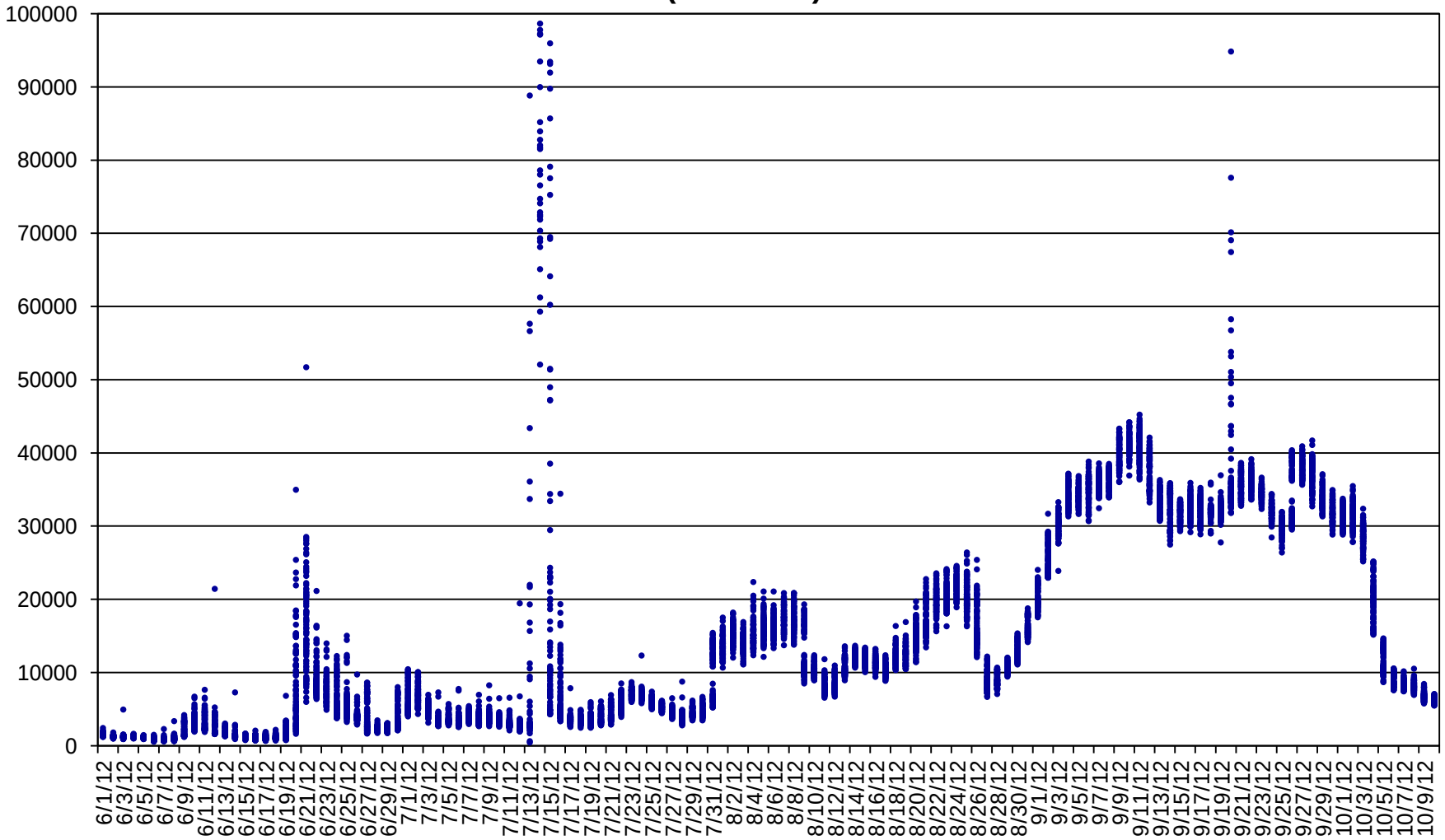
10/3/12
10/5/12
10/7/12
10/9/12


Charles Chlorophyll 2012
(Truncated)
Chlor (ug/L)
100
90
80
70
60
50
40
30
20
10
0
6/1/12
6/3/12
6/5/12
6/7/12
6/9/12
6/11/12
6/13/12
6/15/12
6/17/12
6/19/12
6/21/12
6/23/12
6/25/12
6/27/12
6/29/12
7/1/12
7/3/12
7/5/12
7/7/12
7/9/12
7/11/12
7/13/12
7/15/12
7/17/12
7/19/12
7/21/12
7/23/12
7/25/12
7/27/12
7/29/12
7/31/12
8/2/12
8/4/12
8/6/12
8/8/12
8/10/12
8/12/12
8/14/12
8/16/12
8/18/12
8/20/12
8/22/12
8/24/12
8/26/12
8/28/12
8/30/12
9/1/12
9/3/12
9/5/12
9/7/12
9/9/12
9/11/12
9/13/12
9/15/12
9/17/12
9/19/12
9/21/12
9/23/12
9/25/12
9/27/12
9/29/12
10/1/12
10/3/12
10/5/12
10/7/12
10/9/12

Charles Phycocyanin 2012

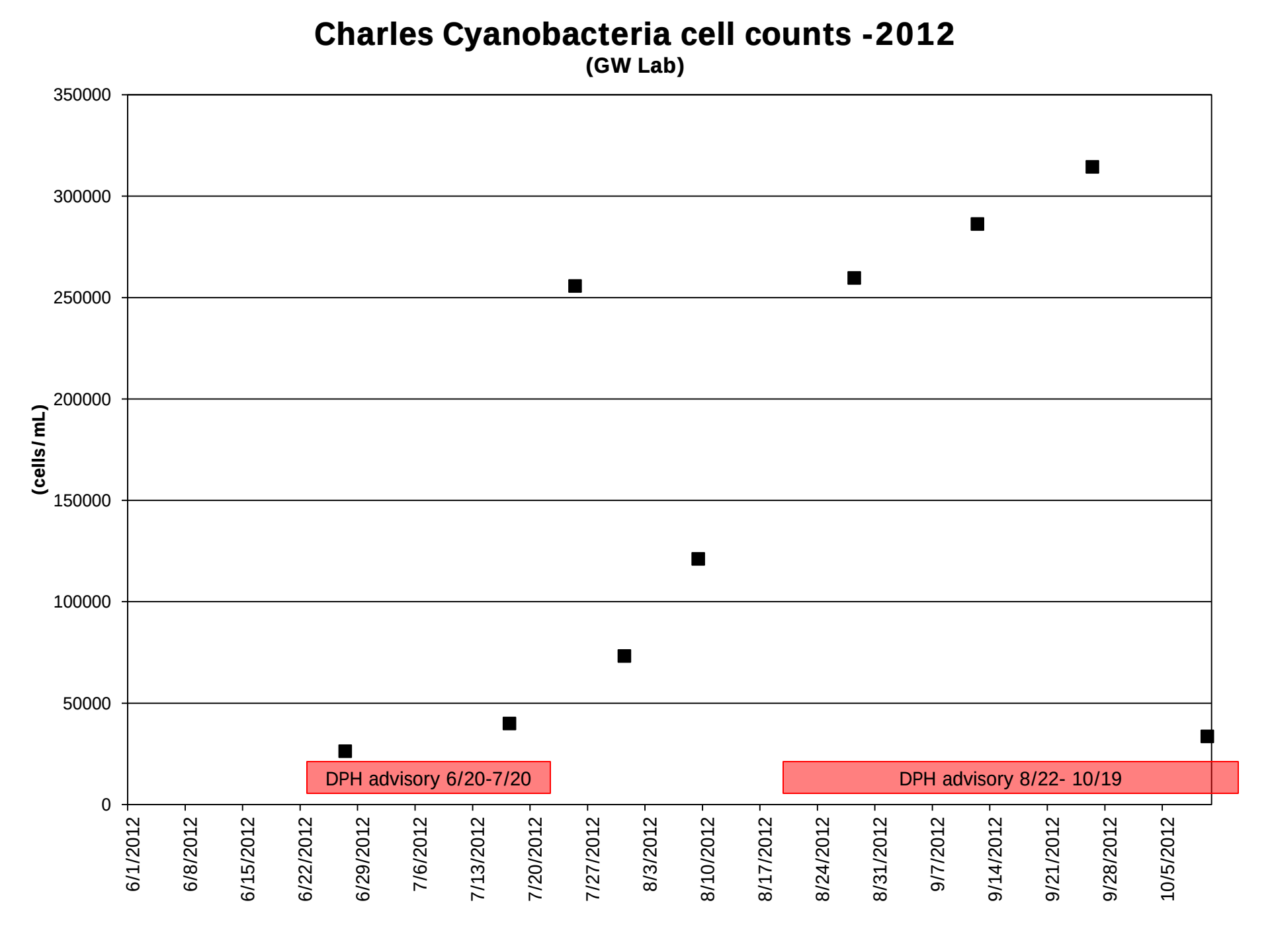
(Truncated)



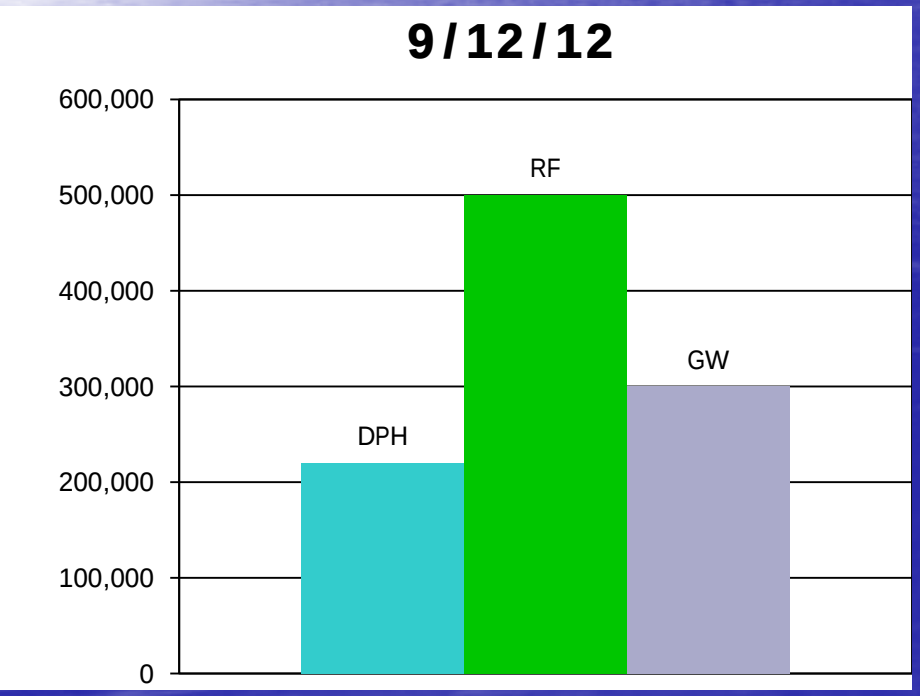
Charles River Cyanobacteria Advisories from DPH - 2012

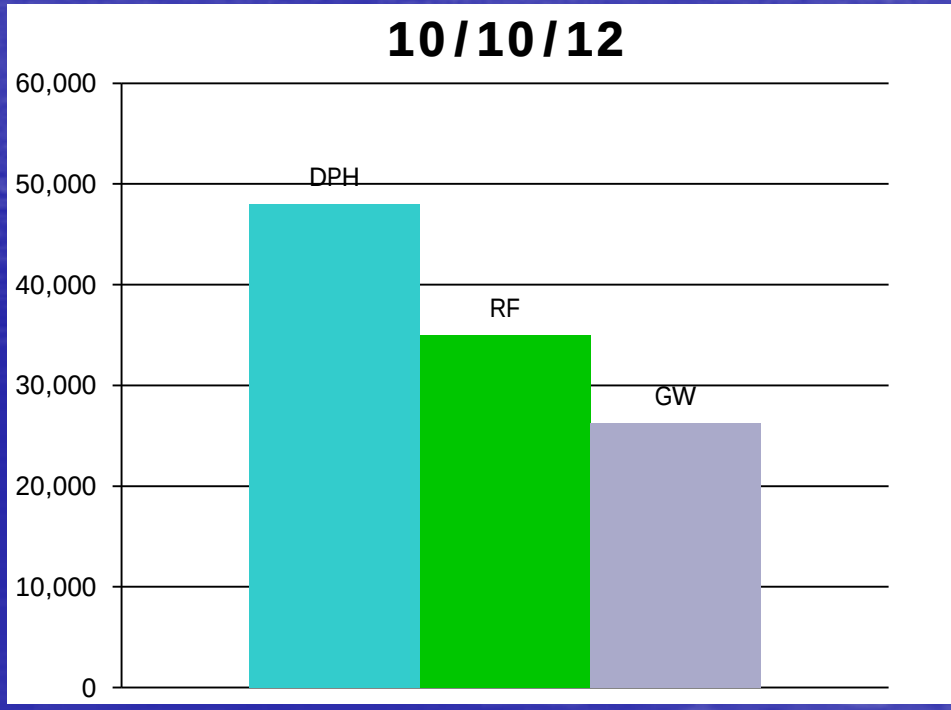
Water Body	City/Town	Advisory recommended	Advisory rescinded	Comments
Charles River	Boston	6/20/2012	7/20/2012	MIT Boathouse to New Dam, reduced to Swim Dock on 7/13/12
Charles River	Newton	8/9/2012	8/29/2012	Sampled at Charles River Canoe and Kayak, ended everywhere but Lasell Boathouse 8/22
Charles River	Boston	8/22/2012	10/19/2012	Lower Basin
Charles River	Waltham	8/24/2012	9/6/2012	Moody St. Dam

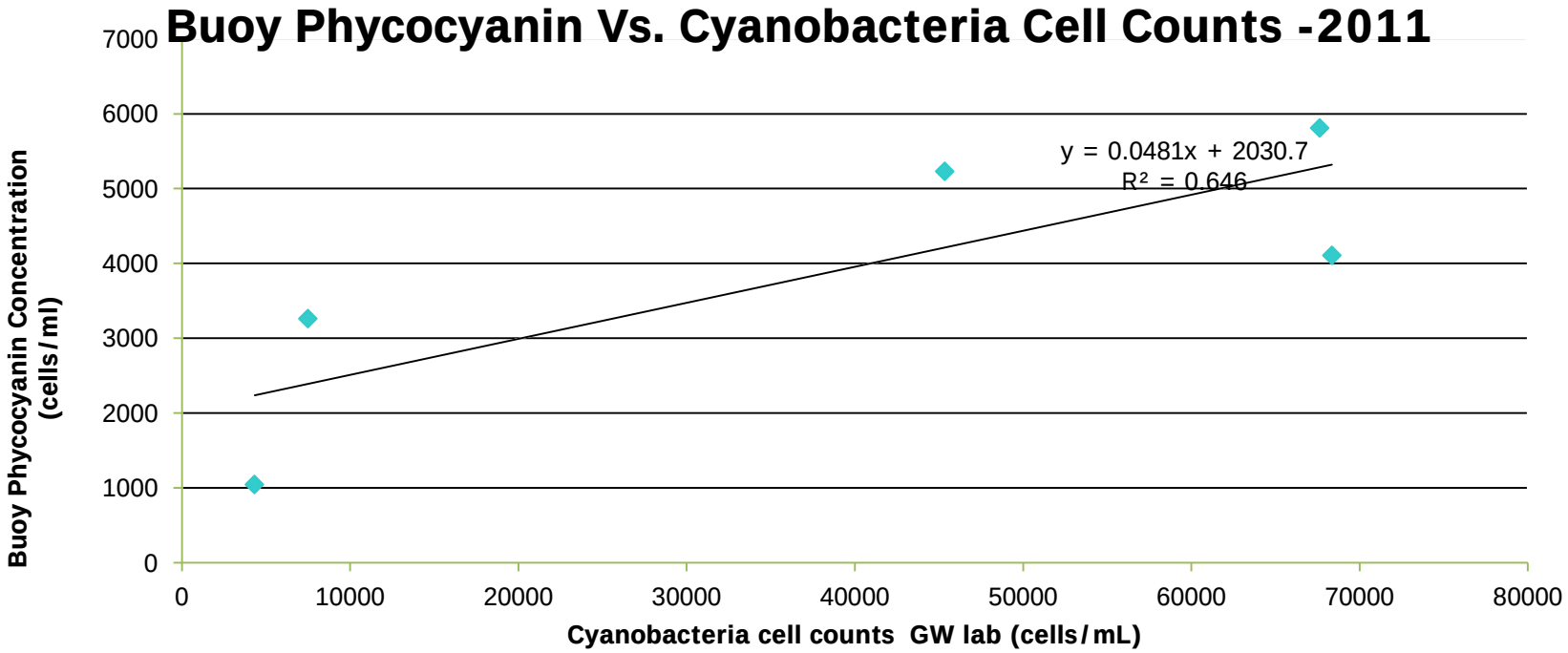
Data courtesy of Vanessa Curran (DPH)

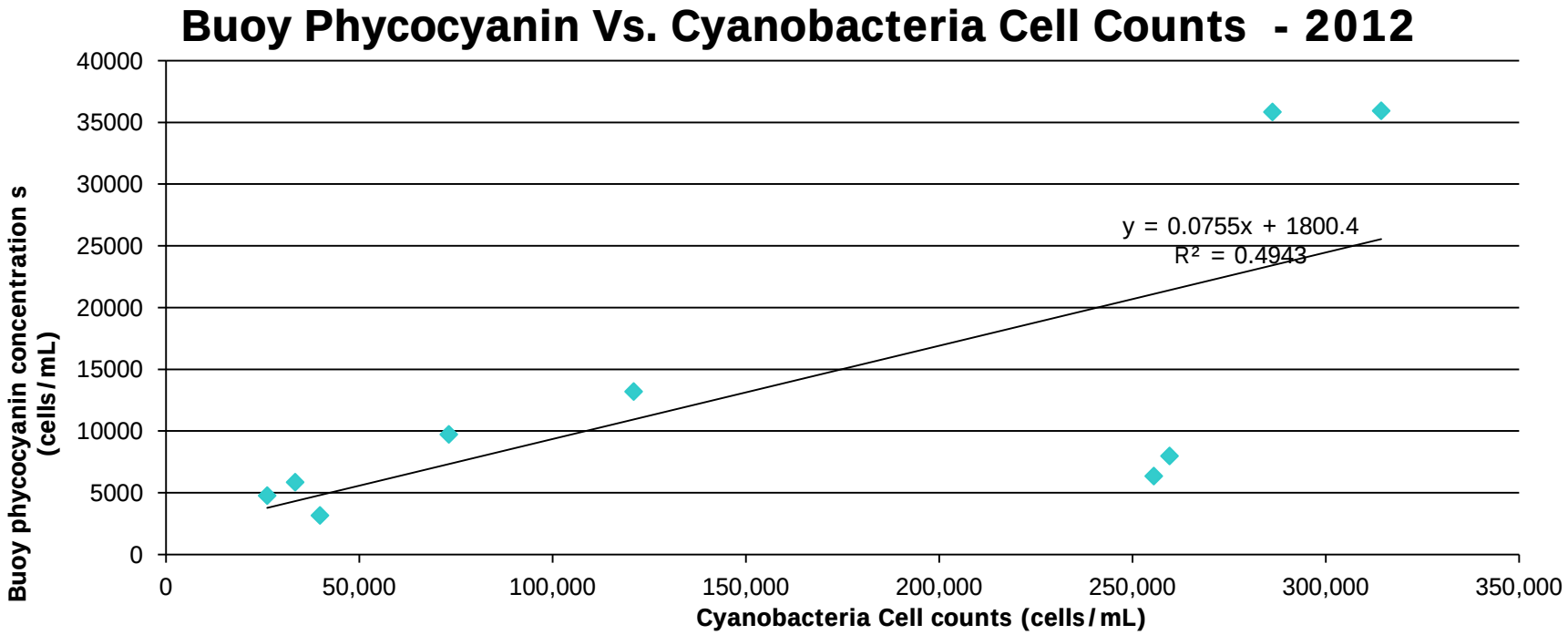

Charles Cyanobacteria cell counts -2012
(GW Lab)
350000
300000
250000
200000
150000
100000
50000
0
(cells/ mL)
DPH advisory 6/20-7/20
DPH advisory 8/22- 10/19
6/1/2012
6/8/2012
6/15/2012
6/22/2012
6/29/2012
7/6/2012
7/13/2012
7/20/2012
7/27/2012
8/3/2012
8/10/2012
8/17/2012
8/24/2012
8/31/2012
9/7/2012
9/14/2012
9/21/2012
9/28/2012
10/5/2012

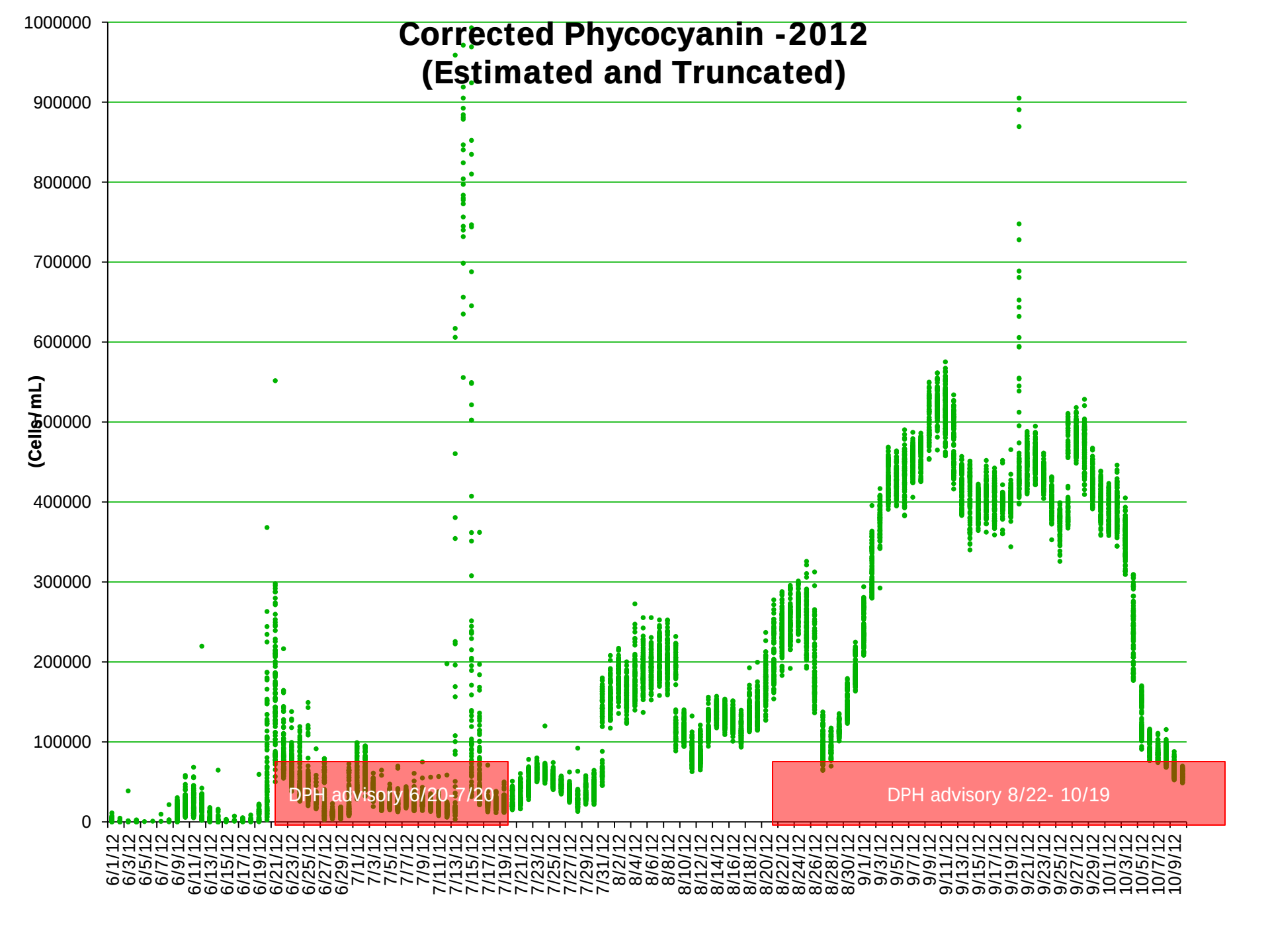
Split samples collected at Community Boating






Buoy Phycocyanin Vs. Cyanobacteria Cell Counts -2011
Buoy Phycocyanin Concentration (cells/ml)
7000
6000
5000
4000
3000
2000
1000
0
y = 0.0481x + 2030.7
R² = 0.646
0
10000
20000
30000
40000
50000
60000
70000
80000
Cyanobacteria cell counts GW lab (cells/mL)


Buoy Phycocyanin Vs. Cyanobacteria Cell Counts - 2012
Buoy phycocyanin concentration s (cells/mL)
40000
35000
30000
25000
20000
15000
10000
5000
0
y = 0.0755x + 1800.4
R² = 0.4943
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
Cyanobacteria Cell counts (cells/mL)


Corrected Phycocyanin -2012
(Estimated and Truncated)
(Cells/mL)
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
DPH advisory 6/20-7/20
DPH advisory 8/22- 10/19
6/1/12
6/3/12
6/5/12
6/7/12
6/9/12
6/11/12
6/13/12
6/15/12
6/17/12
6/19/12
6/21/12
6/23/12
6/25/12
6/27/12
6/29/12
7/1/12
7/3/12
7/5/12
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7/13/12
7/15/12
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8/30/12
9/1/12
9/3/12
9/5/12
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9/11/12
9/13/12
9/15/12
9/17/12
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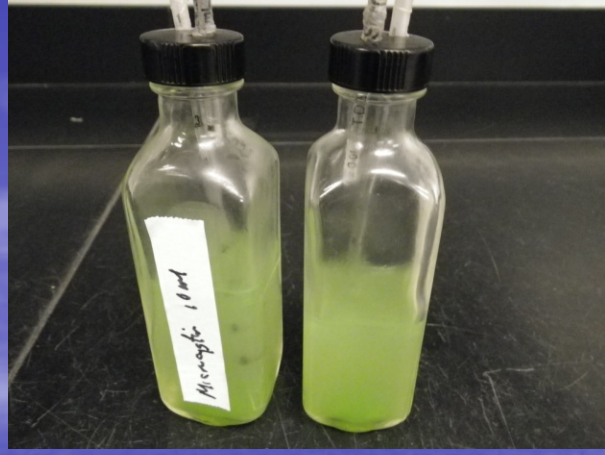
9/23/12
9/25/12
9/27/12
9/29/12
10/1/12
10/3/12
10/5/12
10/7/12
10/9/12

Calibration options for Phycocyanin Probe

- Factory default and zero calibration standard
- Phycocyanin standard
- Culture –Microcystis aeruginosa
- Rhodamine dye solution

Calibration options for Phycocyanin Probes



Calibration option	Advantage	Disadvantage
Zero calibration standard (DI water)	Easy	Hard to compare with other meters
Phycocyanin standard	Relates directly to phycocyanin	Short shelf life, not easy to use
Culture	Relates to cell counts	Time consuming, need equipment
Rhodamine dye	Easy to use, store, and repeat	Secondary standard

Meter Day at Mass DEP on 5/31/12
Is there a way to relate different meters?

Organization	Instrument	Excitation nM	Emission nM
MassDEP	Turner Designs Databank Datalogger with Cyclops 7 probe (phycocyanin sensor)	590	650
US EPA	YSI multi-sensor probe/sondes	565-605[1]	620-700[1]
NE University	YSI multi-sensor probe/sondes	565-605[1]	620-700[1]
MWRA	Turner Designs AquaFluor (cuvette, no probe)	590	670-680
MyRWA	Turner Designs AquaFluor (cuvette, no probe)	590[2]	670-680[2]
CRWA	Hydrolab (Hach) (uses Turner Designs sensor)	590[2]	650[2]

[1] Email from David Fraley, YSI Tech Support, 6/13/12

[2] From product literature, assuming Phycocyanin sensor

Data courtesy of John Fitzgerald-Mass DEP

Meter Day at Mass DEP on 5/31/12
Is there a way to relate different meters?

Data Obtained from Measurements of 3 Samples						
Sample	**MassDEP (Turner Cyclops 7)**	**CRWA (Hydrolab)**	**US EPA (YSI)**	**NE Univ (YSI)**	**MWRA (Turner Aquaflor)**	**MyRWA (Turner Aquaflor)**
Charles River (clean)	2 µg/L PC (70 mV)	6.1 mV	Not measured	0.3 RFUs 700 cells	0.283 units	-0.023 units
90 µg/L Phycocyanin	90 µg/L PC (1700 mV)	53.8 mV	30.1 RFUs 49,600 cells	18.4 RFUs 39,000 cells	9.863 units	11.21 units
Lake Quannapowitt	150 µg/L PC (2800 mV)	100 mV	17.4 RFUs 30,000 cells	10.5 RFUs 23,000 cells	22.07 units	23.52 units

PC = Phycocyanin
mV = millivolts
RFU = Relative Fluorescence Units

Data courtesy of John Fitzgerald-Mass DEP

Can meters and probes be standardized?

- How do you deal with different units?
- Should probes only be used for screening?
- Is it possible to standardize meters at the beginning of the year and establish a conversion.
- Are there other standard indicators that are just as good?

IDEAS, COMMENTS or QUESTIONS?