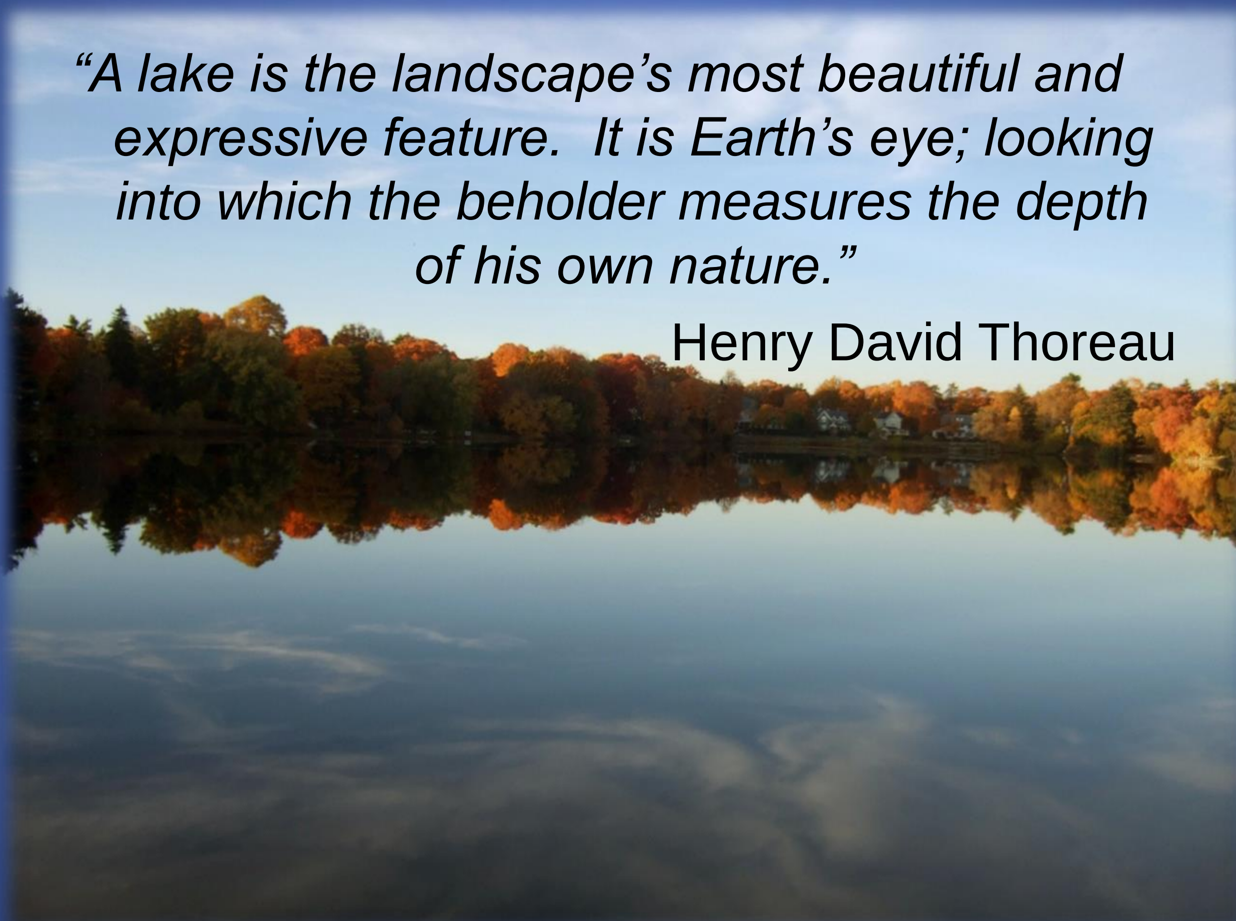
Crystal Lake Conservancy
Third Annual Forum

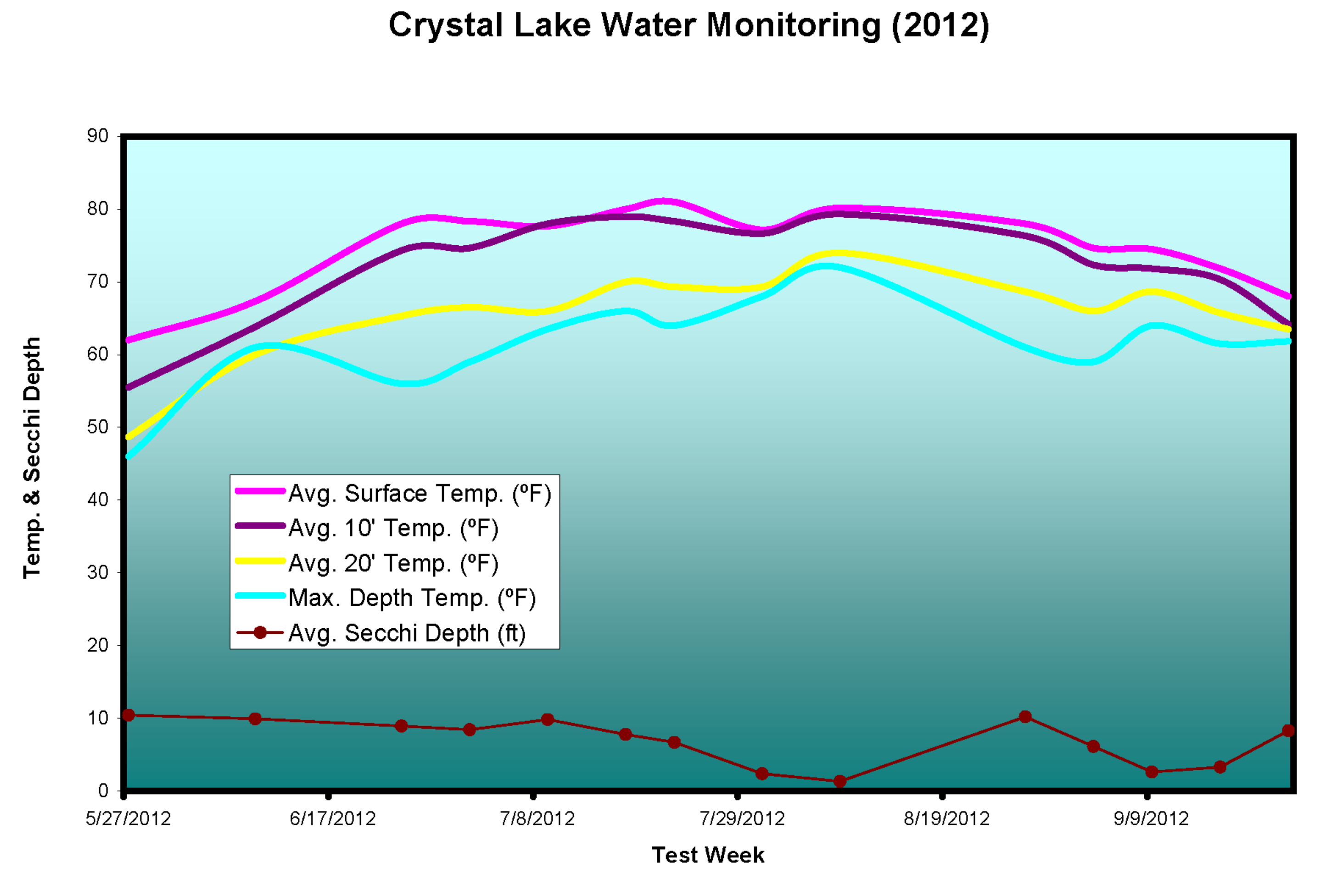


“A lake is the landscape’s most beautiful and expressive feature. It is Earth’s eye; looking into which the beholder measures the depth of his own nature.”

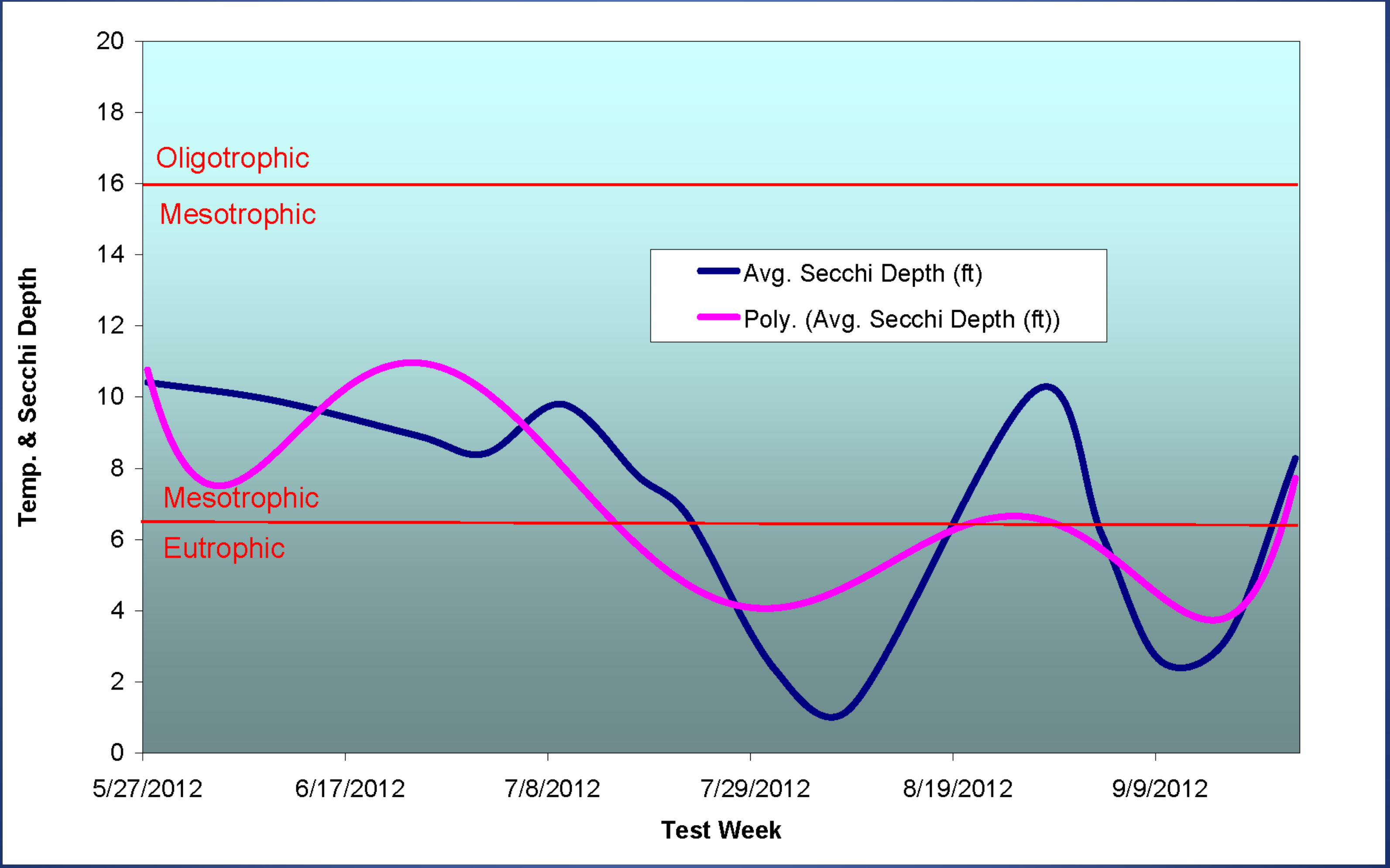
Henry David Thoreau

October 25, 2012

2012 CLC Temperature and Secchi Disk versus Time



2012 CLC Secchi Disk Visibility



AUGUST 2012 CLC WATER QUALITY TESTING

Temperature (°Fahrenheit), DO (Dissolved Oxygen) (mg/L)
pH, ORP (Oxidation Reduction Potential)
TDS (Total Dissolved Solids), Sal (Salinity)
Conductivity (mS/cm^c and mS/cm)

C-650 CRYSTAL LAKE

Time: 9AM **Date:** 8/16/2012

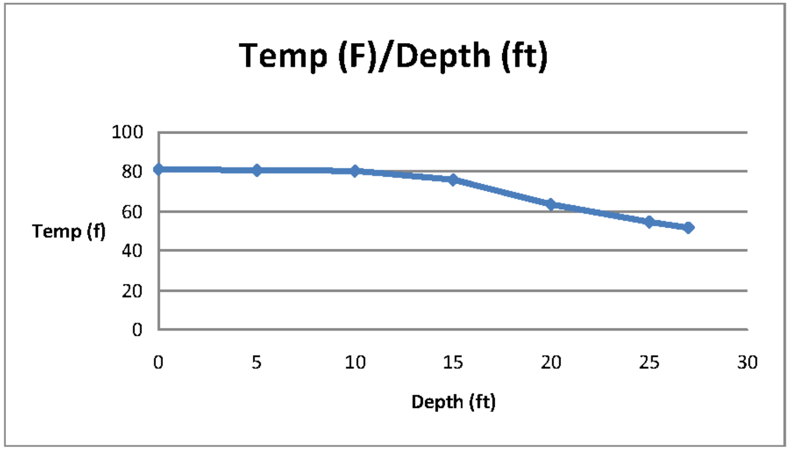
Weather: sunny clear

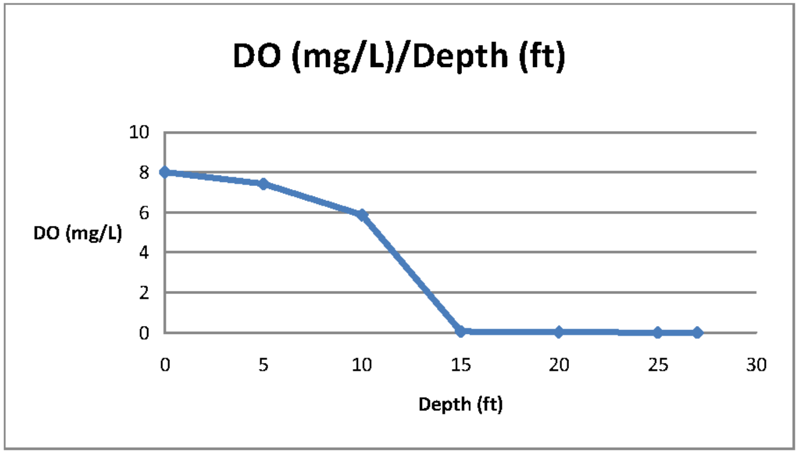
Point 16

Depth: 29ft 2 in

Secchi: 2ft 1in (25in)

Depth (ft)	**0**	**5**	**10**	**15**	**20**	**25**	**27**
Temp (F)	81.19	80.84	80.44	75.87	63.4	54.55	51.65
DO (mg/L)	8	7.43	5.88	0.07	0.02	0.01	0.01
pH	9.65	9.6	8.93	6.82	6.37	6.35	6.64
ORP	62.7	67.4	80.2	-138.5	-191.4	-198	-209
TDS (g/L)	0.187	0.187	0.183	0.187	0.19	0.181	0.214
Sal	0.14	0.14	0.13	0.14	0.14	0.13	0.16
Conductivity (mS/cm^c)	0.288	0.288	0.281	0.287	0.293	0.291	0.341
Conductivity (mS/cm)	0.301	0.299	0.291	0.283	0.254	0.222	0.243





AUGUST 2012 CLC PHOSPHOROUS

Sampling Location: C-650, Newton, MA

TEST RESULTS:

Test	Unit	#1	#2	#3	Method Reference
Total Phosphorous	mg/L	0.05	0.06	0.11	SM 4500 P-E
	PPB	50	60	110	

Mass. Cert. No.: M-MA-1100

Average Phosphorus = 10 PPB

#1 = 5 ft below surface
#2 = Thermocline
#3 = Hypolimnion (bottom)

Trophic Class	Phosphorus Concentration (PPB)
Oligotrophic	0-12
Mesotrophic	12-24
Eutrophic	24+

AUGUST 2011 CLC PHOSPHOROUS

Fall 2011 Phosphorous Testing
Sampling Location: Crystal Lake

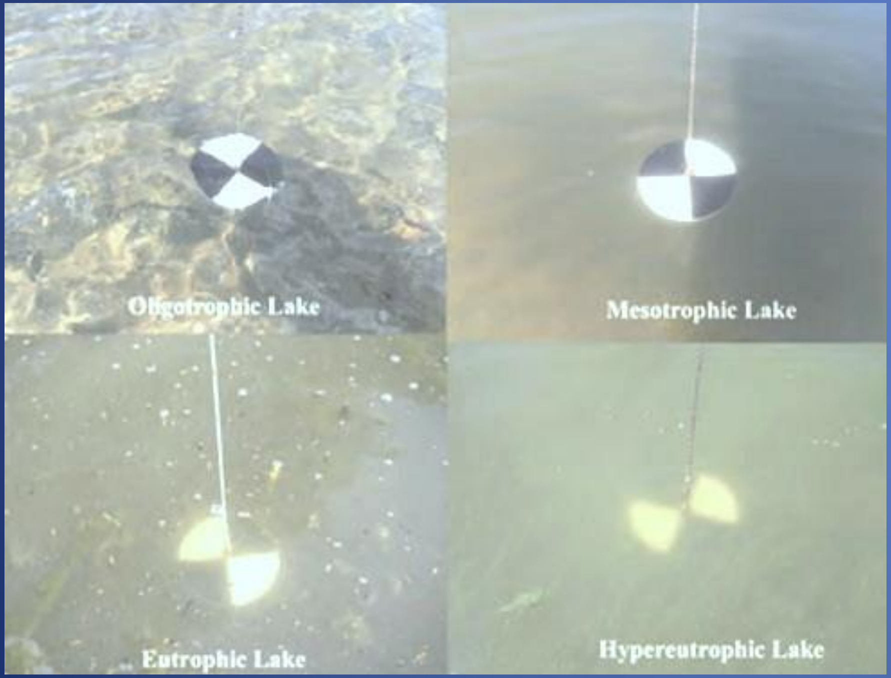
Total Phosphorous Test	Unit	#1	#2	#3	#4	#5	#6	#7	#8	#9	Bath House
August 16, 2011	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	0.07	0.12	-	-	<0.02
	PPB	-	-	-	-	-	**70**	**120**	-	-	-
August 24, 2011	mg/L	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	0.13
	PPB	**40**	-	-	-	-	-	-	-	-	**130**
September 16, 2011	mg/L	0.1	<0.02	0.04	0.03	0.02	0.02	<0.02	-	-	<0.02
	PPB	**100**	-	**40**	**30**	**20**	**20**	-	-	-	-

1&2 = Cronin's Cove
3 = Norwood
4 = Paul's Brook
5-7 = Levingston's Cove
8 = Lake Terrace
9 = Deep Water
10 = Bath House

Trophic Class	Phosphorus Concentration (PPB)
Oligotrophic	0-12
Mesotrophic	12-24
Eutrophic	24+

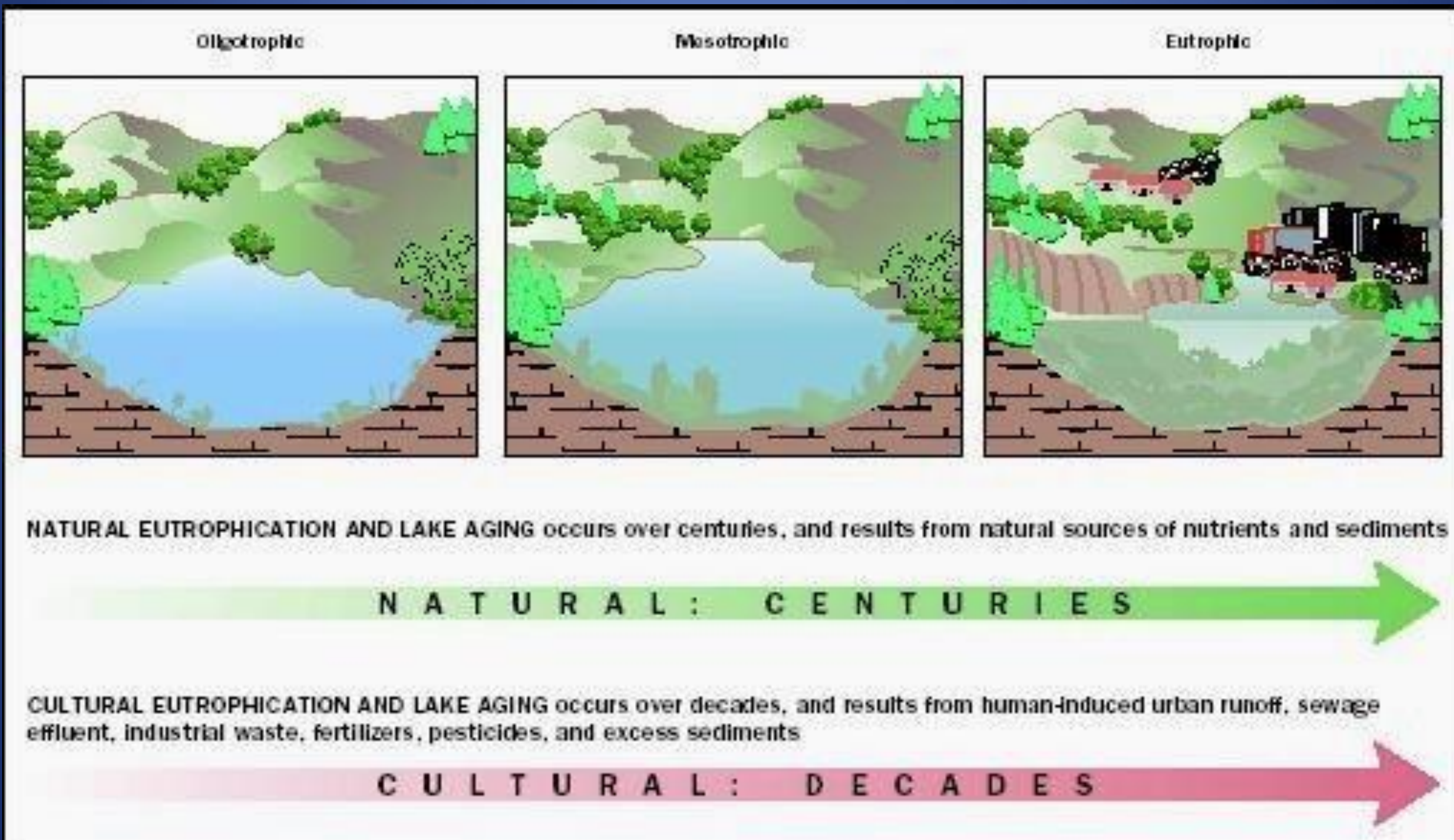
Evaluating the Trophic Status of Crystal Lake

- Secchi Disk Comparison



- Recognizing Problems:
  - Algal Blooms
  - Nuisance aquatic plants
  - Poor drinking water
  - Disappearing fisheries
  - Low dissolved oxygen
  - Shoaling (sedimentation)

Lake Enrichment and Eutrophication



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2012 CLC BACTERIA RESULTS

2012 Bacteria Testing Results

E. Coli MCL = 235
Enterococci MCL = 61

Sample Location	4/26/2012		5/16/2012		6/13/2012		7/19/2012	
	E. Coli	EnteroCocci	E. Coli	EnteroCocci	E. Coli	EnteroCocci	E. Coli	EnteroCocci
Outfall #1 - Cronin's Cove	<10	<10	60	30	**510***	**760***	<10	**70***
Outfall #5 - Levingston's Cove	<10	<10	20	60	130	**380***	50	60
Outfall #8 - Lake Terrace	<10	<10	120	30	130	**520***	<10	30
Location # 9 - Deep Water	<10	<10	20	10	10	10	60	10
Location #10 - Bath House	<10	<10	70	20	10	70*	50	**90***
Outlet #4 - Paul's Brook	<10	<10	40	10	30	10	20	30

Sample Location	7/27/2012		8/16/2012		9/5/2012		10/4/2012	
	E. Coli	EnteroCocci	E. Coli	EnteroCocci	E. Coli	EnteroCocci	E. Coli	EnteroCocci
Outfall #1 - Cronin's Cove	<10	<10	10	10	**700***	**570***	10	10
Outfall #5 - Levingston's Cove	30	<10	<10	<10	220	**240***	10	<10
Outfall #8 - Lake Terrace	<10	<10	20	10	**290***	**260***	10	<10
Location # 9 - Deep Water	<10	<10	<10	<10	130	30	60	30
Location #10 - Bath House	<10	10	<10	10	70	**150***	<10	30
Outlet #4 - Paul's Brook	<10	<10	10	<10	60	**90***	20	<10

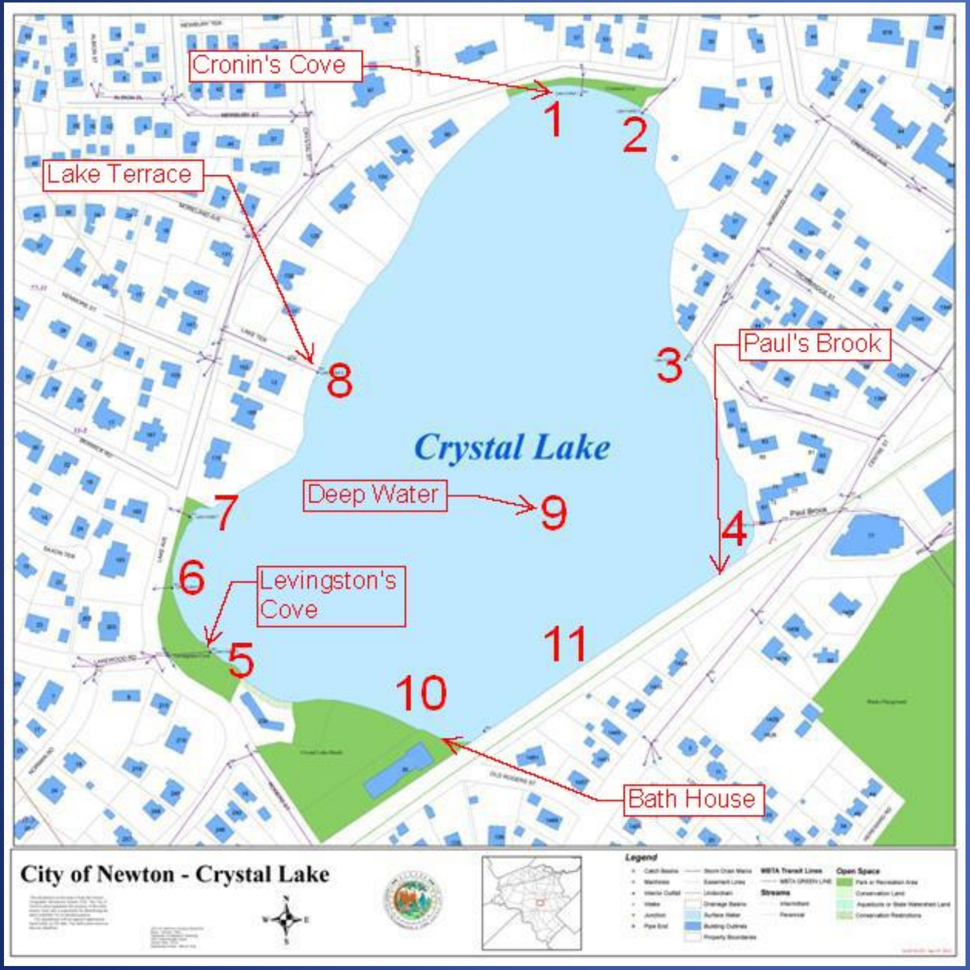
2011 CLC BACTERIA RESULTS

2011 Bacteria Testing Results

E. Coli MCL = 235
Enterococci MCL = 61

Sample Location	8/10/2011		8/24/2011		9/16/2011		9/23/2011	
	E. Coli	EnteroCocci	E. Coli	EnteroCocci	E. Coli	EnteroCocci	E. Coli	EnteroCocci
Outfall #1 - Cronin's Cove Sq.	110	170	55	180	40	30	10	10
Outfall #2 - Cronin's Cove Dock	170	350	110	110	30	10	10	10
Outfall #3 - Norwood	130	290	10	<10	10	<10	30	10
Outlet #4 - Paul's Brook	20	0	<10	<10	10	10	55	80
Outfall #5 - Levingston's Cove Blue Pipe	380	720	380	180	<10	<10	60	220
Outfall #6 - Levingston's Cove Retaining Wall	80	220	40	150	50	10	50	<10
Outfall #7 - Levingston's Cove End of Wall	240	640	10	10	10	10	80	20
Outfall #8 - Lake Terrace	230	260	100	90	60	20	30	<10
Location # 9 - Deep Water	50	120	<10	10	20	<10	10	10
Location #10 - Bath House	90	160	230	<10	<10	<10	220	<10

2012 CLC Testing Locations



Locations 1 - Cronin's Cove

Location 4 – Paul's Brook Outlet

Location 5 – Levingston's Cove

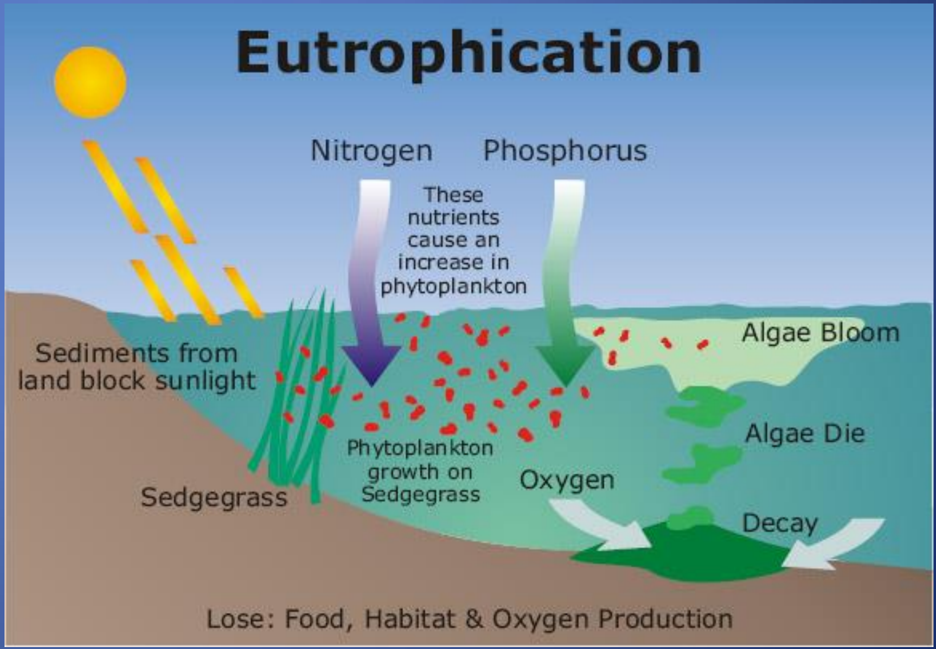
Location 8 – Lake Terrace

Location 9 – Deep Water

Location 10 – Bath House

What Have We Learned?

- Crystal Lake is eutrophic;
  - Visibility below 2 ft and oxygen reduced to zero in lower levels
  - All lakes decline/die
  - Rate of decline is accelerated by nutrients



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What Have We Learned?

- Crystal Lake is nutrient rich (phosphorus)
  - Data on phosphorus indicates high levels are present
  - Rapid increase over last year
  - High phosphorus is related to algae blooms
  - Source is unknown
  - Phosphorus present on street level prior to entering storm drains
  - Phosphorus is distributed differently than bacteria; settles to deeper levels

What Have We Learned?

- Bacteria is present and high in some areas
  - Data is consistent now for several years
  - Bacterial levels more concentrated in cove areas
  - Unpredictable when it occurs
  - Unknown direct source (dried manure?, other sources?)
  - High levels several times but has rapid dilution
  - High levels known to exist in street runoff prior to entering storm drains

What Can We Do?

- Watershed Residents: You <u>CAN</u> help preserve our lake
  - Decrease the amount of nutrients flowing from yards onto adjacent streets and into the lake
  - Reduce the amount of bacterial flow occurring on street level in yards, driveways and street – do not dump waste into drains!
  - Limit fertilizers and pesticides, reduce use of manure and composts, decrease pet waste, reduce stormwater and gutter runoff by infiltrating into soil, manage waterfowl, reduce construction debris
  - Create voluntary compliance
  - Explore regulations if situation is not improved

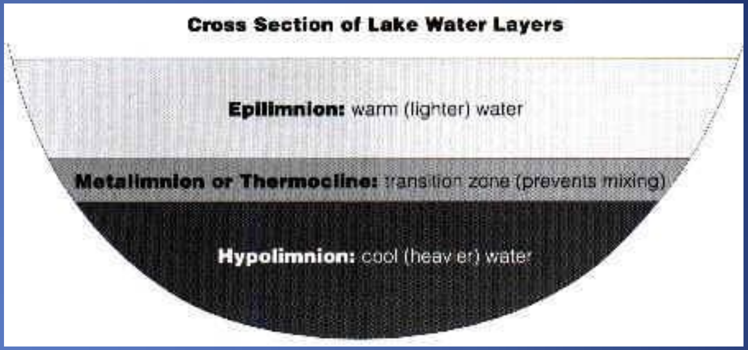
What Can We Do?

- **Investigate the storm drains, sewer lines and do regular clean outs**
  - Leakage from sewer systems can cause detergents and sludge to leak into groundwater supplies, increasing phosphorus load
  - The City has done substantial work to investigate and insure the patency of lines

- **Investigate methods of draining street water into natural filtration areas before running into storm drains: sustainable drainage**
  - Redirect storm drains to catch basins, retention basins, and detention tanks that won't drain directly to lake
  - Explore improved drainage systems – swales, bioswales, permeable paving

What Can We Do?

- In-Lake Restoration Techniques



  - Hypolimnetic aeration: pump oxygen into the hypolimnion
  - Hypolimnetic withdrawal: use siphons to remove nutrient rich water
  - Artificial circulation: aeration to expose water to oxygen (fountains, paddlewheels, air diffusers)
  - Dilution: flush the lake to reduce algae, requires lots of water
  - Nutrient diversion: may require expensive engineering to divert drains
  - Dredging: use heavy hydraulic equipment to increase depth and remove sediment
  - Nutrient inactivation: aluminum, iron, or calcium salts can inactivate phosphorus. Alum treatment (aluminum sulfate) can last eight or more years

What Can YOU Do?

HELP US SAVE

CRYSTAL LAKE

AND

KEEP IT HEALTHY

FOR YEARS TO COME