Amston Lake Annual Monitoring Report for2011

Prepared For:

Amston Lake District

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Review Draft

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EXECUTIVE SUMMARY

1. Metrics have tentatively been proposed for evaluating monitoring results as follows:
   - 1.1.1 Total Phosphorus:
     - 1.1.1.1 Epilimnion phosphorus concentration should average 10 ppb or less during the season.
       = 2011 result was 6.9 ppb.
     - 1.1.1.2 Maximum phosphorus concentration in bottom water should not exceed 20 ppb.
       = 2011 result was 21 ppb.
   - 1.1.2 Secchi Disk Depth:
     - 1.1.2.1 Seasonal average Secchi disk depth should be 5 meters or better.
       = 2011 result was 5.2 meters.
   - 1.1.3 Anoxic Boundary
     - 1.1.3.1 The anoxic boundary should not ascend above 6 meter depth (as measured down from the surface).
       = 2011 result was 5.7 meters.
2. Metrics have not been proposed yet for turbidity,conductivity, aquatic plant community, or filamentous algae growth.
   - 1.2.1 Turbidity (proposed):
     - 1.2.1.1 Seasonal average epilmnetic turbidity should not exceed 1.5 NTU.
       = 2011 result was 1.35 NTU
   - 1.2.2 Conductivity (proposed):
     - 1.2.2.1 Seasonal average whole lake conductivity should not exceed 100μmhos/cm.
       = 2011 result was 90.2 μmhos/cm.
   - 1.2.3 Aquatic plants (proposed):
     - 1.2.3.1 No invasive aquatic plants should inhabit Amston Lake (however, some invasive plants are far worse than others so this may be too inclusive).
       = 2011 survey found no invasive aquatic plants.

1.2.3.2 Native plant growths should not cause recreational impairment or nuisance conditions in the active use areas of the lake. Active use areas of the lake has not been defined yet, but is suggested here to include most lake areas except perhaps the northwestern coves.

= 2011 survey found few dense growths of native aquatic plants. Watershield in Lollypop Cove and water lilies in the southeast cove have been controlled. Very few areas of dense large-leaf pondweed were found.

1.2.4 Filamentous algae (proposed):

1.2.4.1 Dense growths of filamentous algae should not occur in any of the high use areas of the lake.

= 2011 filamentous algae was found to be common in Amston Lake, occurring at 10% of the observation points. However, few areas had dense “pillows” of algae. Use of barely straw has successfully controlled filamentous algae overgrowths.

1.2.5 Sedimentation (proposed):

1.2.5.1 Runoff from the landscape, from either natural or manmade conveyances should not deposit excessive quantities of sediment into the lake.

= 2011 season did not include evaluation of sedimentation in the lake.

1.2.6 Inlet water quality (proposed):

1.2.6.1 Runoff from the landscape, from either natural or manmade conveyances should not contain high concentrations of the plant nutrients phosphorus and nitrogen.

= 2011 season samples showed considerable decrease in phosphorus concentration of inlet water. Average phosphorus concentration from 14 samples was 25 ppb. Average phosphorus from all samples collected between 2001 and 2008 was 272 ppb.

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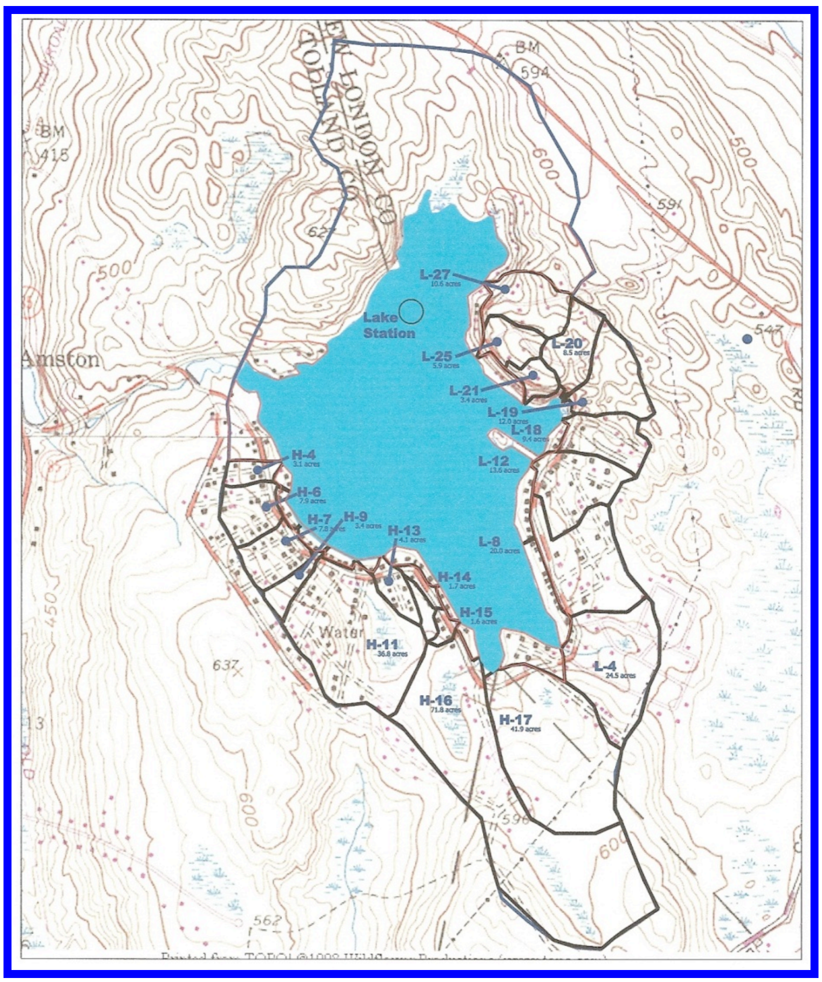
INTRODUCTION

Amston Lake is a 188acre lake in Hebron and Lebanon, Connecticut (**Figure 1**). Water quality monitoring of the lake began in 1994 and has continued annually since that time.This report presents findings of monitoring in 2011,and provides examination of aspects of the 18-year dataset (1994–2011).

The lake has a small watershed of 655 acres-the drainage basin is only 473 acres,or about 2.6 times the area of the lake (**Figure 1**). The small drainage area provides slow hydraulic flushing of the lake, once every 435 days,or about 1.2 years. This is a theoretical period of time for the lake volume to be replacedwith new water from the drainage basin.

Figure 1 – Amston Lake Drainage Basin

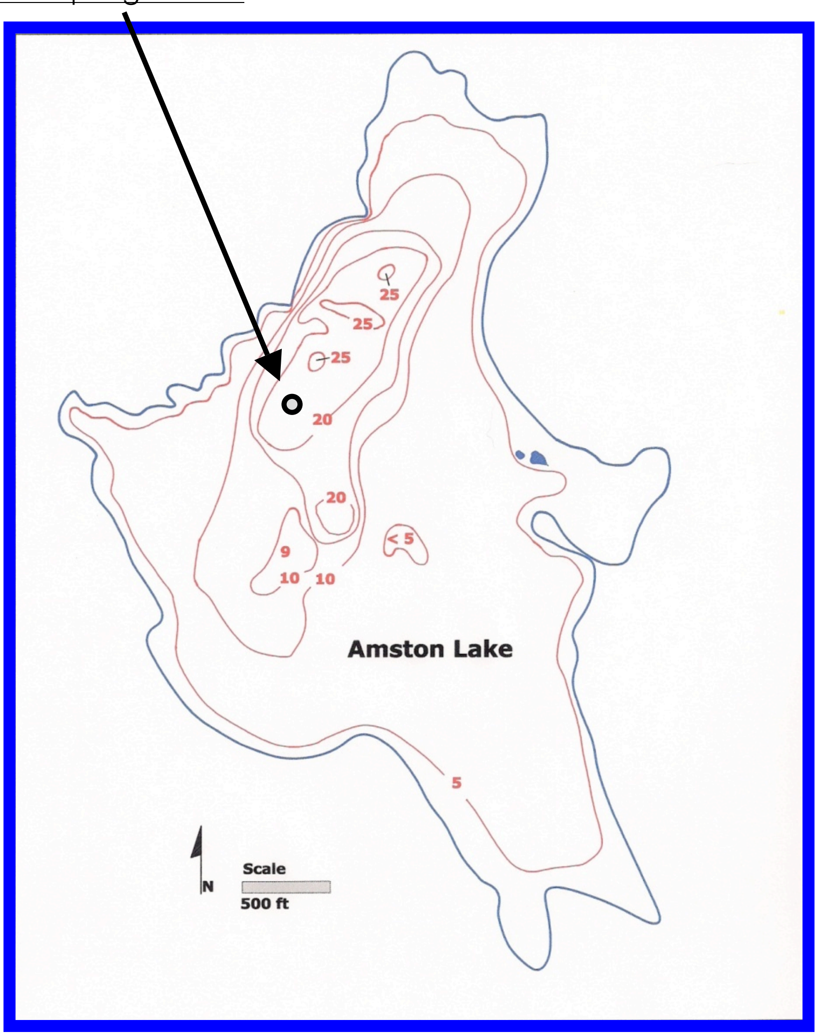


Lake water-quality monitoring was conducted by residents 7 times during the 2011 season, April 22, May 21, July 23, August 7, September 11, and

October 23, 2011. During each sampling visit, three water samples were collected at the deep-water stationwhere the water depth is approximately 25 feet deep **(Figure 2)**. Samples were taken from top, middle, and bottom depths; 1, 4, and 6 meters (3, 12, and 20 feet).In addition, sixteen measurements of water temperature, dissolved oxygen and water clarity measurements were made between May 1st and October 2nd (4/22, 5/1, 5/22, 5/30, 6/5, 6/12, 6/19, 6/25, 7/4, 7/10, 7/23, 8/7, 9/11, 9/25, 10/2, and 10/23/2011).

Figure 2 -Bathymetric map or Amston Lake showing water depth contours (ft.) and deep-water sampling station

Deep-water sampling station



2011 MONITORING RESULTS

In-Lake Water Quality

Total Phosphorus

Total phosphorus concentrations in Amston Lake during the 2011 season are given in **Table 1**.The data from 2002 through 2010areprovided in the Appendix for comparison.

Table 1 – 2011total phosphorus concentrations (ppb) from Amston Lake

Depth (m)	22-Apr	21-May	26-Jun	23-Jul	7-Aug	11-Sep	13-Oct
1	6	10	11	5	6	7	3
4	9	10	5	7	3	7	6
6	13	8	21	11	~	9	7
Average	*9.3*	*9.3*	*12.3*	*7.7*	*5.5*	*7.7*	*5.3*

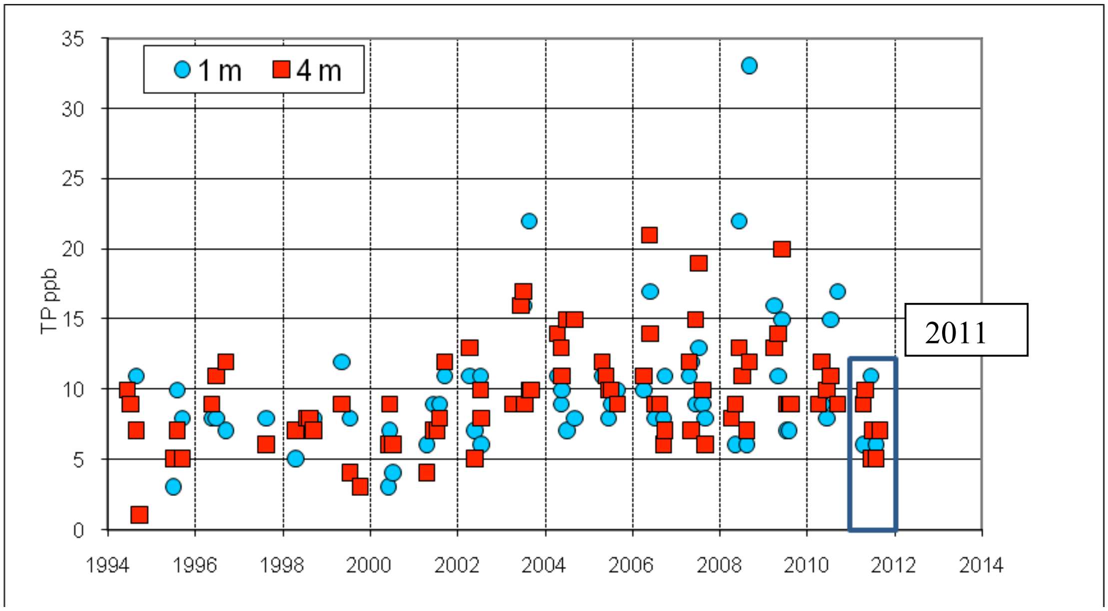
Phosphorus is the primary plant nutrient in fresh water. Generally, lake health is linked to concentration of this nutrient, with greater concentrations causing degraded lake condition. The data in **Table 1** is considered in two ways: first) the concentrations in the top (1 m) and middle (4 m) depths are assessed to determine status of trophic state,and second) the concentrations at the bottom are compared to prior deep-water concentrations to track internal loading possibility.

Epilimnion phosphorus

The 1 and 4 meter phosphorus concentrations represent the epilimnion of the lake. The epilimnion is the upper water layer of a lake where water temperatures are similarly warm allowing mixing due to wind action on the surface. The depth of the epilimnion can be easily determined from water temperature profiles and from the Secchi disk depth. Since the Secchi disk depth measures the distance into the lake that sunlight penetrates, this depth typically marks the bottom of the epilimnion. Water deeper than the Secchi disk depth is dark.

The epilimnion is usually well mixed, so samples collected from within this layer should have similar concentrations. Results of epilimnion sampling are shown in **Figure 3.** Values from 2011 ranged between 3 and 11 ppb.

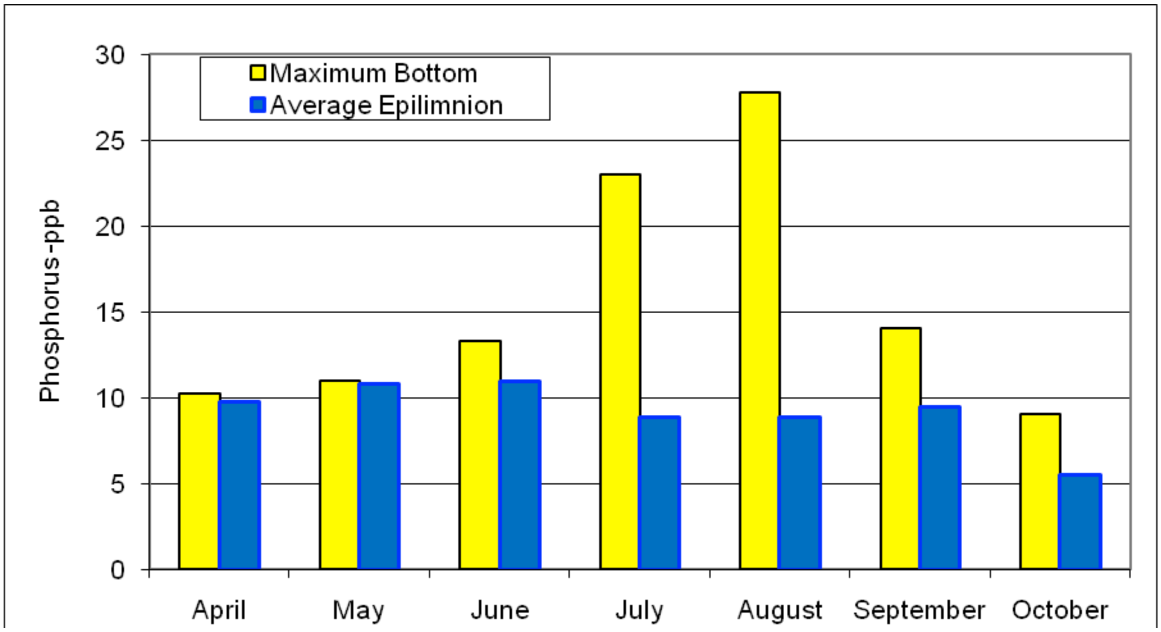
Figure 3 - Phosphorus concentrations from 1 and 4 meter depths



Bottom phosphorus

Phosphorus at the bottom of the lake, below the epilimnion, accumulates through different processes than it does in the upper waters of the lake.Figure 4 shows phosphorus concentrations in bottom water increasing during July and August while epilimnion phosphorus remains comparatively constant. During other months, concentrationat the bottom is similar, or identical, to upper waters. During July and August, water at 6 meters is without dissolved oxygen (see Figure 11pg.19). Higher phosphorus concentrations at the bottom during this time wasdue to internal recycling from either diffusion out of anaerobic bottom sediments or decomposition of accumulated organic material. The loss of dissolved oxygen from these waters is the principal causative agent in determining the resulting water quality at the bottom. The two processes, loss of dissolved oxygen and chemistry of the water combine to sustain and accelerate the condition. Although slow to start, dissolved oxygen loss and water chemistry changes in bottom water can progress quickly because of morphometric factors and feedback. The morphometry factor involves the expanding volume of anoxic water encompassing a larger surface area of bottom sediments, while the feedback involves the residuals left in the sediments after each season.

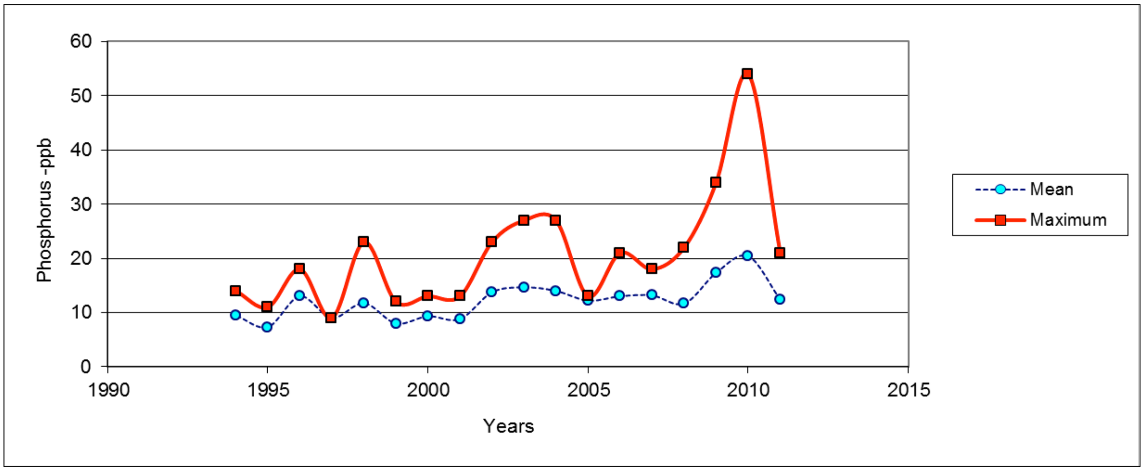
Figure 4 - Seasonality of Bottom Water Phosphorus Concentrations



For those reasons, the average and maximum phosphorus concentrations at the bottom of the Amston Lake have been tracked since monitoring began. Both average and maximum values appeared to be increasing at the close of 2010 as shown in **Figure 5** below. During the period 1994–2008, average bottom water concentration ranged between 7 and 15 ppb, with a mean of 11 ppb. The average concentrations in 2009 and 2010 were above this range, 17 ppb in 2009, and 20 ppb in 2010. The average bottom water phosphorus concentration in 2011 was 12 ppb, within the range from 1994-2008.

The maximum concentration that occurs annually is also tracked. The maximum concentration at 6 meters, typically occurring during July or August, represents the worst case condition of bottom waters during the season. The maximum seasonal concentrations between 1994 and 2008 ranged between 9 and 27 ppb with an average of 18 ppb. In 2009 and 2010, the maximum concentrations were 34 ppb and 54 ppb, respectively, a dramatic increase over prior years. The maximum concentration in 2011 was21 ppb, returning to within the established range.

Figure 5 - Phosphorus Concentrations from 6 Meter Depth



Secchi Disk Depth

The Secchi disk depth is a measure of the clarity of lake water. Water clarity is probably the most important of limnological parameters because it involves,to some degree, most other aspects of lake condition. Declining clarity affects temperature, dissolved oxygen, usable aquatic habitat, growth of aquatic plants, releases of minerals and metals from sediments, shifts in plankton composition, and loss of aesthetic and economic value. Secchi disk depth also estimates depth of the epilimnion layer and the depth of the littoral zone, the part of the lake where aquatic plants can grow. The water clarity is directly linked to phosphorus concentration in the water. Increasing phosphorus causes decreasing water clarity.

Secchi disk depth at Amston Lake was measured 15 times during the 2011season (Table 2). Average for the year was 5.2 meters (17 feet) the range of the readings was between 3.7 meters and 6.9 meters, an excellent water clarity season. The last reading of the season (6.9 meters -22.6 feet taken on October 23, 2011), was a few feet shy of the bottom of the lake, meaning that sunlight was reaching bottom sediments throughout the lake at that time.

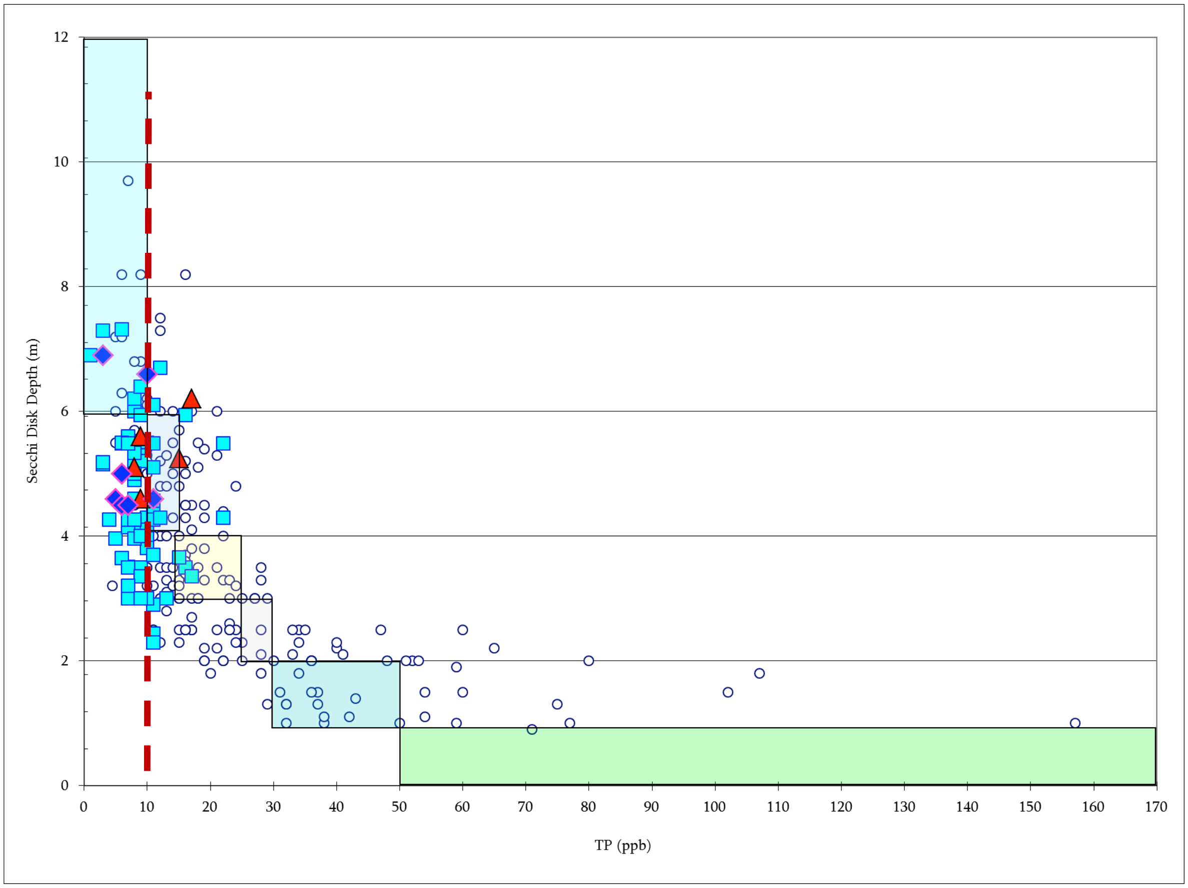
Table 2 – 2011 Amston Lake Secchi disk depths

Depth	22-Apr	8-May	22-May	30-May	5-Jun	12-Jun	19-Jun
Meters	5.0	6.0	6.6	5.2	5.0	4.5	3.7
(Feet)	(16.4)	(19.7)	(21.7)	(17.1)	(16.4)	(14.8)	(12.1)

Depth	25-Jun	10-Jul	23-Jul	7-Aug	11-Sep	25-Sep	2-Oct	23-Oct
Meters	4.6	5.1	4.6	4.5	4.5	5.7	5.7	6.9
(Feet)	(15.1)	(16.7)	(15.1)	(14.8)	(14.8)	(18.7)	(18.7)	(22.6)

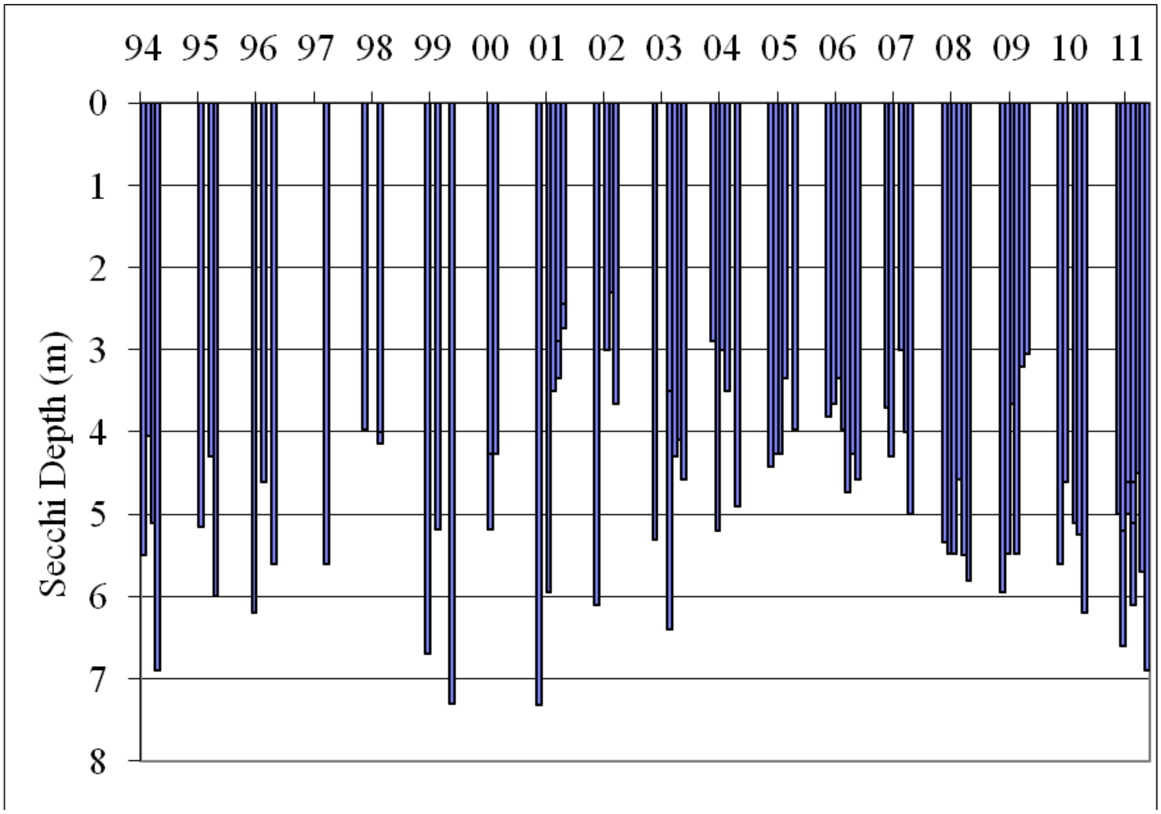
The relationship between phosphorus and Secchi disk depth is shown in Figure 6 with Amston Lake data shown as blue squares, 2010 values shown as large red triangles, and 2011 values shown as purple diamonds. The open circles are from CT lakes sampled by the CT Agricultural Experiment Station in the 1970's. The relationship shows a couple of important aspects of lake function. First, lakes with low phosphorus (less than 10 ppb)have wide fluctuation in water clarity indicating that lake clarity varies from year-to-year naturally and that clarity is extremely sensitive to tiny changes in phosphorus. Second, as phosphorus increases from 10 to 30 ppb, water clarity decreases from about 6 meters to about 2 meters, a loss of 4 meters of clarity with 20 ppb additional phosphorus concentration in the lake. The decline in water clarity is almost always caused by a progressive increase in blue-green algae. Third, once phosphorus has increased to concentrations in excess of 30 ppbwater clarity shows very little additional decreases as phosphorus continues to increase. This is due to the overwhelming dominance of blue-green algae in the water column that has become so thick that sunlight becomes limiting to further algae growth. Forth, as phosphorus concentration increases the sensitivity to shifting lake condition declines rapidly. This last aspect means that as phosphorus in the lake increases causing clarity to decline, the likelihood of being able to reverse the condition diminishes.

Figure 6 - Phosphorus vs. Secchi disk depth (triangles 2010, and diamonds 2011, and blue squares all remaining Amston data) in Amston Lake, together with CT lake data (open circles)



Generally, the Amston Lake data falls to the left of 10 ppb phosphorus line (red dashed line in **Figure 6)** indicating that the lake is oligotrophic, or in the best water quality category. The lake experiences wide fluctuation in clarity response from year-to-year, as shown by the blue squares in **Figure 6** ranging from 2.3 meters to 7.3 meters, and the bars in **Figure 7**, which shows all Secchi disk measurements made to date at Amston Lake. The time series of Secchi disk data in **Figure 7** shows changes in clarity over the last 18 years. The period when clarity had declined and was becoming poor, between 2001 and 2008, is easily seen, as well as the noticeable improvement in clarity since that time.

Figure 7 - Secchi disk depth record for Amston Lake, 1994–2011



Specific Conductance

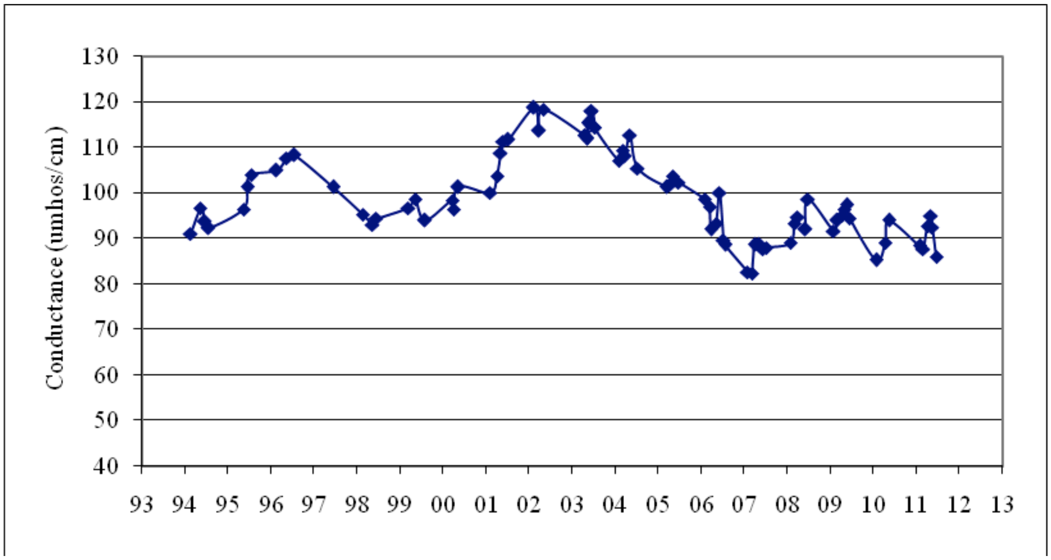
The specific conductance is the capacity of water to carry an electrical current. The conductivity is directly proportional to the amount of salts dissolved in the water. Typically,the salts originate from road runoff and domestic wastewater disposal. Conductance values from 2011 are given in **Table 3**. The history of conductivity of the Amston Lake water is shown in **Figure 8**.

The conductance of the lake water steadily increasedfrom what could be considered background levels of 90 µmhos/cm in 1994, to peak values of 120 µmhos/cm in 2002. Conductivity of lake water declined between 2003 and 2006, with stable readings that average 91µmhos/cm since that time.

Table 3 - Conductance (µmhos/cm) valuesfrom Amston Lake during 2011

Depth (m)	22-Apr	21-May	26-Jun	23-Jul	7-Aug	11-Sep	23-Oct
1	87	86	92	94	93	86	86
4	89	89	92	93	92	86	87
6	89	88	94	98		86	88

Figure 8– Long-term trend inconductivity of Amston Lake water



Turbidity

Turbidity is a measure of the cloudiness of the water. Lake water becomes cloudy due to either suspended sediments or planktonic algae. The turbidity of surface waters (1 meter sample) averaged 1.4 NTU for the 2011 season (**Table 4**).As an example, the highest amount of turbidity allowed by law in drinking water is 5 NTU. Poland Spring water typically has a turbidity of 0.05 NTU. High readings of 4.4 NTU at 4 meters in April, and 2.4 NTU at the surface in August are unexplained. Slightly elevated readings in May and June could have been due to pollen. The high reading of 4.1 at 6 meters in June is probably due to onset of anoxic water at that depth.

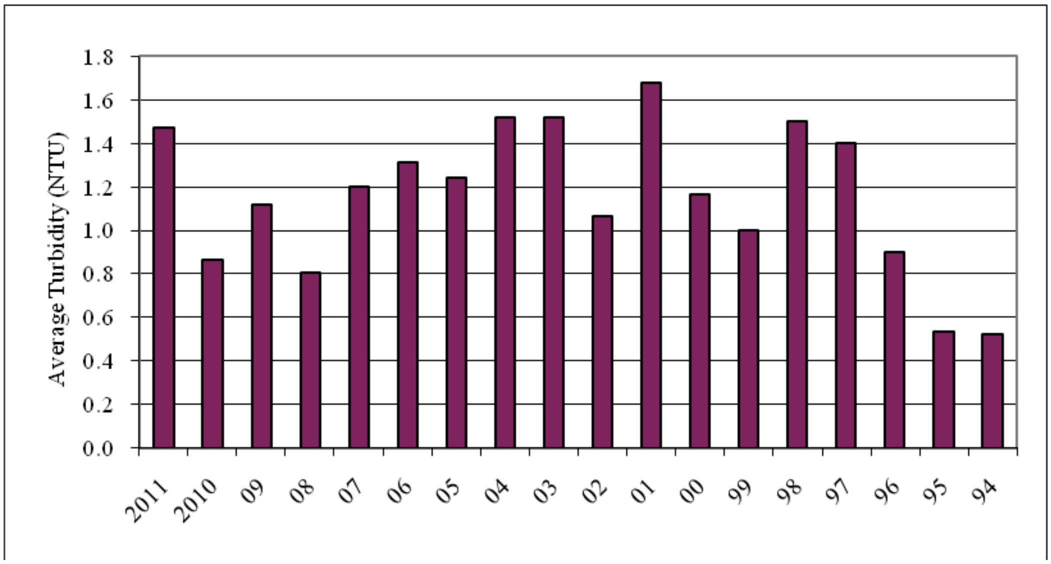
Table 4 - Turbidity (NTU) values from Amston Lake water in 2011

Depth (m)	22-Apr	21-May	26-Jun	23-Jul	7-Aug	11-Sep	23-Oct
1	0.7	1.6	1.4	0.6	2.4	0.7	0.21
4	4.4	1.2	1.3	0.7	1.3	2.3	0.13

6	0.7	1.8	4.1	1.6	No data	1.4	0.33

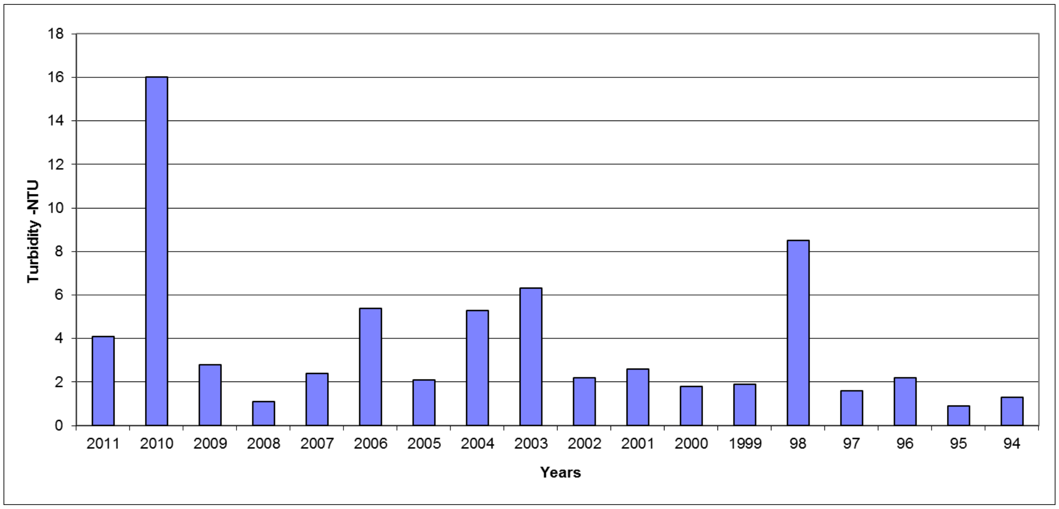
The trend in average turbidity of Amston Lake water over the last 18 years is shown in Figure 9. Data from 2011 appears to be in contrast to declining turbidity in the lake seen over the last several years.

Figure 9 -Average annualturbidity (NTU)at Amston Lake, 1994–2011



The maximum bottom water (6 meters) turbidity measured during 2011 was consistent with prior data results prior to 2010, Figure 10. Most maximum values, occurring during summer months of July and August, have been about 2 NTU, although a few have been as high as 6 NTU with the highest prior reading at 8 NTU. The highest value in 2010 was 16 NTU, twice the highest prior reading.

Figure 10 – Maximum bottom water turbidity (NTU) at Amston Lake, 1994–2011



Temperature / Dissolved Oxygen Conditions

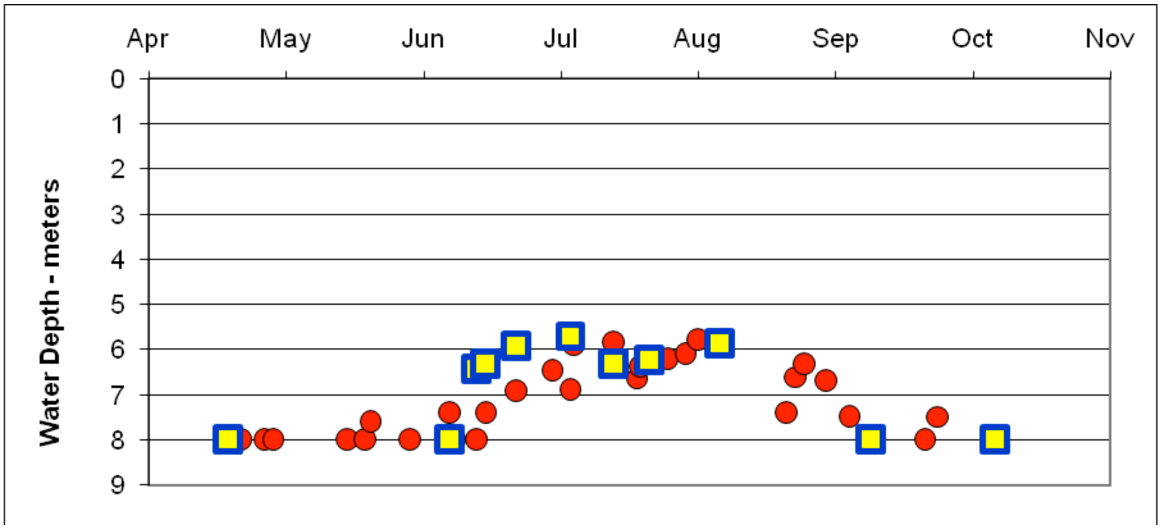
Temperature

Profile data was collected 16 times during 2011 (see page 8 for dates). Temperature data was similar to prior seasonswith stratification occurring in July and August and complete lake mixed by September. Mixed is defined by having similar water temperatures from the top to the bottom of the water column. When the lake is stratified, there is a layer of cooler, isolated, water at the bottom.

Dissolved Oxygen

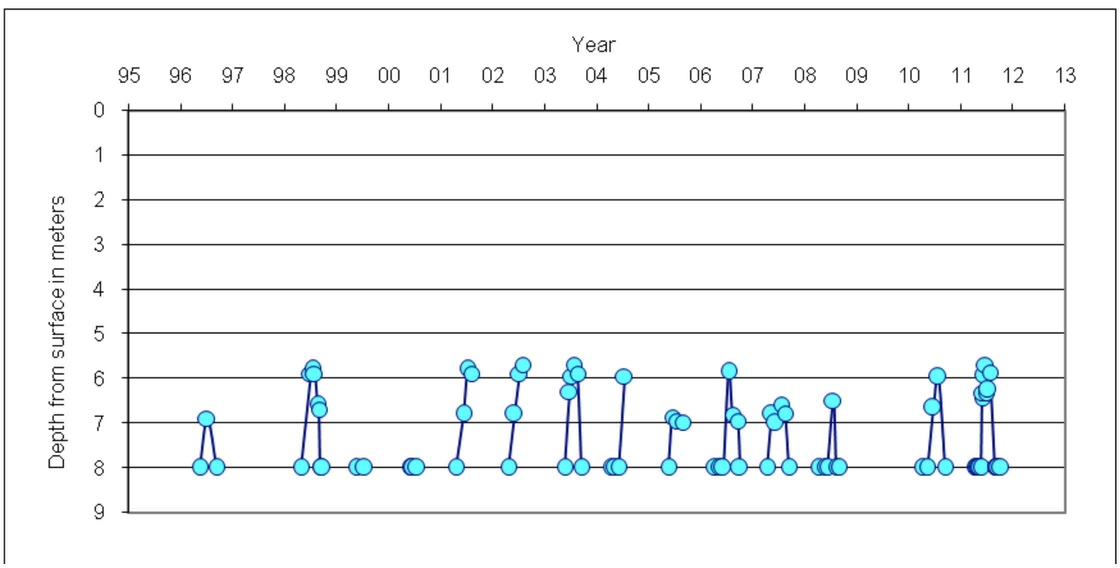
Dissolved oxygen in the water is principally diffused from the atmosphere but is also produced by aquatic weeds and algae. Water can hold only limited amounts of dissolved oxygen, referred to as the saturation limit, whichis dependent on the water temperature. Water near the bottom of the lake, in the deepest strata, can become isolated from the plants and the atmosphere during the summer when the lake is stratified. During this period, early June to early September, dissolved oxygen near the bottom is completely depleted by bacterial decomposition of organic matter (Figure 11). When dissolved oxygen decreases to zero the water is referred to as anoxic. Anoxic water, or anoxia,allows phosphorus and ammonia nitrogen to be released from sediments.

Figure 11–Composite trend in development of anoxic water at the bottom of Amston Lakeusing data from all years on record (solid red circles) and 2011 measurement only (blue/yellow squares)



No anoxic boundary was detected in 1995, 1999, or in 2000, and only brief anoxia was observed in 1996. Sustained anoxic water was first recorded in 1998 when the boundary reached 5.8 meters (measured as the depth below the surface) near the end of July. No dissolved oxygen data was collected in 1994, 1997, or 2009. Anoxic water has been detected near the bottom of the lake annually since 2001 as shown in **Figure 12.**

Figure 12 - Trend in anoxic boundary development at Amston Lake 1996–2011



Drainage Basin Sampling

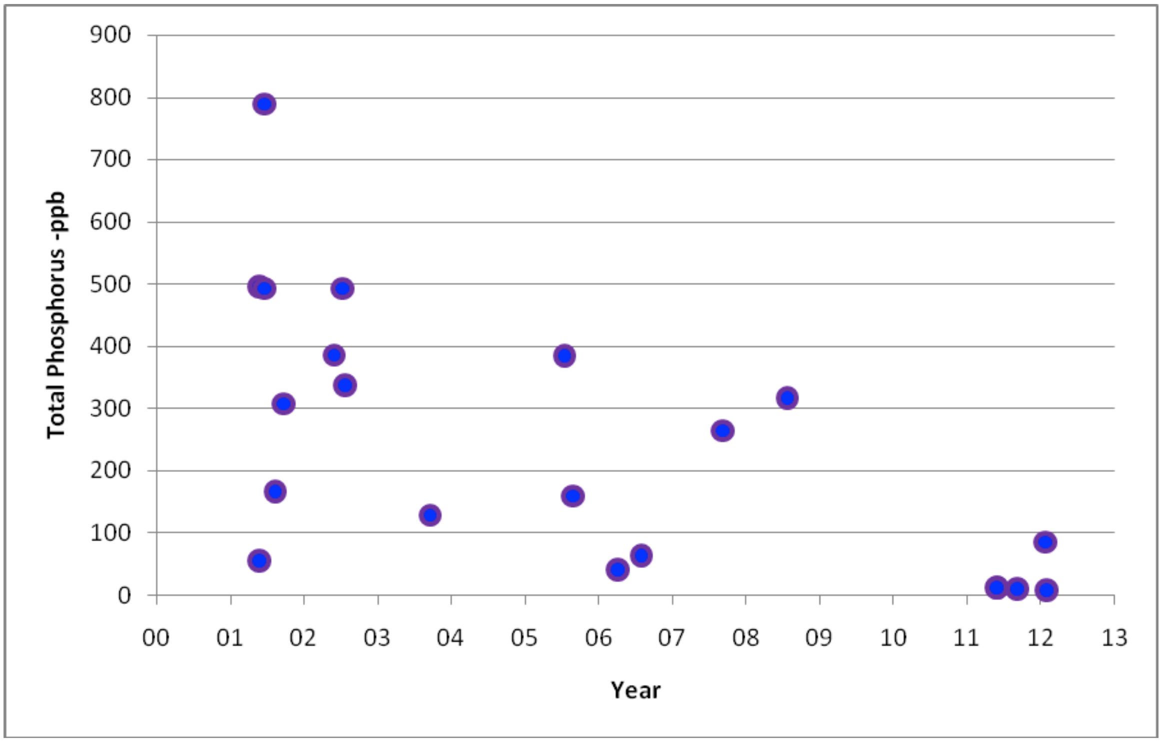
Water samples from inlet drains to Amston Lake were collected three times in 2011, and twice so far in 2012. Only a few of the many identified inlets to the lake were sampled (**Table 5**). Phosphorus results from the 2011-2012 samples were very low compared to prior sampling results. Means of the sample results, given in **Table 5,** are less than 20 ppb –except one sample of 143 ppb collected from L-8 that brought the mean for that eventup to 86 ppb.

Table 5 – Recent storm drain phosphorus results

	2/5/2012	1/29/2012	9/11/2011	6/5/2011	6/4/2011
Drain #					
H-4					
H-6			5		13
H-7					
H-9			6		
H-11	13		7	20	
H-13					
H-14	5			9	
H-16			27	10	
H-17			9		
L-3					
L-4		29			
L-8		143			
L-12					
L-17					
L-19					
L-20					
L-21					
L-25					
L-27					
L-28A					
L-28B					58
L-30					
L-44					
L-49					
Mean	9	86	11	13	19

These results are extremely encouraging because they are so much lower than prior data (see **Table 6** for prior data). Means from all collection events are shown graphically in **Figure 13**. The chart shows the startling decrease in phosphorus in the inlet water to the lake. If these new values are representative of the water quality flowing into Amston Lake, the total lake loading of phosphorus from the drainage basin should be considerable lower than before.

Figure 13 – Storm drain phosphorus results for Amston Lake inlets



Based on these preliminary results, it appears warranted to re-sample as many of the inlets as possible in 2012. Water samples should be collected from both natural water courses and culvert outfalls at the point of entry to the lake. To be most productive, the samples should all be collected on the same day. Sets of samples should also be collected during both dry and wet weather conditions.

Table 6 - Amston Lake storm water testing results, 2002-2008

	2008		2007		2006		2005			
Site	**7-29**		**9-11**		**4-8**		**7-19**		**8-30**	
	TP	Nitrate	TP	Nitrate	TP	Nitrate	TP	Nitrate	TP	Nitrate
All results in ppb										
H-4	465	285			21	885	355	460		

H-6	530	290	311	112	64	135	425	305		
H-7	400	1,000	256	120	18	445	300	289		
H-9	370	375	264	128	97	225	795	294		
H-11	290	310	204	104	41	170	350	239	166	48
H-13	13	< 20								
H-16			360	370	23	45	134	283	181	450
H-17	256	355	~	~	18	185	635	555	132	2,700
L-3			~	~	43	230	~	~	~	~
L-4	213	445	116	280	43	165	144	460	157	249
L-8			~	~	41	200	300	770	191	380
L-12			395	56	75	965	252	1,100	257	490
L-17					46	810	~	~	~	~
L-18			217	330						
L-19					16	485	152	500	161	206
L-22					~	~	~	~	220	188
L-25					28	770	~	~	110	910
L-27					11	200	~	~		
L-28A					30	2,020	310	< 20	425	360
L-28B					64	1,850	~	~	~	~
L-30					7	<20	~	~	~	~
L-44					9	<20	~	~	~	~
L-49					13	110	~	~	~	~

	2001					2002		
Site	**5-23 6 PM**	**6-17 8:30**	**6-17 9:45**	**8-13**	**9-21**	**5-30**	**7-12**	**7-23**
Total phosphorus (ppb)								
H-4		595				245	670	
H-6					182	595		
H-7		480				320	275	
H-9		580		219	434	422	685	
H-11		320	790	149		430	344	324
H-13				132				
H-14								
H-16								764
H-19								620
L-4	41					214		383
L-8	72					103		91
L-12	55					240		72
L-19						980		320
L-21								129
L-22						317		

Aquatic Plants

The aquatic plants in Amston Lake were surveyed by NEAR on June 30, 2011 and October 7, 2011. To-date, no invasive species have been found in Amston Lake. Thelist of aquatic plants found in Amston Lake is given in **Table 7**. The table includes both CT Agricultural Experiment Station (CAES) survey results from 2006, and NEAR survey results from 2011. Between the two surveys, 26 species of aquatic plants have been found in Amston Lake so far.

Of that number, 7 or 9species (depending on which survey is considered) are common to abundant (having a frequency of 10% or greater),with remaining species uncommon to very scarce.

Wild celery is the most abundant aquatic plant species in Amston Lake showing little change in frequency between the two surveys. The occurrence of this species is widely distributed around the lake. Large-leaf pondweed appears to have decreased in abundance between 2006 and 2011, while Robbins pondweed shows a similar increase over the same time period. Watershieldshows an increase in abundance despite control measures taken to reduce coverage of this plant in Lollypop Cove. This apparent discrepancy is probably a function of the slightly different survey methods. Common waterweed and stonewort showed large decreases in abundance. These changes may be due to the increase in Robbins pondweed as the latter plant may be replacing the former two. Most other species showed little to no change between the two surveys. Some of these species that registered little change, such as white water lily and arrowhead, show difference in abundance that are probably related to differences in survey methods.

Not shown in **Table 7** is the occurrence of dense filamentous algae. During the CAES survey, filamentous algae was found at a frequency of 2%, while in 2011, NEAR found dense filamentous algae to have a frequency of 12%, indicating these growths had become more plentifully around the lake.

Table 7–Percent occurrence of aquatic plantspecies in Amston Lake

Common Name	Scientific Name	Frequency (%)	
		2006	2011
Wild Celery	*Vallisneriaamericana*	64	65
Robbins Pondweed	*Potamogetonrobbinsii*	35	60
Large-leaved Pondweed	*Potamogetonamplifolius*	48	27
Watershield	*Braseniaschreberi*	4	13
Waterweed	*Elodea nuttallii*	36	12
Water Naiad	*Najasflexilis*	11	11
White Water Lily	*Nymphaeaodorata*	3	10
Arrowhead	*Sagittariagraminea*	12	5
Tiny-leaved Pondweed	*Potamogetonbicupulatus*	3	4
Purple Bladderwort	*Utriculariapurpurea*	0	3
Floating-leaf Pondweed	*Potamogetonnatans*	1	3
Pickerelweed	*Pontederiacordata*	1	3

Coontail	*Ceratophyllumechinatum*	2	2
Leafy Pondweed	*Potamogetonepihydrus*	0	2
Yellow Water Lily	*Nupharvariegata*	2	2
Slender Pondweed	*Potamogetonberchtoldii*	0.5	1
Clasping-leaved Pondweed	*Potamogetonperfoliatus*	1	1
Leafless Milfoil	*Myriophyllumtenellum*	8	1
Spikerush	*Eleocharisacicularis*	4	1
Waterwort	*Elatine minima*	4	1
Tiny Duckweed	*Lemna minor*	1	1
Bladderwort	*Utriculariagibba*	0.5	0
Bladderwort	*Utriculariaradiata*	0.5	0
Pipewort	*Eriocaulonaquaticum*	0.5	0
Stonewort	*Chara*	28	0
Muskgrass	*Nitella*	0	6

SUGGESTED ACTIONS FOR 2012

An extensive revision was made to the ALD goals and Objectives for this report. Perhaps the most important action item for 2012 would be for ALD Board of Directors to review this list and make adjustments where appropriate. Additional actions to be considered during 2012 are as follows:

1. Metrics have been suggested for evaluating the lake monitoring data collected annual from the Deep-water station, these should be examined for continuity with the vision for Amston Lake, and determined to reflect feasible and attainable goals for lake water quality.
2. Additional metrics may be needed to help interpret other parameters, or new parameters may be considered for future monitoring.
3. Metrics are needed to assess aquatic plant growths in the lake. Currently no details have been formalized that provide descriptions of allowable plant growth, acceptable types of growth, and areas where natural plant communities will be tolerated. A method is needed for evaluating the success of treatments and other control strategies that includes quantifiable ways of measuring satisfactory levels of control.
4. Re-sample as many of the inlets to the lake as possible. Sampling should be conducted during both dry and wet weather conditions. As many events should be performed during the season as possible. During each event, collections should be made on the same day.
5. Prioritize the storm water discharge sites around the lake to facilitate choosing locations for improvements to the storm water conveyance system.
6. Monitor the Northwest Cove to verify improvements post-dredging. Design and install vegetated rain-garden or other nutrient trapping system on the lots.Based on the success of installed raingardens at Northwest Cove, other drains around the lake could be considered for rain gardens.

Actions Roster

1. Continue monitoring the lake at deep-water station for water quality parameters (clarity, temperature, dissolved oxygen, phosphorus, nitrogen, conductivity, and turbidity) monthly between April and October.

1.1	Deep-water Testing Event Log

1994	Four tests = June, July, August, September
1995	Three tests = June, August, September
1996	Three tests = May, July, September
1997	One test = August
1998	Four tests = April, July, August, September
1999	Three tests = May, July, October
2000	Three tests = June, June, July
2001	Five tests = April, June, July, August, September
2002	Four tests = April, June, July, August
2003	Six tests = April, July, July, July, August, September
2004	Five tests = April, May, June, July, September
2005	Five tests = April, May, June, July, September
2006	Seven tests = April, May, June, July, August, September, October
2007	Six tests = April, May, June, July, August, September
2008	Six tests = April, May, June, July, August, September
2009	Six tests = April, May, June, July, August, September
2010	Five tests = April, May, July, August, September
2011	Seven test = April, May, June, July, August, September October

1.2	**Water Quality Condition Tracking**	
1.2.1	**Phosphorus Concentration Results (Epi<10 ppb, Bottom Max <20 ppb Spring Average <10 ppb)**	
1994-2000	Epi Average = 6.9 ppb Bottom Max = 9 – 23 ppb ↑(1 value exceeds)	
2001	Epi Average = 8 ppb Bottom Max = 13 ppb	Spring = 5 ppb
2002	Epi Average = 8.8 ppb Bottom Max = 13 ppb	Spring = 11 ppb ↑(exceeds)
2003	Epi Average = 13 ppb ↑(exceeds) Bottom Max = 27 ppb ↑(exceeds)	Spring = 9 ppb
2004	Epi Average = 11.3 ppb ↑(exceeds) Bottom Max = 27 ppb ↑(exceeds)	Spring = 11 ppb ↑(exceeds)
2005	Epi Average = 10 ppb Bottom Max = 13 ppb	Spring = 12 ppb ↑(exceeds)
2006	Epi Average = 17 ppb ↑(exceeds) Bottom Max = 21 ppb ↑(exceeds)	Spring = 11 ppb ↑(exceeds)
2007	Epi Average = 10.9 ppb↑ (exceeds) Bottom Max = 18 ppb	Spring = 12 ppb ↑(exceeds)
2008	Epi Average = 12.2 ppb ↑(exceeds) Bottom Max = 22 ppb ↑(exceeds	Spring =8 ppb
2009	Epi Average = 11.6 ppb ↑(exceeds) Bottom Max = 34 ppb ↑(exceeds)	Spring = 13.7 ppb ↑(exceeds)
2010	Epi Average = 10.9 ppb ↑(exceeds) Bottom Max = 54 ppb ↑(exceeds)	Spring = 8.7 ppb
2011	Epi Average = 6.9 ppb Bottom Max = 21 ppb ↑(exceeds)	Spring = 9.3 ppb

1.2.2	Phosphorus Estimated Annual Load in kg P/ yr (<100 kg P/yr)
1994-1998	94
1999	124 ↑(exceeds)
2000	45
2001	57
2002	124 ↑(exceeds)
2003	102 ↑(exceeds)
2004	124 ↑(exceeds)
2005	136 ↑(exceeds)
2006	134 ↑(exceeds)
2007	136 ↑(exceeds)
2008	90
2009	155 ↑(exceeds)
2010	98
2011	105

1.2.3	Water Clarity Results - Seasonal Averages in meters (>5 meters)
1994	4.6 ↓(deficient)
1995	5.2
1996	5.5
1997	5.6
1998	4.6 ↓(deficient)
1999	6.0
2000	4.6 ↓(deficient)
2001	4.0 ↓(deficient)
2002	3.8 ↓(deficient)
2003	4.5 ↓(deficient)
2004	3.8 ↓(deficient)
2005	4.1 ↓(deficient)
2006	4.0 ↓(deficient)
2007	4.0 ↓(deficient)
2008	5.2
2009	4.5 ↓(deficient)
2010	5.4
2011	5.2

1.2.4	Anoxic Boundary Maximum Ascent Depth in meters below the surface (<6 meters)
1996	6.9
1998	5.8 ↑(exceeds)
1999	bottom - no anoxia

2000	bottom - no anoxia
2001	5.8 ↑(exceeds)
2002	5.7 ↑(exceeds)
2003	5.7 ↑(exceeds)
2004	5.95 ↑(exceeds)
2005	6.87
2006	5.85 ↑(exceeds)
2007	6.58 ↑(exceeds)
2008	6.5
2009	~ no data
2010	5.97 ↑(exceeds)
2011	5.69 ↑(exceeds)

2. Develop, maintain, and refine an aquatic plant management plan.

2.1	Conduct seasonal aquatic plant reconnaissance include one scan for invasive plants.
1996	First aquatic plant survey performed by Ecosystem Consulting Service - no invasive aquatic plants, dominant plants were Robbins pondweed, large-leaved pondweed, and wild celery in deeper water, and white and yellow lily and watershield in shallow coves.
1998	July = Aquatic plant surveyconducted by Northeast Aquatic Research– no invasive aquatic plants, Large-leaf pondweed growth extensive forming a band around the lake, watershield and water lilies beds prolific.
1999	June and August = NEAR conducted two aquatic plant surveys – no invasive aquatic plants, Large-leaf pondweed growth extensive, watershield and water lilies beds prolific.
2000	June= NEAR conduced one aquatic plant survey - – no invasive aquatic plants, Large-leaf pondweed growth extensive, watershield and water lilies beds prolific. Filamentous algae growth reported to be extensive around culvert outfalls.
2001	June and September = NEAR conducted two aquatic plant surveys - no invasive aquatic plants. Robbins pondweed that once covered most of the bottom of the lake was gone.
2003	July = NEAR conducted reconnaissance of aquatic plant beds finding no return of Robbins Pondweed. Water lily hydroraking performed in August
2004	June=-NEAR conducted one aquatic plant survey no invasive aquatic plants. No return of Robbins Pondweed was found. Expansion of watershield and water lilies in both the southern and Lollypop coves.
2005	June = NEAR conduced one aquatic plant survey - no invasive aquatic plants. Watershield continues to expand in Lollypop Cove. Northeast Cove
2006	August = CT Agricultural Experiment Station conducted invasive species survey of Amston Lake: No invasive species were found.
2007	Aquatic plants observed by Residents - No invasive species reported. Evidence provided that Robbins Pondweed is making a comeback. Also, additional bottom covering species including Naiad and Nitella were observed growing in 6 -8 feet of water.
2008	July = NEAR conducted one aquatic plant survey - no invasive species reported.There are large beds of beneficial Robbins Pondweed in Southwest Cove and in front of H-11.
2009	July = NEAR conducted one aquatic plant survey - no invasive species found. Robbins Pondweed shows continued re-growth around the lake.
2010	August = Residents conducted sampling for invasive weeds along transects in three locations: near boat launches at Main Beach and Lollipop Cove ROW. No invasive species found.
2011	June/October = NEAR conducted whole lake plant survey –no invasives found

2.2	Develop detailed goals for the watershield management program.
2003	Inner end of Lollypop Cove hydroraked to remove dense water lily growths
2007	Resident volunteers meet to hand pull watershield and lilies in August. Results were short lived.
2008	The ALD Board mailed detailed information on watershield and lily control options to all residents in March 2008. The ALD Board held an informational meeting for residents on watershield and lily control options in early May 2008. District voted in May to use glyphosate (Rodeo) to control watershield and lilies (floating leaved plants). Application to take place in late summer at locations to be determined by

	the Weed Committee. Priorities were Lollipop and Frances Coves. Rodeo was applied to floating leaved plants (watershield and water lily in Frances Cove and Lollipop Cove on September 17, 2008.
2009	Rodeo treatment of watershield and waters lilies in 2009 was very effective. The floating beds were greatly reduced. In October, the ALD Board considered touch-up treatment in 2010.
2010	Rodeo touch-up treatment was done in early September 2010 in the same areas as in 2008. Rodeo treatment follow up contamination tests on wells were completed and all results were negative (no contamination).
2011	No actions required.

2.3	**Identify other areas around the lake where watershield and water lilies are a nuisance.**
2010	Weed committee is investigating other areas in Amston Lake that may need treatment and/or monitoring.
2011	No information

2.4	**Continue with the demonstration of barley straw as a way of controlling filamentous algae at the storm water outfalls.**
2007	Whole barley straw bales were put in the lake at the H-11 outflow in the spring and were removed in the fall. Filamentous algae was significantly reduced at H-11
2008	Barley straw was used again at H-11 and other areas of the lake and has been successful in reducing algae. Still need to investigate areas that drain into the Lake.
2009	Barely straw was relatively unsuccessful compared to previous years. Factors may have included a very wet cold spring. Still need to investigate areas that drain into the lake.
2010	Barley straw was more successful this year. Still need to investigate areas that drain into the lake.
2011	Barley straw was more successful this year. Still need to investigate areas that drain into the lake.

2.5	**Initiate and maintain a boat inspection program. Every effort should be made to keep out invasive weeds. This is a high priority of the ALD Board.**
2006	Boat launch inspection program is initiated. All boats entering Amston Lake on trailers must be inspected prior to the trailer entering the water. No invasive plant species were found.
2007	Boat launch inspection program continued. More boat launch inspectors are needed. No invasive plant species were found.
2008	Boat launch inspection program continued. No invasive species found.
2009	Boat launch inspection program continued. No invasive species found.
2010	Boat launch inspection program continued. No invasive species found.
2011	Boat launch inspection program continued. No invasive species found.

2.6	**Designate areas where floating leaved plants can flourish naturally.**
	No Action

2.7	**Conduct pre and post herbicide treatment surveys.**
	No Action

3. Maintain active involvement in the process to install sanitary sewers on the Lebanon side of Amston Lake.

3.1	Maintain involvement with Lebanon Waste Water Study and Sewer Implementation. ALD resident(s) to serve on Lebanon WPCA.Keep in communication with DEP officials.
2006	Lebanon approved 2 year funding for Amston Lake Wastewater Study & hired Wright Pierce to conduct the study. Wright Pierce began work on the study. Lebanon conducted several public hearings on the study in 2006 – 2007.
2007	Wright Pierce completed the Amston Lake Wastewater Plan in June 2007. Lebanon Board of Selectmen accepted and endorsed the final draft of the Wright Pierce Plan in November. The Plan recommends installation of low-pressure sewer system connected to Hebron.
2008	Lebanon Selectmen met in July '08 on the plan, to install a low pressure sewer system on the Lebanon side of Amston Lake. The plan was submitted to the DEP in January '08. As of 8/1/08, DEP had not yet approved the plan. No recommendation was made in the plan as to which streets will be sewered. This aspect is to be determined by the to-be-established WPCA. Lebanon passed an ordinance to establish a WPCA.
2009	Lebanon WPCA constituted. Two ALD Lebanon residents appointed to WPCA. State files Consent Order for Lebanon to follow the recommendations of the Wright Pierce study (e.g., implement sewers). Lebanon WPCA obtains preliminary project pricing.
2010	Lebanon voters approve the Amston Lake project at referendum in May. Lebanon WPCA hires Fuss & O'Neill of Manchester to design the sewer project. Field surveys and design work in full swing at end of year. Primary source of funding is determined to be USDA Rural Development. Negotiations with Hebron, Colchester and East Hampton on inter-municipal agreements ongoing.
2011	Update?

4. Continue monitoring bathing beaches for indicator bacteria during the summer months.

4.1	Maintain active summer beach monitoring for bacterial indicators.
2006	All tests completed throughout summer months.
2007	All tests completed throughout summer months.
2008	E coli found in some Lebanon side streams, lake samples had only low levels.
2009	All tests completed to date.
2010	All tests completed to date. Several beach closings were required this year due to high E-coli readings in several areas.
2011	No information.

5. Investigate, monitor, and develop storm water control program.

5.1	Continue to monitor water quality from storm drains. Maintain a database of storm drain data.

2001	2 to 4 storm drains sampled during 4 rain events
2002	4 to10 storm drains sampled during 3 rain events
2005	10 to 12 storm drains sampled during 2 rain events
2006	19 storm drains sampled during 1 rain event
2007	8 storm drains sampled during 1 rain event
2008	8 storm drains sampled during 1 rain event
2009	No storm water samples collected
2010	No storm water samples collected
2011	15 samples collected in 2011 and early 2012 = results show very low phosphorus

5.2	Prioritize the outfalls in order of severity based on the total load and nutrient concentration. Identify and catalogue storm drain outfall points that are causing filamentous algae growth. at least from H-11, H-16, H-17, and L4
2006	H17 and H16 (SW Cove), H-11 (Bass Lake Road) and L4 (351 Deepwood) were recognized as priorities for Storm Drain remediation. The Lake Scientist advised us to obtain the Connecticut DEP Storm Water Guidance manual at http://dep.state.ct.us/wtr/stomwater/strmw An older ALD Storm Drain Committee created a written analysis as to which of the Lebanon roads need better storm drain control.

5.3	Estimate the water flows during at least one storm from high priority culverts.
2006 - 2011	No action

5.4	Prioritize the storm drain culverts in order of severity of pollutant discharge: Target reduce sediment input to Amston Lake from storm drains by 75%.
2006	Hebron swept in March. Lebanon swept in May. Hebron cleaned storm drains. Lebanon did not clean storm drains.
2007	Hebron swept in March. Lebanon swept in April. Hebron cleaned storm drains. Lebanon cleaned storm drains. Hebron Amston Lake Storm Water study draft completed.
2008	Hebron has swept 2 times in March. Hebron Amston Lake Storm Water study final report is due.
2008	Both towns swept early this year. Need to continue asking Towns to keep storm drain sumps cleaned out. Need to monitor construction for sediments.
2009	Streets swept as per normal Town practice.
2010	Streets swept as per normal Town practice. Dave O'Brien working with Town of Hebron to replace one of the Deepwood Drive storm drains with an advanced system that will remove sediment.
2011	No information.

5.5	Evaluate proposals for storm water controls. Maintain active communication with local officials and Town Boards regarding storm water improvements.
2006	Hebron Amston Lake Storm Water study draft completed. Lebanon selectmen are interested in learning about the Hebron study.
2007	Hebron Amston Lake Storm Water study final report is due. Planning should begin for Lebanon to upgrade storm drains during sewer construction.
2009	Dave O'Brien working with Town of Hebron to replace one of the Deepwood Drive storm drains with an advanced system that will remove sediment.

2010	Dave O'Brien working with Town of Hebron to replace one of the Deepwood Drive storm drains with an advanced system that will remove sediment.
2011	No information.

5.6	**Investigate all culvert outfalls to determine which ones have accumulated sediment deltas and estimate the quality of sediments at each.**
2006	Need to investigate pros and cons of removing sediments from the Lake.
2007	Continued to investigate pros and cons of removing sediments from the Lake. Researched various contractors.
2008	Continued to investigate pros and cons of removing sediments from the Lake. Researched various contractors and methods.
2009	Dredging of Frances Road Cove area determined to be best test location because of access and property owner permission.
2010	Frances Road Cove area was dredged by a reach excavator in February 2010.
2011	No information.

6. Continue to investigate feasible control options for Northeast Cove

6.1	**Obtain written permission from the landowners at lots 83 and 95 allowing access to the site for sample collection and feasibility analysis.**
2010	Lots purchased by abutter?
6.2	**Continue collecting water quality samples from the sites listed in the 2009 Lake Monitoring Report.**
2010	1 sample at shoreline RE:TP =179 ppb, Ammonia = 400 ppb, TKN = 2,750ppb
6.3	**Investigate the feasibility of containment or inactivation of the nutrients and bacteria on the property.**
2006	Dredging was considered but it is costly. Permits from both Conn. DEP and Lebanon Inland Wetland Commission are needed before excavation. May need permit from Army Corp. of Engineers.
2007	Water garden was considered but not installed. Barley straw in bags was placed but did not have much effect in this location. They were put in much later than the H-11batch.
2008	Several residents have clear-cut lots in this area. Need to continue to monitor the effect.
2009	Area still subject of complaints. Very high e coli readings obtained along shoreline in Northeast Cove area.
2010	Northeast Cove area dredged with dragline in November 2010.
6.4	**Seek to determine the sources of contamination.**
	No actions

7. Develop a comprehensive watershed management plan in order to reduce the amount of phosphorus and other contaminants entering the Lake.

7.1	**Reduce or eliminate the use of phosphorus fertilizers in the watershed.**
2007	The Lake Monitoring Report shows that phosphorus loading into the lake has increased since the 1990s. The Report emphasizes that phosphorus entering the lake has the most detrimental impact on water quality.

2009	Total phosphorus levels in April were the highest recorded in that month. Concentrations in May and June were also higher than normal. The bottom water phosphorus concentration in July was the highest yet recorded from bottom waters during the summer.
2010	Awaiting Lake monitoring Report
2011	No information.

7.2	**Investigate wetlands that feed the detention pond next to Bass Lake Road in order to reduce the proliferation of filamentous algae at the Bass Lake Road H-11 culvert outflow.**
2006	No action.
2007	No action.
2008	No action.
2009	No action.
2010	No action.
2011	No information.

7.3	**Control resident Canada geese at Amston Lake**
2008	There are not too many this year.
2009	There are not too many this year.
2010	There are not too many this year. (how many is too many ?)
2011	No information.

7.4	**Control pet waste in Amston Lake**
2008	No action
2009	No action
2010	Discussed by Board in response to resident complaints, no action.
2011	No information.

7.5	**Reduce or eliminate the use of nitrogen fertilizers in the watershed.**
2008	Information on proper use of fertilizers and where to get them, as well as information on phosphorus and its effects on the lake, was sent to all residents in the spring.
2009	No action.
2010	No action.
2011	No information.

7.6	**Monitor, with the intent to review and comment on all proposals for new developments, and alterations to existing structures, that occur within the Amston Lake Watershed.**
2006	One District Resident serves on Lebanon Inland Wetlands Commission.
2007	One District Resident serves on Lebanon Inland Wetlands Commission.
2008	Several District Residents attended Grossman development hearings. One District Resident serves on Lebanon Inland Wetlands Commission.
	Several District Residents attended Grossman development hearings.
2010	Grossman development hearings continue.
2011	No information.

7.7	**Monitor approved construction activities to ensure compliance with regulations and conditions especially with erosion and sedimentation controls.**
2008	Monitoring of construction has improved. Lake manager advised one developer to build rain gardens and the contractor complied. District residents have been monitoring other construction sites and meeting with Town officials on the same.
2009	No action.
2010	No action.
2011	No information.

7.8	**Develop a long range strategy to improve the Town development regulations within the Amston Lake Watershed, perhaps modeled after Columbia Lake.**
2008	No action.
2009	No action.
2010	No action.
2010	No information.

8. Provide recommendations for improving the shoreline lake edge where buffers are lacking, and provide general guidance for homeowners.

8.1	**Pursue an educational program for lake front owners about the benefits of maintaining a healthy shoreline.**
2008	Homeowners manual being developed by Board.
2009	Homeowners manual being developed by Board.
2010	Homeowners manual being developed by Board.
2011	No information

8.2	**Encourage the use of shoreline buffers. Target: Encourage natural wetland plant riparian zones around lake shore.**
2008	The purpose is to encourage riparian barriers rather than grass down to the lake. Should also encourage water gardens to absorb storm water.
2009	Need volunteers to push this.
2010	Need volunteers to push this.
2011	No information

8.3	**Develop a watershed protection zone or overlay district.**
2007	"Amston Lake Watershed" signs installed to increase awareness of watershed issues.
2008	
2009	
2010	
2011	

8.4	**Review Town ordinances that restrict tree cutting.**

2008	No action.
2009	No action.
2010	No action.
2011	No information

8.5	**Develop a parcel database.**
2008	No action.
2009	No action.
2010	ALD Board taking steps to develop a parcel database.
2011	No information.

9. Establish environmentally activist community.

9.1	**Establish an educational process to foster best management practices within the Amston Lake watershed.**
2006	District presentation from Lake Waramaug on lake management.
2007	District presentation on invasive plant species.
2008	District presentation on nuisance weed management conducted in May.
2009	
2010	
2011	

9.2	**Consider a Land Trust for preserving undeveloped land as open space.**
2008	
2009	
2010	
2011	

9.3	**Establish communication with the Lebanon and Hebron Open Space planning groups.**
2008	
2009	
2010	
2011	

9.4	**Conduct a property owner survey.**
2008	No action.
2009	No action.
2010	May be able to utilize Fuss & O'Neill data.
2011	

9.5	**Ask science teachers at RHAM and Lyman Memorial High School for student involvement in some of our Lake testing.**
2007	None to date. Need a District high school resident to work on this.
2008	Need volunteers to push this.
2009	Need volunteers to push this.
2010	Need volunteers to push this.

2011	

Closing: Hold a post-season evaluation meeting, review listed goals, and make recommendations about the upcoming year.

∞	**Hold annual progress meetings to review and evaluate Amston Lake goals.** **1 -Re-evaluate the set of goals for Amston Lake.** **2 -Assess the results of the monitoring conducted during the year.** **3 -Define and prioritize the critical issues facing Amston Lake** **4 -Set down a vision for Amston Lake.**
2006	Held meeting with Lake Scientist in February 2006 &November 2006
2007	Held meeting with Lake Scientist in December 2007
2008	Held meeting with Lake Scientist in May 2008
2009	Held meeting with Lake Scientist in April 2009, July 2009
2010	
2011	Held meeting with Lake Scientist in March 2012

APPENDIX

1 = PRIOR PHOSPHORUS CONCENTRATION RESULTS

2010

Depth (m)	16Apr	22-May	2-Jul	6-Aug	24-Sep
1	9	9	8	15	17
4	9	12	10	11	9
6	8	12	19	54	9
Average	***8.7***	***11.0***	***12.3***	***26.7***	***11.7***

2009

Depth (m)	19-Apr	20-May	25-Jun	20-Jul	10-Aug	4-Sep
1	16	11	15	7	7	9
4	13	14	20	9	9	9
6	12	14	22	12	34	10
Average	***13.7***	***14.0***	***19.0***	***7.0***	***21.5***	***9.3***

2008

Depth (m)	18-Apr	20-May	18-Jun	29-Jul	21-Aug	10-Sep
1	8	6	22*	11	6	33*
4	8	9	13	11	7	12
6	8	9	10	22	15	7
Average	***8.0***	***9.0***	***15.0***	***14.7***	***11.0***	***17.3***

* suspiciously high -possible outliers

2007

Depth (m)	27-Apr	25-May	19-Jun	28-Jul	28-Aug	21-Sep
1	11	12	9	13	9	8
4	12	7	15	19	10	6
6	13	14	18	12	12	10
Average	**12.0**	**10.5**	**14.0**	**14.7**	**11.0**	**8.0**

June 19, 2007 Shallow water sampling results

Depth (m)	Site 2	Site 3	Site 4	Site 5	Site 6
1	7	6	6	7	8
Bottom	26 (1.5m)	9 (3 m)	17 (2.5 m)	27 (2 m)	~

2006

Depth (m)	4-21	5-30	6-14	7-27	8-23	9-26	10-9
1	10	***58****	17	8	***51****	8	11
4	11	21	14	9	9	6	7
6	12	12	13	12	21	7	14
Average	**11.0**	**16.5**	**14.7**	**9.7**	**15.0**	**7.0**	**10.7**

* = sample results suspiciously high, not used for calculation of average values

2005

Depth m	18-Apr	30-May	23-Jun	21-Jul	6-Sep
1	11	11	8	9	10
4	12	11	10	10	9
6	13	10	12	13	13

mean	12	11	10	11	11

2004

Depth (m)	4-19	5-20	6-9	7-20	9-22
1	11	9	10	7	8
4	14	13	11	12	15
6	7	9	15	27	12
Average	11	10	12	16	12

2003

Depth (m)	4-28	7-1	7-20	7-31	8-28	9-23
1	9	9	16	9	22	10
4	9	16	17	9	10	10
6	9	10	20	15	27	7
Average	9	12	18	11	20	9

2002

Depth (m)	4-27	6-8	7-15	8-3
1	11	7	11	6
4	13	5	10	8
6	9	10	23	13
Average	11	7	15	9

2 = PRIOR TURBIDITY RESULTS

2010

Depth m	16-Apr	22-May	2-Jul	6-Aug	24-Sep
1	0.9		0.7	0.9	0.9
4	0.8		0.8	0.9	0.8
6	0.7		1.3	16.0	0.7

2009

Depth m	19-Apr	20-May	25-Jun	20-Jul	10-Aug	4-Sep
1	1.0	1.1	1.4	0.5	0.9	1.4
4	0.7	0.7	1.7	0.6	0.9	0.7
6	1.0	1.9	2.8	0.5	1.1	1.2

2008

Depth m	18-Apr	20-May	18-Jun	29-Jul	21-Aug	10-Sep
1	1.3	0.6	0.5	~	0.6	1.2
4	0.7	0.7	0.6	~	0.7	0.8
6	1.1	0.7	0.7	~	1.0	0.9

2007

Depth m	27-Apr	25-May	19-Jun	28-Jul	28-Aug	21-Sep
1	1.2	0.7	0.8	1.6	1.5	0.5
4	1.7	0.6	0.9	1.7	1.6	0.7
6	1.4	0.8	1.3	1.5	2.4	1.0

2006

Depth m	21-Apr	30-May	14-Jun	27-Jul	23-Aug	26-Sep	9-Oct
1	0.9	0.8	1.1	0.9	1.1	1.3	0.7
4	1.1	0.9	1.3	1.1	1	1.2	0.9

6	0.9	1.2	1.7	2.1	5.1	1.1	0.9

2005

Depth (m)	18-Apr	30-May	23-Jun	21-Jul	6-Sep
1	0.9	1.9	0.7	0.9	1
4	0.9	1.1	0.9	1.3	1.3
6	1.2	1.2	1.1	2.1	2.1

2004

Depth (m)	19-Apr	20-May	9-Jun	20-Jul	22-Sep
1	1.2	1.0	1.3	1.0	0.7
4	1.4	1.3	1.6	1.5	0.7
6	1.5	1.1	1.8	5.3	1.3

2003

Depth (m)	April 28	July 1	July 20	July 31	Aug. 28	Sept. 23
1	~	0.7	1.1	0.8	1.0	1.1
4	~	1.0	1.8	0.9	1.1	1.3
6	~	1.3	1.4	1.9	6.3	1.1

2002

Depth (m)	April 27	June 8	July 15
1	0.6	0.9	1.4
4	0.6	0.9	1.6
6	0.5	0.9	2.2

2001

Depth (m)	April 22	June 16	July 16	August 8	Sept. 18
1	4.3	0.6	1.6	1.0	2.3
4	0.9	0.9	1.1	1.4	2.2
6	1.1	0.6	2.0	2.6	2.5

4 = PRIOR CONDUCTANCE RESULTS

2010

Depth m	16-Apr	22-May	2-Jul	6-Aug	24-Sep
1	86		86	89	86
4	86		89	91	86
6	84		92	102	84

2009

Depth (m)	19-Apr	20-May	25-Jun	20-Jul	20-Aug	4-Sep
1	92	92	95	96	102	95
4	91	95	95	95	94	94
6	92	95	95	98	96	94

2008

Depth (m)	18-Apr	20-May	18-Jun	29-Jul	21-Aug	10-Sep
1	89	103	96	~	91	110
4	89	94	94	~	92	93
6	89	83	94	~	93	93

2007

Depth (m)	27-Apr	25-May	19-Jun	28-Jul	28-Aug	21-Sep

1	84	81	91	89	84	88
4	82	84	87	88	88	88
6	82	82	88	89	91	88

2006

Depth (m)	21-Apr	30-May	14-Jun	27-Jul	23-Aug	26-Sep	9-Oct
1	100	97	93	92	108	89	86
4	98	97	90	91	92	90	89
6	98	97	93	97	100	90	91

2005

Depth (m)	18-Apr	30-May	23-Jun	21-Jul	6-Sep
1	~	100	102	103	102
4	~	100	102	102	102
6	~	104	101	106	103

2004

Depth (m)	19-Apr	20-May	9-Jun	20-Jul	22-Sep
1	108	109	108	112	105
4	107	109	108	112	105
6	106	110	108	114	106

2003

Depth (m)	April 28	July 1	July 20	July 31	Aug. 28	Sept. 23
1	~	111	111	114	116	115
4	~	111	111	114	116	115
6	~	116	114	118	122	113

2002

Depth (m)	April 27	June 8	July 15
1	119	113	117
4	119	113	118
6	118	115	120

5 = PRIOR SECCHI DISK DEPTH READINGS

2010

Depth (m)	16-Apr	22-May	2-Jul	6-Aug	24-Sep
Meters (Feet)	5.6 (18.4)	4.6 (15.1)	5.1 (16.7)	5.3 (17.2)	6.2 (20.3)

2009

Depth (m)	19-Apr	20-May	25-Jun	20-Jul	20-Aug	4-Sep
Meters (Feet)	5.9 (19.5)	5.5 (18)	3.7 (12)	5.5 (18)	3.2 (10.4)	3.0 (10)

2008

Depth (m)	18-Apr	20-May	18-Jun	29-Jul	21-Aug	10-Sep
Meters (Feet)	5.3 (17)	5.5 (18)	5.5 (18)	4.9 (15)	5.5 (18)	5.8 (19)

2007

Depth (m)	21-Apr	25-May	19-Jun	28-Jul	28-Aug	21-Sep

Meters (Feet)	3.7 (12)	4.3 (14)	~	3.0 (9.8)	4.0 (13.1)	5.0 (16.4)

2006

Depth (m)	May 28	June 14	July 16	Aug.23	Sept. 26	Oct. 9
Meters (Feet)	3.7 (12)	3.4 (11)	4.0 (13)	4.7 (15.5)	4.3 (14)	4.6 (15)

2005

Depth (m)	April 18	May 30	June 23	July 21	Sept. 9
Meters (Feet)	4.4 (14.5)	4.3 (14)	4.3 (14)	3.4 (11)	4.0 (13)

2004

Depth (m)	April 18	May 20	June 9	July 20	Sept. 16
Meters (Feet)	2.9 (9.5)	5.2 (17)	3.0 (10)	3.5 (11.5)	4.9 (16)

2003

Depth (m)	April 28	July 1	July 20	July 31	Aug. 28	Sept. 23	Oct. 15
Meters (Feet)	5.2 (17)	6.4 (21)	3.5 (11.5)	3.5 (11.5)	4.3 (14)	4.1 (13.5)	4.6 (15)

2002

Depth (m)	April 27	June 8	July 15	August 3
Meters (Feet)	6.1 (20)	3.0 (10)	2.3 (7.5)	3.65 (12)

2001

Depth (m)	April 22	June 16	July 16	August 8	August 18	Sept. 3	Sept. 18
Meters (Feet)	7.3 (24)	5.9 (19)	3.5 (11.5)	3.4 (11)	2.9 (9.5)	2.6 (8.5)	2.4 (8)