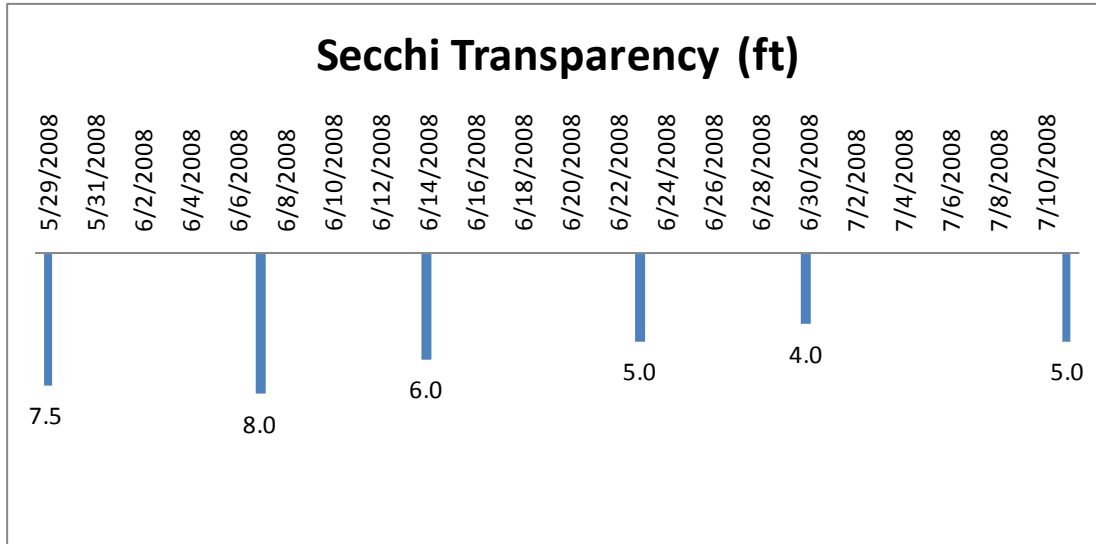


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Culver Lake – Status 2008 (a mid-summer report)



The Summer of 2008 began with Culver Lake exhibiting relatively good water clarity. Secchi transparency was 7.5 ft in late May, and increased to 8 ft in early June. Photosynthetic activity was relatively low, as indicated by oxygen saturation in surface water only slightly above 100%. Through the first half of June, photosynthetic activity increased and water clarity decreased. Transparency decreased from 8 ft in the beginning of June to 4 ft at the end of June. Transparency has improved some upto mid-July.

Depth	% DO Saturation					
	5/29/2008	6/7/2008	6/14/2008	6/23/2008	6/30/2008	7/11/2008
0	104	112	132	110	103	111
1	103	114	134	111	104	113
2	103	112	132	111	108	115
3	101	109	124	106	111	111
4	100	108	105	91	53	103
5	95	97	77	57	42	22
6	92	91	74	54	39	21
7	88	78	63	47	37	16
8	85	74	64	52	41	28
9	81	71	61	46	40	29
10	74	64	59	44	39	25
11	67	59	53	39	34	22
12	58	55	51	39	28	17
13	52	45	43	25	24	15
14	21	20	2	4	8	2

Thermal stratification had begun to establish by late May, yet no strong thermocline had developed. Significant density gradients were observed at shallow depths on 6/7. Subsequently, the surface water was mixed to a greater extent and a strong thermocline developed at 4m.

RTRM						
Depth	5/29/2008	6/7/2008	6/14/2008	6/23/2008	6/30/2008	7/11/2008
0	0	0	0	0	0	0
1	4	25	17	0	0	16
2	11	19	7	0	0	19
3	4	18	39	12	3	6
4	2	10	119	35	133	12
5	14	29	82	92	43	119
6	26	67	43	60	80	75
7	10	39	30	38	35	56
8	7	6	10	11	13	13
9	10	16	10	9	6	11
10	16	12	12	8	9	13
11	23	12	17	10	13	9
12	13	12	12	17	12	7
13	8	9	8	9	9	12
14	2	3	5	3	7	9

The % DO Saturation has been relatively low since mid-June indicating a moderate level of photosynthetic activity (not an intense prolonged bloom). Oxygen decline at the depths of the strongest density gradient (highest Relative Thermal Resistance to Mixing; RTRM) on July 11 suggest that dead algae cells are accumulating on the thermocline.

Dissolved Oxygen						
Depth	5/29/2008	6/7/2008	6/14/2008	6/23/2008	6/30/2008	7/11/2008
0	9.9	9.7	10.6	9.4	8.4	9.0
1	9.9	10.1	10.8	9.4	8.5	9.3
2	10.0	10.0	10.7	9.4	8.9	9.5
3	9.8	9.9	10.3	9.1	9.1	9.2
4	9.7	9.9	9.4	8.0	4.8	8.7
5	9.4	9.0	7.4	5.4	3.8	2.0
6	9.1	8.1	6.6	5.0	3.9	1.7
7	8.9	7.8	6.7	5.5	4.3	3.0
8	8.5	7.6	6.5	5.0	4.2	3.1
9	8.1	7.1	6.4	4.8	4.2	2.7
10	7.6	6.7	5.9	4.3	3.7	2.4
11	6.8	6.4	5.9	4.5	3.2	2.0
12	6.3	5.4	5.1	3.0	2.7	1.7
13	5.5	5.3	1.8	1.9	1.8	0.3
14	2.6	2.5	0.3	0.5	1.0	0.2

Culver 2008 Chemistry			Ammonia-N			Nitrate-N		
Total P as P								
Depth (m)	5/22/2008	25-Jun	Depth (m)	5/22/2008	25-Jun	Depth (m)	5/22/2008	25-Jun
1	18	22	1	74	32	1	<10	<10
3		22	3		36	3		<10
5		12	5		46	5		<10
7		11	7		14	7		52
9		11	9		<10	9		52
12		34	12		515	12		49
14			14			14		
Turbidity NTU			Silica			Total Iron		
Depth (m)	5/22/2008	25-Jun	Depth (m)	5/22/2008	25-Jun	Depth (m)	25-Jun	
1	2.1	<10	1	0.07	0.55	7		
3		<10	3			9	0.05	
5		<10	5			12	0.09	
7		52	7			14		
9		52	9					
12		49	12					
14			14					
						Total Mn		
						Depth (m)	25-Jun	
						7		
						9	0.16	
						12	1.7	
						14		

The total phosphorus content has not been high during 2008. Although phytoplankton analyses have not been completed yet, I suspect that the decline in transparency during June 2008 is more a problem of “the wrong kind of algae” rather than “too much algae”. From descriptions the algae responsible for the decline in transparency is a Cyanobacteria (*Anabaena sp* and/or *Aphanizomenon sp.*). These bluegreen photosynthetic bacteria have several very competitive advantages over more desirable algae groups. They are able to use nitrogen in the air (atmosphere) so are not dependant on nitrate dissolved in lake water. Note that nitrate was below detection limits in all surface water samples. These organisms also become very buoyant and can form a canopy which out-competes other species (not unlike a closed canopy woodland shading the understory). Unfortunately, even though the total amount of phytoplankton biomass is probably not unusually large, it is concentrated near the surface (reducing clarity and creating a nuisance condition). Limiting the depth of light penetration also makes aeration more difficult because deep production of oxygen by photosynthesis doesn't occur. So far aerobic conditions have persisted to 12m deep; but dying algae and limited light penetration increase the demand for oxygen from aeration. Silica (which is required by more desirable Diatoms) and nitrate (which is required by more desirable Greens) have been exhausted early in 2008. Hence the N-fixing Cyanobacteria have become more dominant.

Over the years since 1990 Culver Lake improved significantly, and is much healthier than it once was. However, the N-fixing Cyanobacteria remain a significant component of the phytoplankton assemblage despite lower overall densities and biomass.

Potential Future Activities

As discussed at the Winter Presentation Meeting, several possible upgrades/modifications are being evaluated. These will be discussed with the Normanoch Board; including:

- Replacement of the Air Distribution Manifold - This would make operation of the system and seasonal adjustments easier and more reliable.
- Add the capability to more rapidly mix/destratify the lake down to the middle of the current aerated layer. Note that the water layer between 5-10 m remains cold, relatively low in Total Phosphorus, and could serve as a nitrate source to the surface layer. The deepest hypolimnion generates ammonia, which is nitrified to nitrate in the mid-depth aerated layer. That could, potentially help to favor Green Algae over N-fixing Bluegreen Algae. A set of diffuser systems set along the 7-9m bottom contour could be activated at the time that Cyanobacteria begin to compete with Diatoms and Greens. The surface would be cooled. Buoyancy of Cyanobacteria cells would be less of an advantage. This is NOT intended as switching to a destratification approach! It would be used intermittently at very specific times, using the existing compressed air system.
- Add a Layer Aerator specifically designed to focus on the 3.5-7.5m depth range. This would be run more continuously to break the competitive advantage of initiating a bloom at the thermocline and subsequently ascending. It would also provide cool water habitat refuge immediately below the epilimnetic layer. And it would help to transport dissolved oxygen to the top of the aerated mid-depth layer for further distribution downward by the existing Layer Aerators (recall- photosynthetic oxygen production is an important component of oxygen input in Layer Aeration).

Other possible management actions could be considered in the future, such as:

- Adding a PSA Oxygen concentrator so the compressed air sent to aerators is greater than the 21% atmospheric composition. Essentially more aeration without more in-lake equipment.
- Add a low dose ozone treatment to the compressed air-stream at selected times to discourage initiation of N-fixing Cyanobacteria (or other oxidant).
- Conduct a very well planned and timed algaecide treatment; for example a depth-selective treatment just as a shift from Greens/Diatoms to Cyanobacteria is occurring.

These additional “possible management actions” are not recommended at this time, but are worth examining and discussing.

In summary Culver Lake has improved substantially since 1990. Yet effective lake management is an on-going effort, and includes the waterbody and entire watershed area (zero P fertilizer – lawns don’t need P they need nitrogen which if in a nitrate form is not an impact – could be somewhat beneficial; rain gardens and other stormwater quality improvement methods, etc.).

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