

Lake Washington

2006

Water Quality Assessment Report



Water Quality Report

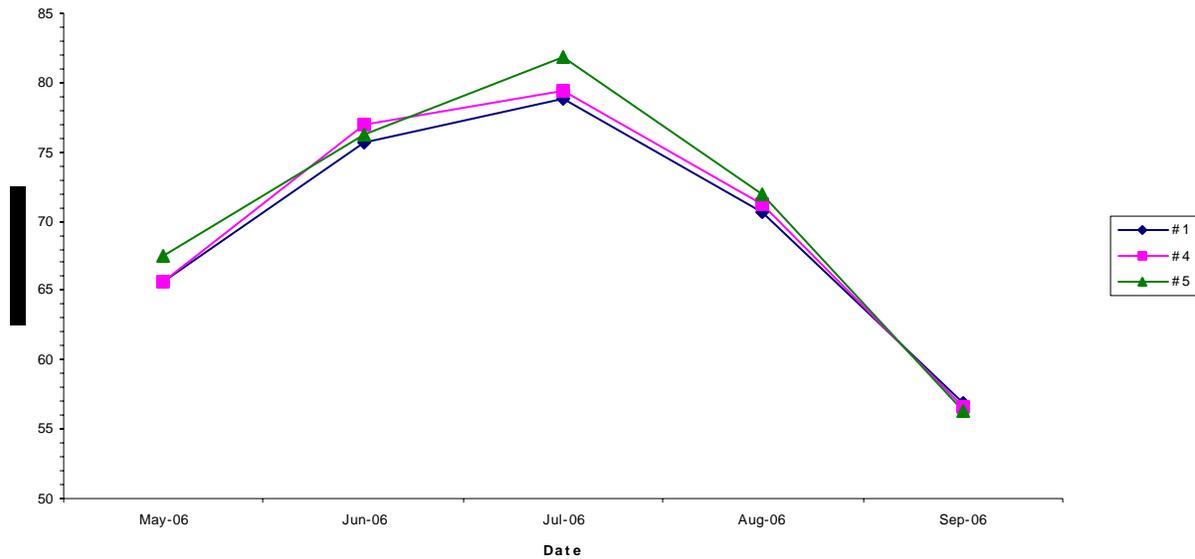
On May 26th, June 30th, July 27th, August 29th, and September 20th, 2006, Professional Lake Management, using a Hach Hydrolab Quanta water quality probe gathered and recorded water quality data from Lake Washington, Meeker County. The data collected came from three sites on the lake, shown in the map below.



The following data was collected and will be further discussed throughout this report; temperature, dissolved oxygen (D.O.), conductivity, pH, total phosphorus (TP), chlorophyll-a (Chl-a), alkalinity, and trophic status index values (TSI). In addition to those, total suspended solids (TSS), total dissolved solids (TDS), sulfate, chloride and iron will also be discussed. These parameters indicate in different ways, the current health of the lake as well as the future health of the lake.

Date	Site	Temp (F)	D.O. (mg/L)	Cond. (US/cm)	pH	Secchi (m)	TSI (S)	TP (Ug/L)	TSI (P)	Chl-a (Ug/L)	TSI (Ch)	TSS (mg/L)	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Iron (mg/L)
5/26/06	#1	65.7	11.16	366	7.99	1.5	54.2	19	46.6	12.0	55.0	N/A	N/A	N/A	N/A	N/A
5/26/06	#4	65.7	11.76	365	8.06	1.5	54.2	20	47.3	18.0	59.0					
5/26/06	#5	67.5	11.37	364	8.11	1.5	54.2	28	52.2	14.0	56.5					
6/30/06	#1	75.7	8.46	362	8.46	2.0	50.0	50	60.6	5.3	47.0	3.0	248.0	N/A	N/A	N/A
6/30/06	#4	77.0	9.08	359	8.52	2.0	50.0	70	65.4	6.4	48.8					
6/30/06	#5	76.2	9.23	359	8.48	2.0	50.0	70	65.4	4.5	45.4					
7/27/06	#1	78.8	6.00	362	7.50	1.0	60.0	25	50.6	6.0	48.2	N/A	N/A	N/A	N/A	N/A
7/27/06	#4	79.4	9.03	353	7.76	1.0	60.0	22	48.7	5.0	46.4					
7/27/06	#5	81.8	8.11	350	7.83	1.0	60.0	15	43.2	5.0	46.4					
8/29/06	#1	70.72	7.92	352	7.64	1.0	60.0	40	57.3	16.0	57.8	N/A	N/A	20.4	18	<0.10
8/29/06	#4	71.2	9.02	344	7.86	1.0	60.0	33	54.6	17.0	58.4					
8/29/06	#5	71.9	9.79	341	7.90	1.0	60.0	27	51.7	15.0	57.2					
9/20/06	#1	56.9	9.35	350	7.80	0.5	70.0	32	54.1	13.0	55.8	N/A	N/A	N/A	N/A	N/A
9/20/06	#4	56.6	9.12	350	7.71	0.6	67.4	29	52.7	17.0	58.4					
9/20/06	#5	56.3	9.22	350	7.72	0.5	70.0	28	52.2	13.0	55.8					

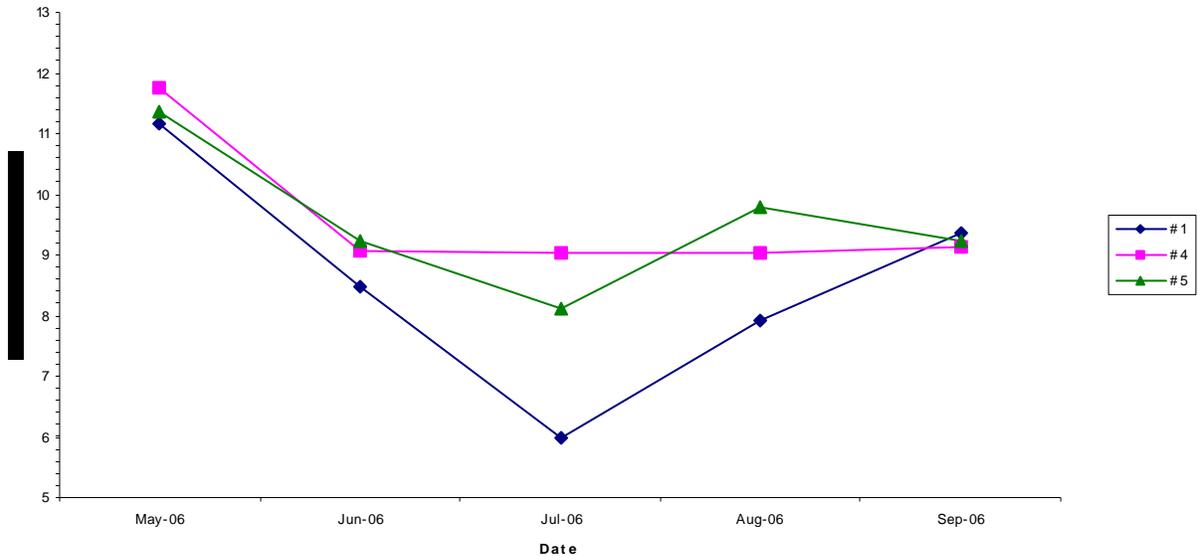
Temperature of Washington Lake Throuhgout Summer 2006



Temperature

The temperature of a lake makes a big impact on the biological life in the lakes such as the fish, insects and the plants. Temperatures that become too warm may decrease the oxygen levels in the lake making survival of fish, insects and plants more difficult. Lakes actually have a variation of temperatures depending on the depth. The average temperatures, which can be seen in the chart above, are all in the correct range throughout the summer. There is very little variation between the sites. Site #5 got to be the warmest in July likely due to its shallow depth.

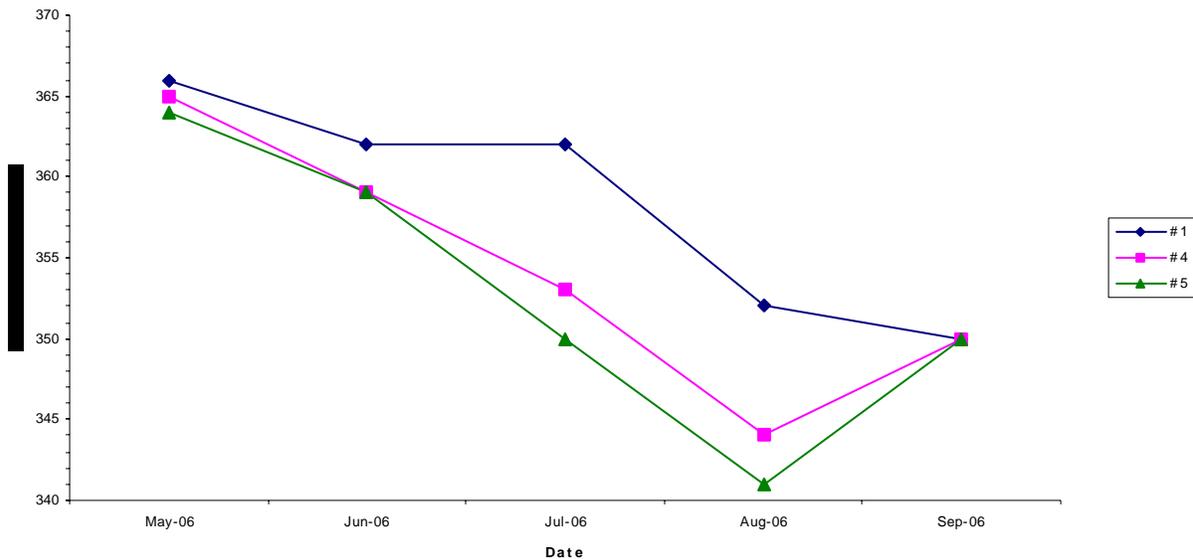
Dissolved Oxygen of Lake Washington Summer 2006



Dissolved Oxygen

Dissolved Oxygen measures the amount of oxygen in the water. It is produced by the plants through photosynthesis and used by nearly all aquatic organisms for survival. Because photosynthesis is dependent on sunlight, dissolved oxygen varies depending on the temperature the sunlight helps create as well. The higher the temperatures, the less gasses water can hold, which will produce less oxygen in the water. Oxygen can also be introduced to the water by the air and inflowing streams. Oxygen levels will also decrease with depth, as there is less sunlight to help generate photosynthesis. Dissolved Oxygen is measured in mg/L and must be at a level above three mg/L for aquatic organisms to survive. The oxygen levels in Lake Washington fall in healthy ranges. Site #1 fell low in July. This is probably because that site is the deepest, and when the depth increases, oxygen levels will decrease.

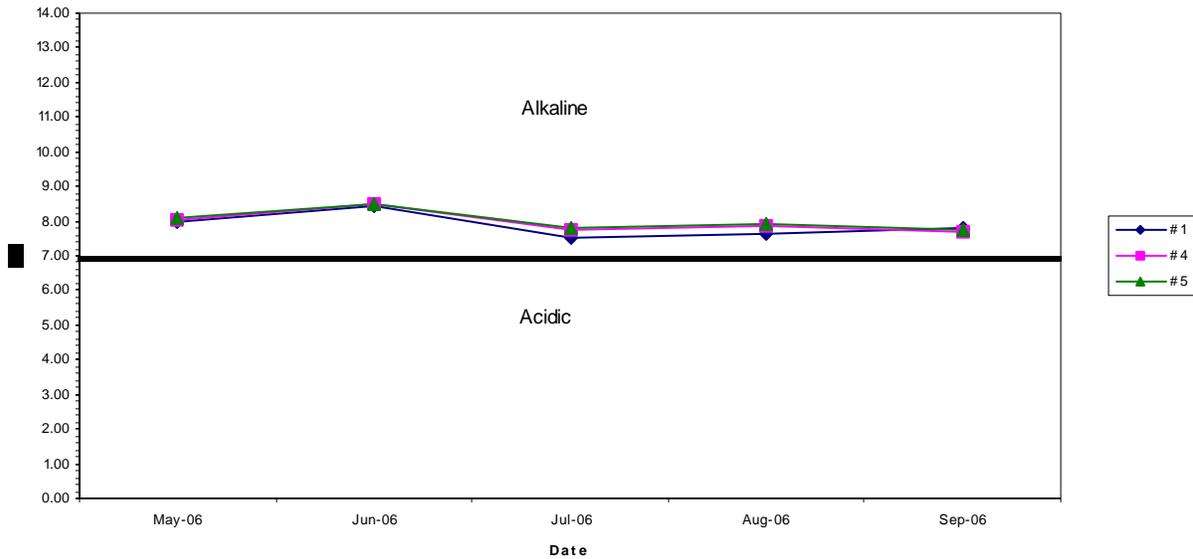
Conductivity of Lake Washington Summer 2006



Conductivity

Electrical conductivity estimates the total amount of dissolved ions in the water and is controlled by things such as the rock composition of the lake, the size of the watershed relative to the area of the lake, wastewater and runoff, and bacterial metabolism. The rock composition can add ions to the lake depending on the type of rock, for example a lake with a limestone basin will have a higher conductivity. A larger watershed can increase the amount of soils brought into a lake, which can increase the conductivity, as can wastewater and runoff. Bacterial metabolism, which is present in every lake, only becomes a problem when there is an overabundance of bacteria causing an increase in the carbon dioxide of a lake and in turn increasing the conductivity. The conductivity levels for the ecoregion in which Lake Washington falls (North Central Hardwood Forests Region) are usually between 300 and 400 $\mu\text{S}/\text{cm}$. Lake Washington falls in the normal range and indicate no associated problems. The levels decreased throughout the summer, likely due to the lack of rain that would normally bring in more ions.

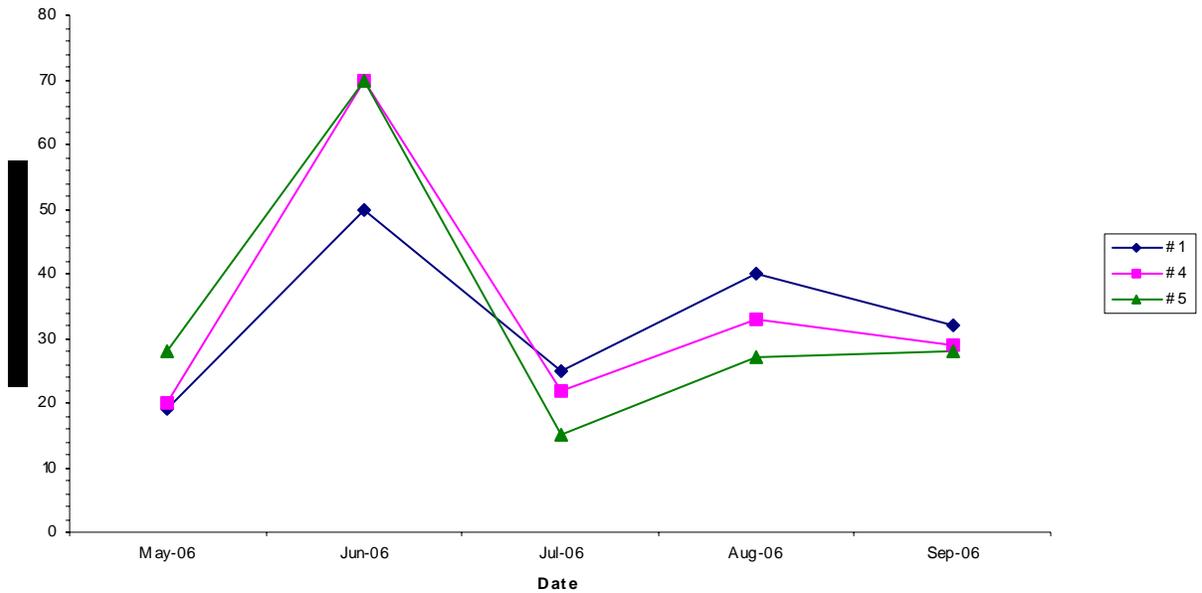
Average pH of Lake Washington Summer 2006



pH

The measurement of pH indicates a lake's acid level. Lower pH levels, usually below six, indicate more acidic waters and levels above nine indicate alkaline waters. Acidic waters can affect fish and fish spawning, possibly leading to a fish kill. The pH levels of Lake Washington as shown in the chart above are all above the neutral pH of seven, within the normal pH range, an alkaline range. June is a growing season for aquatic plants, which increases photosynthesis, decreasing the amount of carbon dioxide in the water and increasing the pH. This can explain why the pH levels went up slightly in late June.

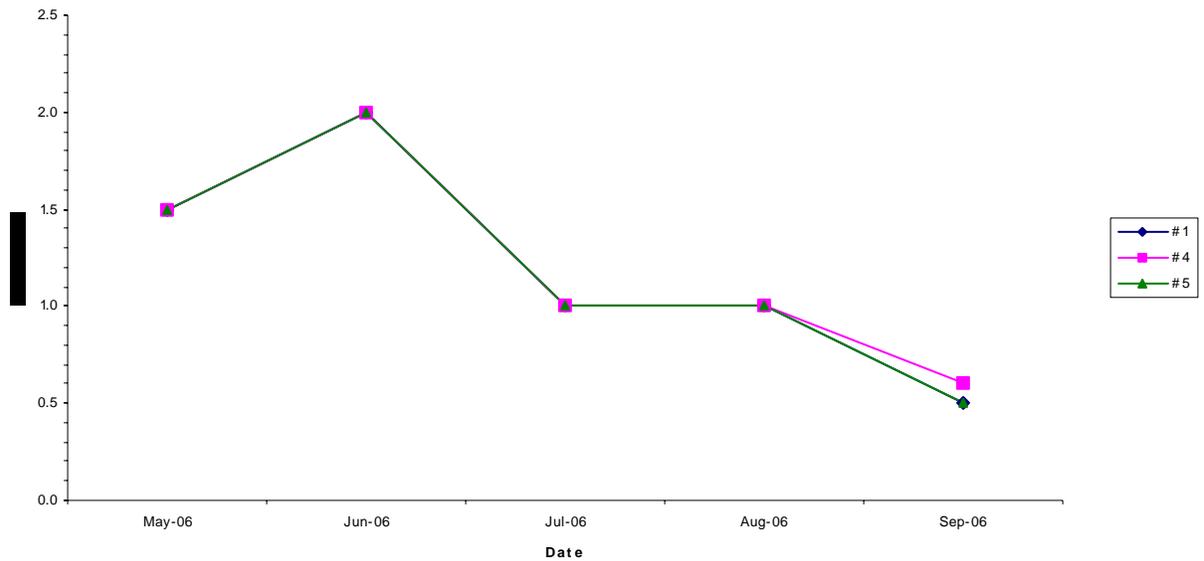
Total Phosphorus Levels of Lake Washington Throughout Summer 2006



Total Phosphorus

Phosphorus promotes aquatic plant growth and comes from sources such as soil erosion, detergents, septic systems, runoff and animal waste. Average phosphorus levels for the ecoregion of Lake Washington (North Central Hardwood Forests Region) according to the MPCA is 23 to 50 µg/L. The good water quality range should be between 20 and 30 µg/L. The lower the level, the better water quality. Lake Washington levels are mostly within those levels, except in the month of June. With the exception of June Lake Washington is healthy on the basis of phosphorus. The high levels in June, however, indicate unhealthy waters that lead to algal blooms. It is likely that with increased plant growth in June, the phosphorus levels also increased. Overgrowth of aquatic plants will cause phosphorus levels to increase. This could explain the increased levels in Lake Washington, but other issues such as runoff could be a factor as well. Phosphorus is also a good indicator for a lake's nutrient status or trophic state, which will be explained further in the TSI section of this report.

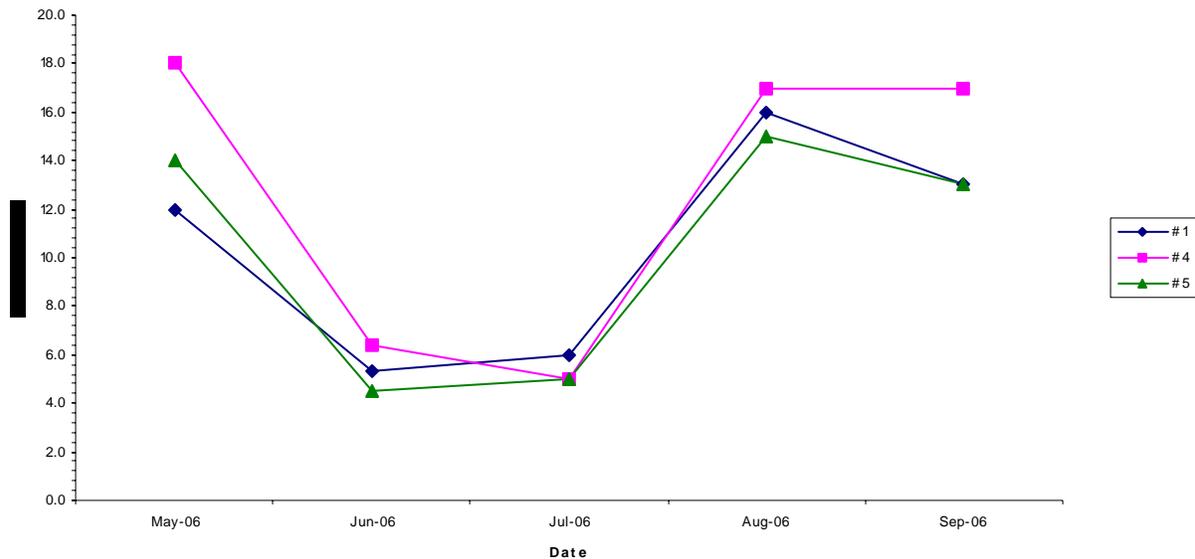
Clarity of Lake Washington Summer 2006



Clarity

Clarity is determined using a secchi disk, to see how clear the water is or how far down from the surface the secchi disk can be seen. The average secchi disk readings for the North Central Hardwood Forests ecoregion are 1.5 meters to 3.2 meters. Lake Washington falls below and within this level. The May and June readings indicate good water quality, but the other readings are bordering on poor water clarity. If water levels are low, more sediment can be brought in, and lower readings will come out with less water to read from. Clarity can also be used to indicate the trophic status of a lake, which will be explained in the TSI section of this report.

Chlorophyll-a of Lake Washington Throughout Summer 2006



Chlorophyll-a

Chlorophyll-a is the green pigment that is responsible for the conversion of sunlight into chemical energy during photosynthesis. The measurement of chlorophyll-a is best used for indicating the amount of algae in lakes. Higher readings of chlorophyll-a indicate more algae, which can indicate unhealthy waters. Lake Washington's chlorophyll-a readings range from 4.5 to 18 $\mu\text{g/L}$. Readings for the lake's ecoregion should be between five and 22. Lake Washington falls in to this range. Although within this range, the higher readings are bordering unhealthy waters. The May readings are likely higher due to nutrient overload from ice melting and bringing more in. Lower water levels, excessive growth in the lake, and possible factors such as runoff likely attributed to the higher readings in August and September.

Total Suspended Solids

Suspended solids include soil, industrial waste, dead plant or animal material, live organisms, and sewage. Too many suspended solids can decrease water clarity, as well as light availability necessary for growth of aquatic plants, and harm fish and other aquatic organisms. Sediment can clog fish gills destroy aquatic habitats. High total suspended solids can also cause

an increase in water temperature because the particles can trap heat from the sun. TSS readings can also indicate high levels of nutrients, bacteria, metals, and other chemicals, because these attach to sediment. For the North Central Hardwood Forests Region, TSS should be between two and six mg/L and Lake Washington falls in this range with a reading of three mg/L.

Total Dissolved Solids

Total dissolved solids come from sources such as agricultural runoff, leaching of soil contamination and water pollution industrial or sewage treatment plants. The chemicals associated with TDS are calcium, phosphates, nitrates, sodium, potassium and chloride, which are found in nutrient and stormwater runoff, as well as runoff from roads where de-icing salts are applied. For human consumption, TDS readings would need to be below 500mg/L, however odor and appearance will usually prevent human consumption far below this level. Aquatic ecosystems such as lakes, can withstand a TDS reading up to 1000mg/L. Washington Lake had a reading of 248mg/L which doesn't indicate any associated problems.

Sulfate

Sulfates are related to the types of minerals found in the water and to acid rain. Also, if water is depleted of oxygen, sulfate can be reduced to hydrogen sulfide, which is toxic to aquatic organisms. If sulfate is high, the iron in a lake can also decrease because it settles out in sediment as iron sulfide. The public health limit for sulfate is 500mg/L. Lake Washington falls far below this with a reading of 20.4mg/L, indicating no associated problems.

Chloride

Chloride enters a lake from septic systems, animal waste, potash fertilizer, and road salt drainage. An increase in chloride often indicates that other potentially harmful nutrients are entering the water. Chloride does not affect plant or algae growth and is not toxic to aquatic organisms. The chloride level for Lake Washington is 18mg/L, whereas the public health limit is 250mg/L. This indicates that runoff is not necessarily a problem for Lake Washington.

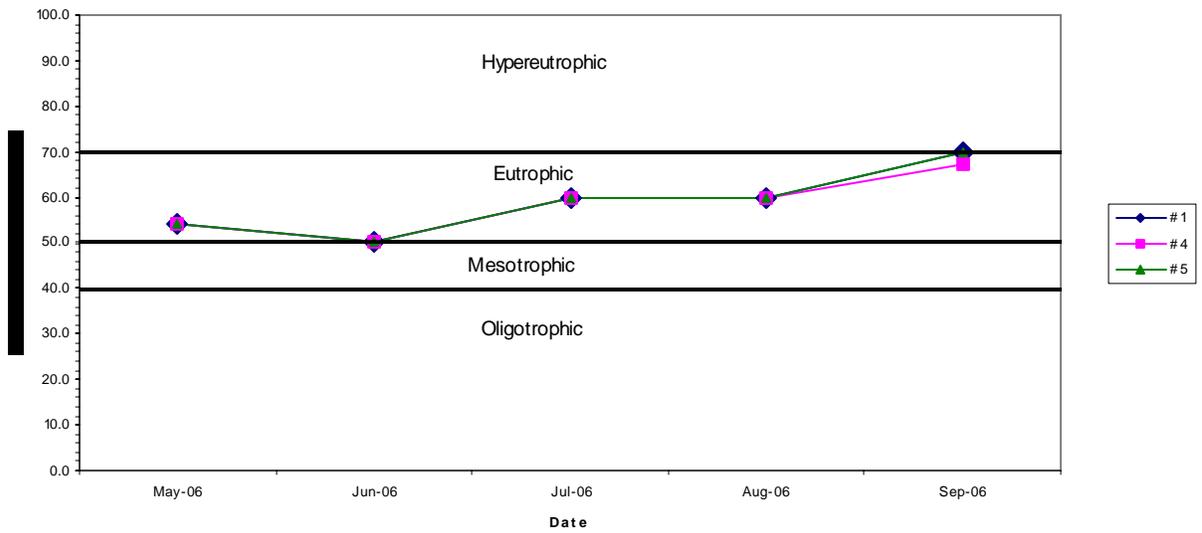
Iron

Iron in a lake can form sediment particles that store phosphorus as long as oxygen is present. As a lake loses oxygen, such as in the winter, that iron and phosphorus will dissolve in the water. Because of this, algae blooms may still appear in iron rich lakes for many years, even if phosphorus levels are controlled. Lake Washington had a level less than 0.1mg/L. The public health limit is 0.3mg/L, indicating no associated problems.

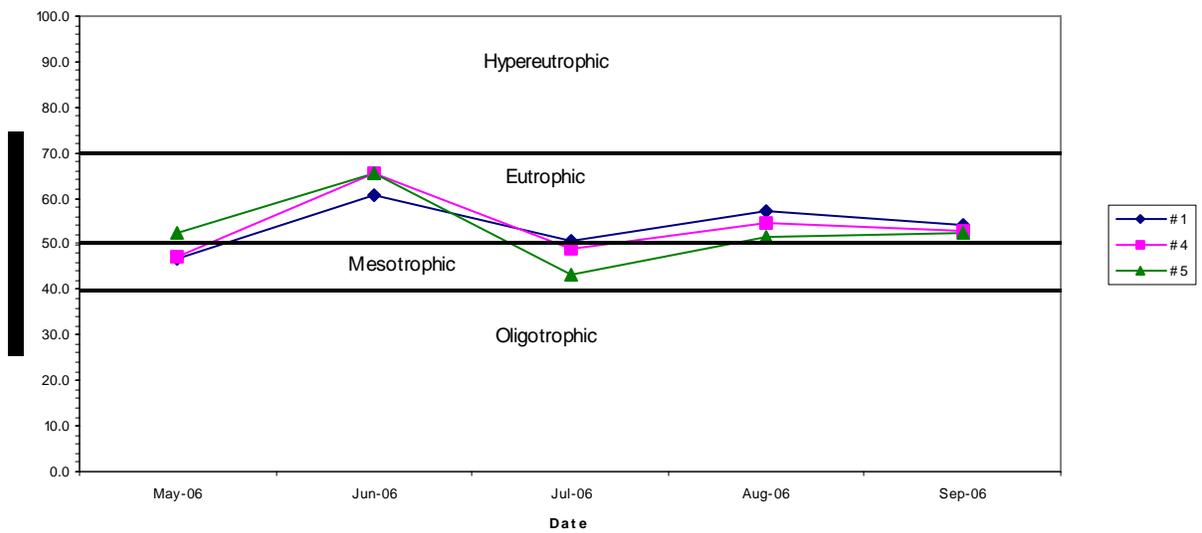
Trophic Status Index

There are four trophic states, hypereutrophic, eutrophic, mesotrophic, and oligotrophic. . . Hypereutrophic lakes are extremely high in nutrients and unhealthy. Eutrophic lakes are high in nutrients and support a large amount of plants and animals, usually very weedy and susceptible to oxygen depletion and could lead to further problems. Mesotrophic lakes are in between the other two types, with good fisheries, productions and occasional algal blooms. Oligotrophic lakes are clear slightly low in nutrients and are capable of sustaining desirable fisheries of large game fish. The following graphs will show the trophic status index ranges Lake Washington fell into for 2006 using secchi disk readings, total phosphorus readings and chlorophyll-a readings.

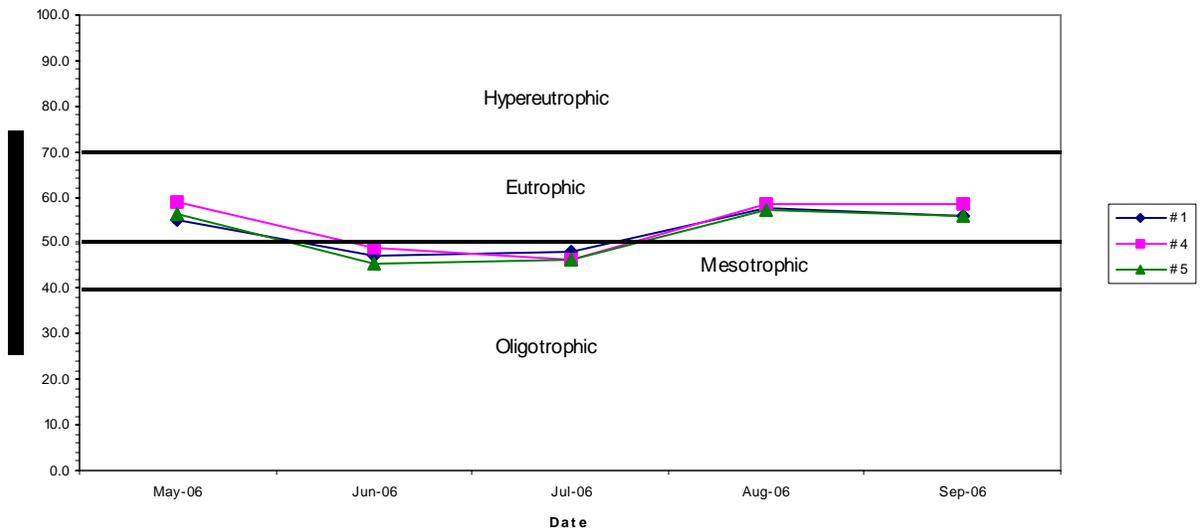
Trophic Status Index Based on Secchi Disk readings for Lake Washington Throughout Summer 2006



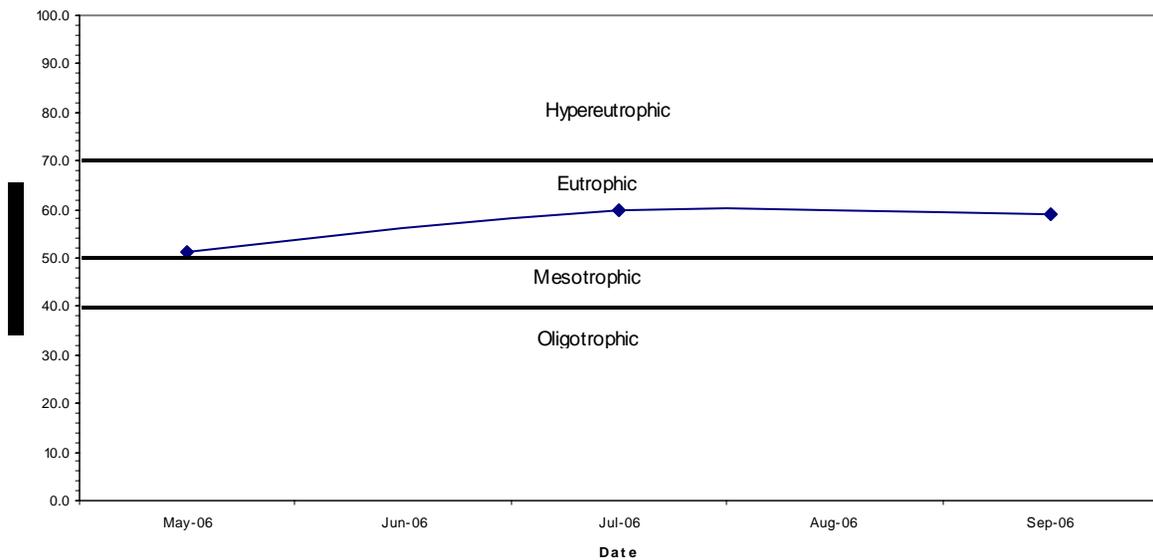
Trophic Status Index Based on Total Phosphorus for Lake Washington Throughout Summer 2006



Trophic Status Index Values Based on Chlorophyll-a for Lake Washington Throughout Summer 2006



Average Trophic Status Index Values for Sibley Lake Throughout Summer 2006



Conclusion

The parameters collected for Lake Washington indicate a slightly unhealthy lake. The parameters indicate the lake is in a eutrophic state putting it at risk. The risk however, could be result of the low water levels and abundant plant growth. It may also be from human sources such as runoff. It is best to continue water quality monitoring in 2007 to assure that this trend does not continue. Continuous monitoring is the key to a healthy lake.