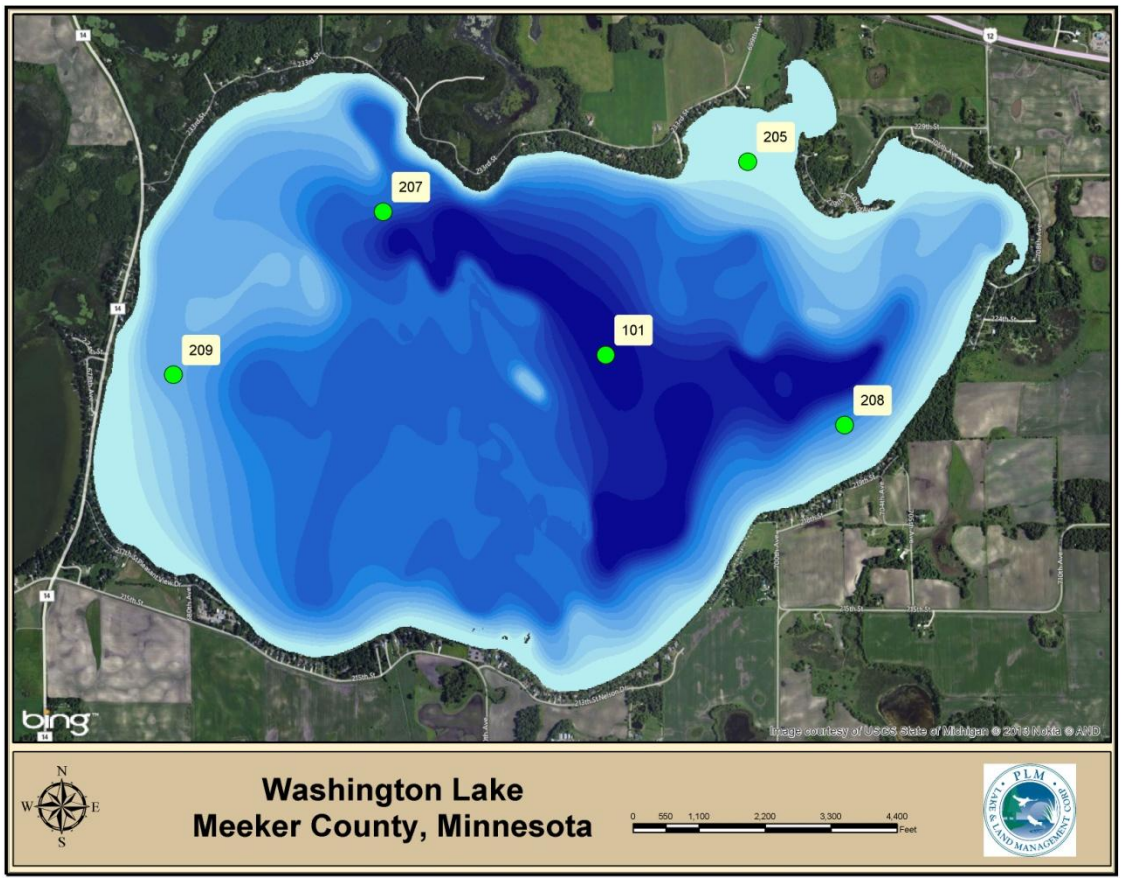
Lake Washington

2014

Water Quality Assessment Report

Water Quality Report

On June 3rd, June24th, July 14th, August 25th, and September 15th, 2014, PLM Lake & Land Management Corp. using a Hach Hydrolab Quanta water quality probe gathered and recorded water quality data from Lake Washington, Meeker County. The data collected came from five sites on the lake, shown in the map below

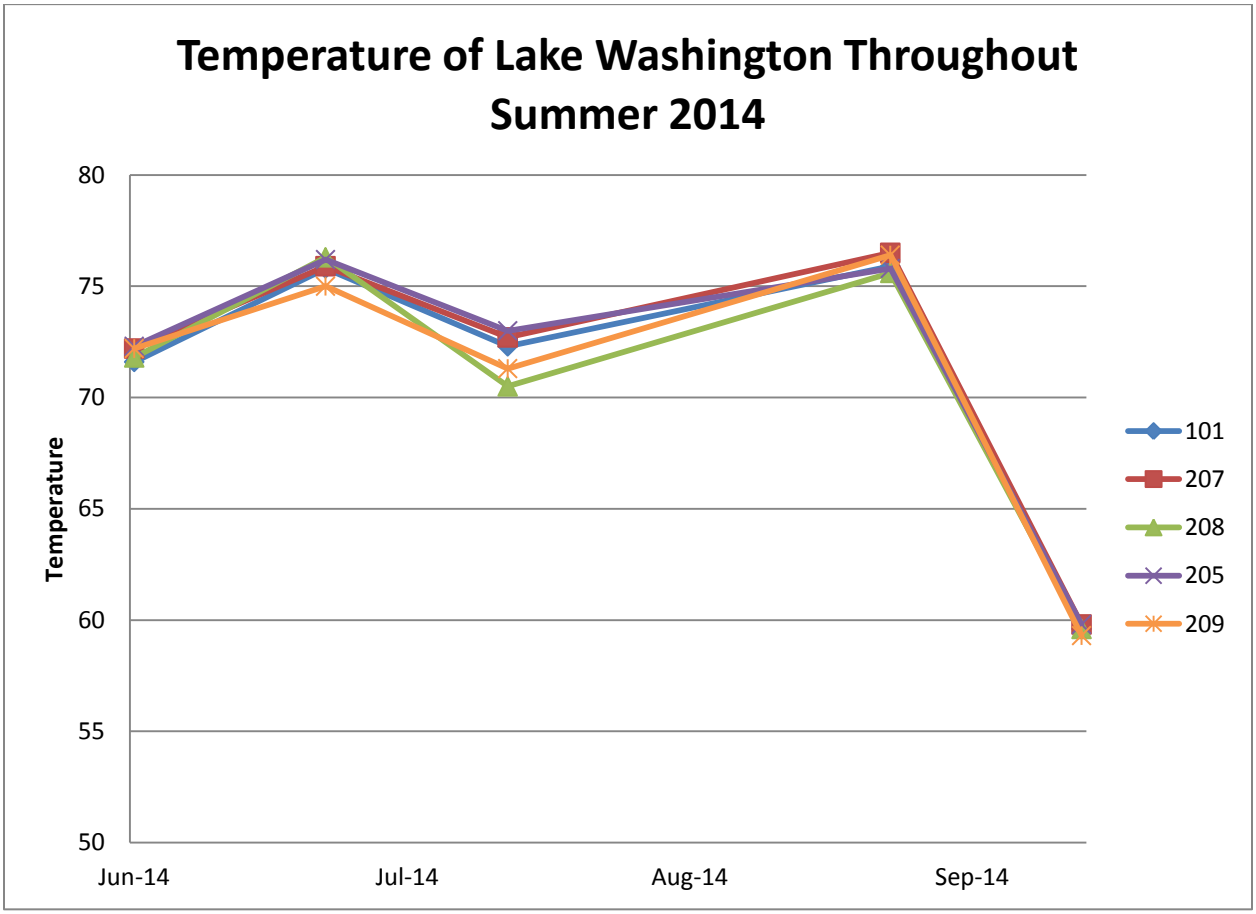


The following data was collected and will be further discussed throughout this report; temperature, dissolved oxygen (D.O.), conductivity, pH, total phosphorus (TP), chlorophyll-a (Chl-a), and trophic status index values (TSI). In addition to those, total suspended solids (TSS) and total dissolved solids (TDS) were taken at site 101. 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)	Conductivity (US/cm)	pH	Secchi (m)	TSI (S)	TP (Ug/L)	TSI (P)	Chl-a (Ug/L)	TSI (Ch)	TSS (mg/L)	TDS (mg/L)	TSI (AVG)
6/3/2014	101	71.6	7.87	364	8.3	1.570	53.50	21	48.05	9	52.15	4	N/A	51.24
6/3/2014	207	72.2	7.8	365	8.28	1.440	54.75	24	49.98	9	52.15	N/A	N/A	52.29
6/3/2014	208	71.8	8.48	365	8.28	1.700	52.35	30	53.20	7	49.69	N/A	N/A	51.75
6/3/2014	205	72.3	7.85	362	8.27	1.000	60.00	22	48.72	9	52.15	N/A	N/A	53.63
6/3/2014	209	72.2	8.25	364	8.34	1.700	52.35	24	49.98	9	52.15	N/A	N/A	51.50
6/24/2014	101	75.8	9.31	359	8.4	1.600	53.23	25	50.57	9	52.15	4	212	51.98
6/24/2014	207	75.9	8.75	358	8.73	1.600	53.23	21	48.05	8	51.00	N/A	N/A	50.76
6/24/2014	208	76.3	10.17	352	8.73	1.440	54.75	21	48.05	8	51.00	N/A	N/A	51.27
6/24/2014	205	76.2	10.73	350	8.77	0.914	61.29	22	48.72	7	49.69	N/A	N/A	53.23
6/24/2014	209	75	6.11	368	8.39	1.200	57.37	34	55.00	11	54.12	N/A	N/A	55.50
7/14/2014	101	72.3	8.11	348	8.73	0.914	61.30	36	55.82	16	57.80	N/A	N/A	58.31
7/14/2014	207	72.7	8.42	348	8.7	0.914	61.30	41	57.70	16	57.80	N/A	N/A	58.93
7/14/2014	208	70.5	9.08	347	8.83	0.850	36.00	26	51.13	18	58.95	N/A	N/A	48.70
7/14/2014	205	73	9.07	345	8.81	0.914	61.30	31	53.67	22	60.92	N/A	N/A	58.63
7/14/2014	209	71.3	9.59	341	8.84	0.914	61.30	56	62.20	14	56.49	N/A	N/A	59.99
8/25/2014	101	75.9	7.47	330	8.91	0.914	61.30	25	50.57	13	55.76	7	N/A	55.87
8/25/2014	207	76.5	7.51	331	8.90	0.927	61.09	26	51.13	12	54.98	N/A	N/A	55.73
8/25/2014	208	75.6	7.75	330	9.02	0.927	61.09	25	50.57	12	54.98	N/A	N/A	55.55
8/25/2014	205	75.8	9.08	330	9.03	0.812	63.00	25	50.57	10	53.19	N/A	N/A	55.59
8/25/2014	209	76.4	8.81	325	9.00	0.864	62.11	24	49.98	10	53.19	N/A	N/A	55.09
9/15/2014	101	59.6	8.79	326	9.11	0.916	61.26	26	51.13	15	57.17	N/A	N/A	56.52
9/15/2014	207	59.8	8.5	325	9.08	0.914	61.30	25	50.57	14	56.49	N/A	N/A	56.12
9/15/2014	208	59.6	9.06	326	9.12	1.220	57.13	24	49.98	10	53.19	N/A	N/A	53.43
9/15/2014	205	59.8	9.33	324	9.21	0.787	63.45	28	52.20	8	51.00	N/A	N/A	55.55
9/15/2014	209	59.3	9.30	325	9.12	0.838	62.55	24	49.98	8	51.00	N/A	N/A	54.51

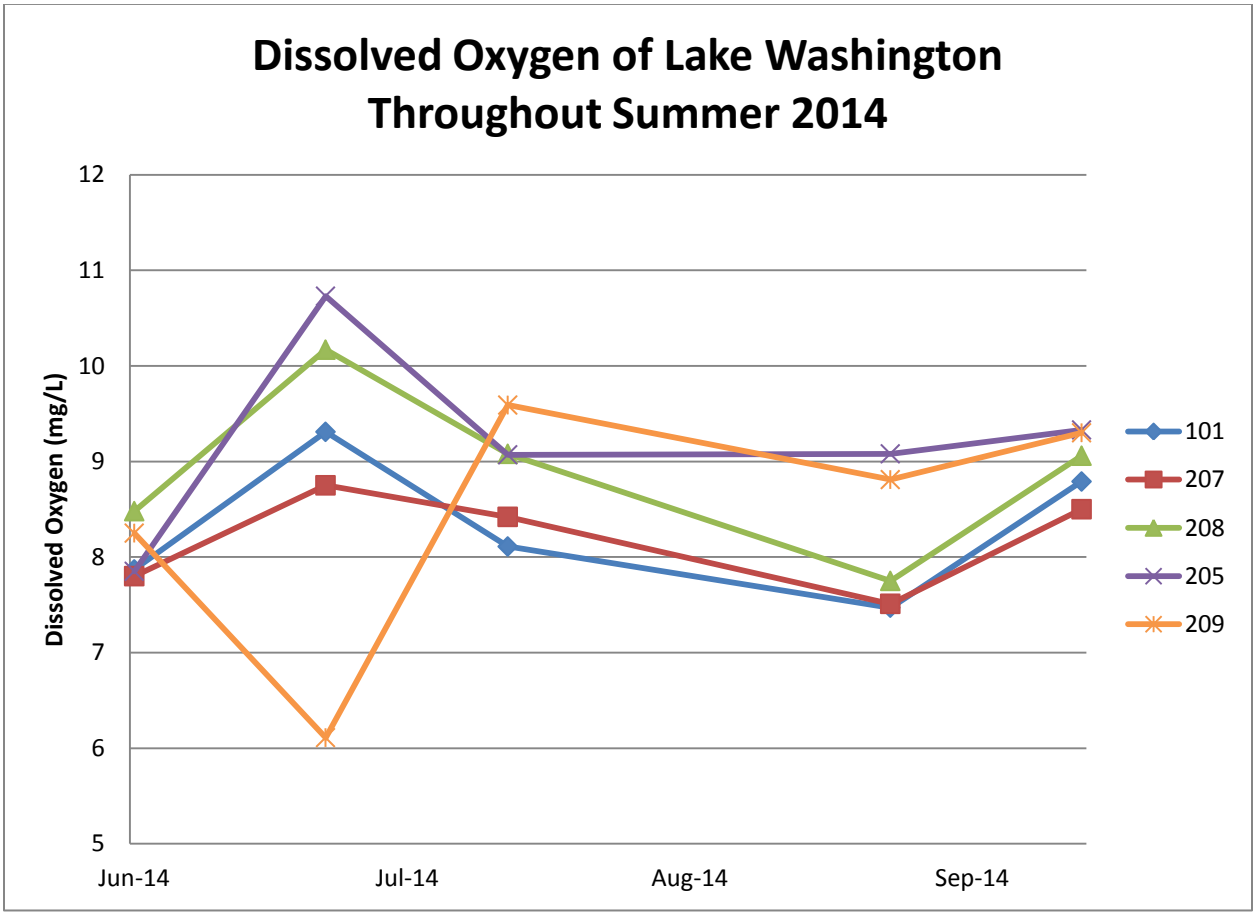
Temperature

The temperature of a lake makes a big impact on the biological life in the lakes such as fish, insects and aquatic plants. Temperatures that become too warm may decrease the oxygen levels in the lake making survival of fish, insects and plants more difficult. Lakes have a variation of temperatures depending on the depth, and climate.



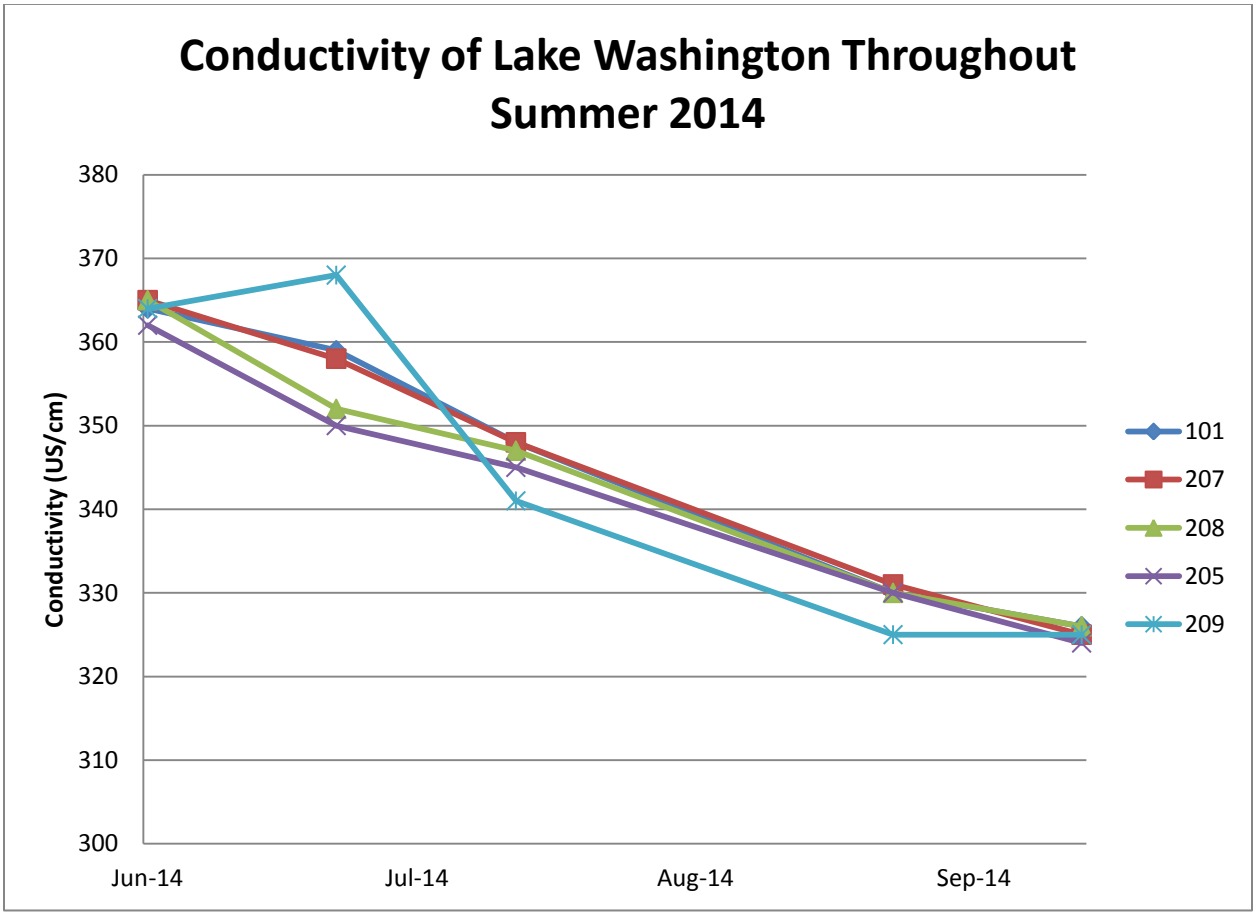
Dissolved Oxygen

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.



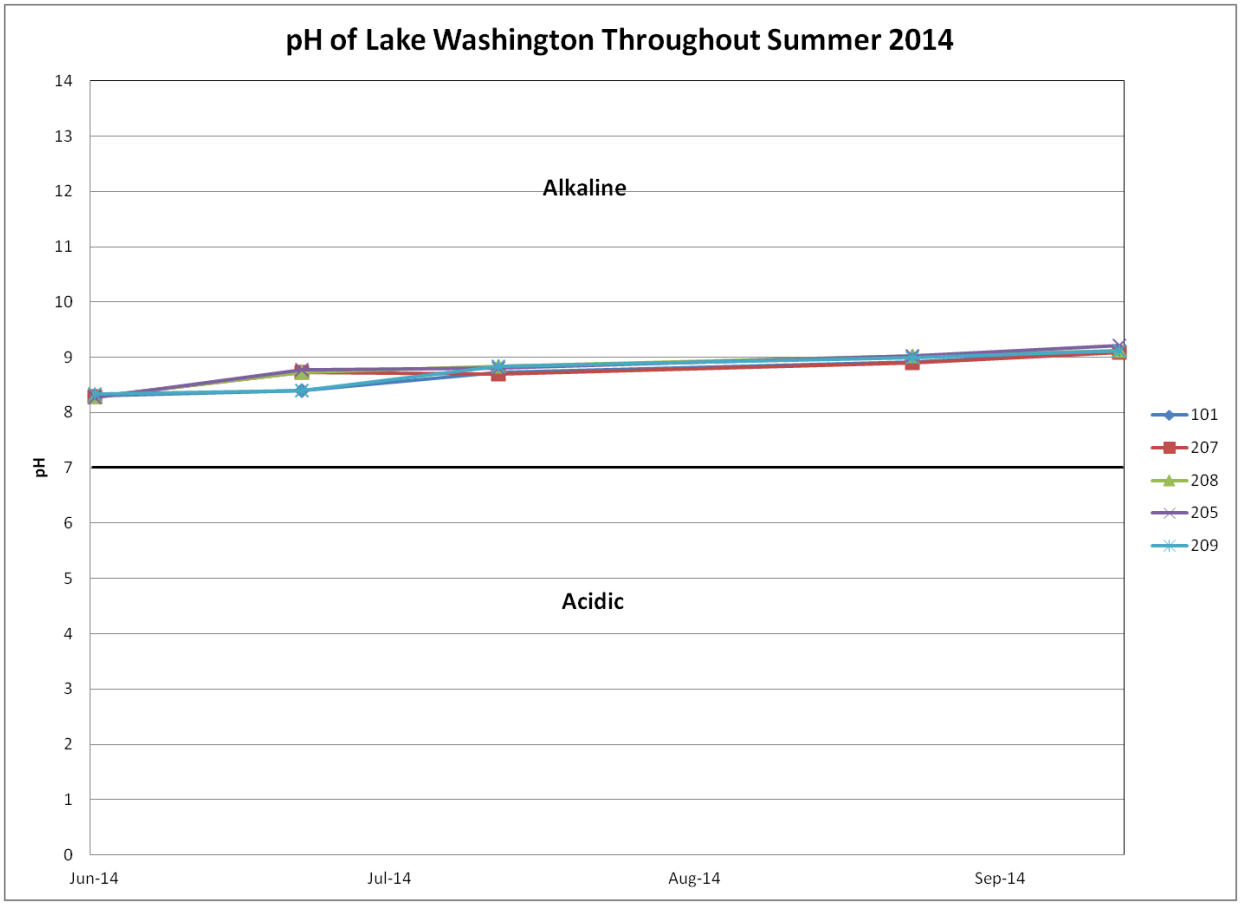
Conductivity

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.



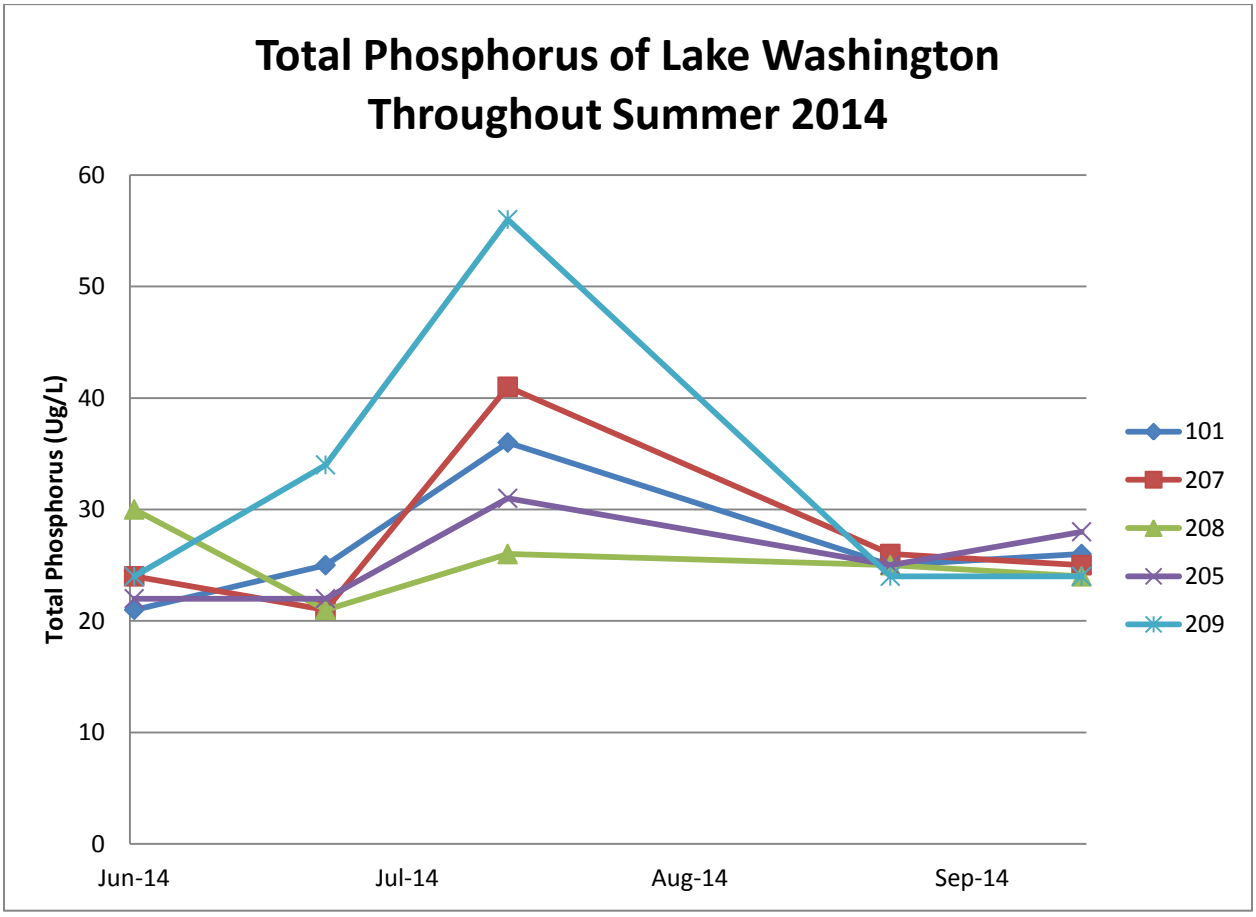
PH

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. Since aquatic plants are growing throughout the summer, this can increase photosynthesis, decreasing the amount of carbon dioxide in the water and increasing the pH. As winter nears, the pH level will begin decreasing.



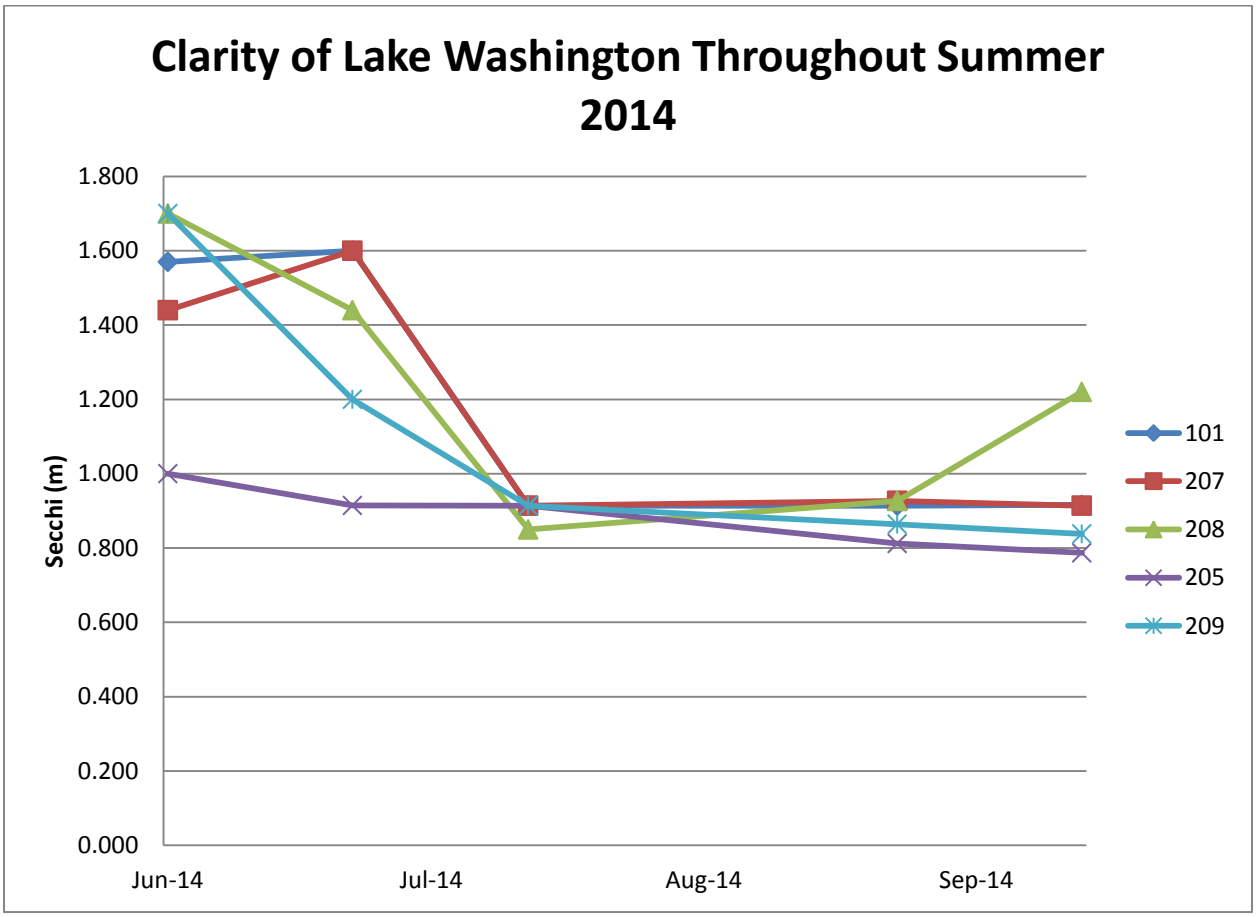
Total Phosphorus

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 are 23 to 50 µg/L. The good water quality range should be between 20 and 30 µg/L. The lower the phosphorus level, the better the water quality. 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.



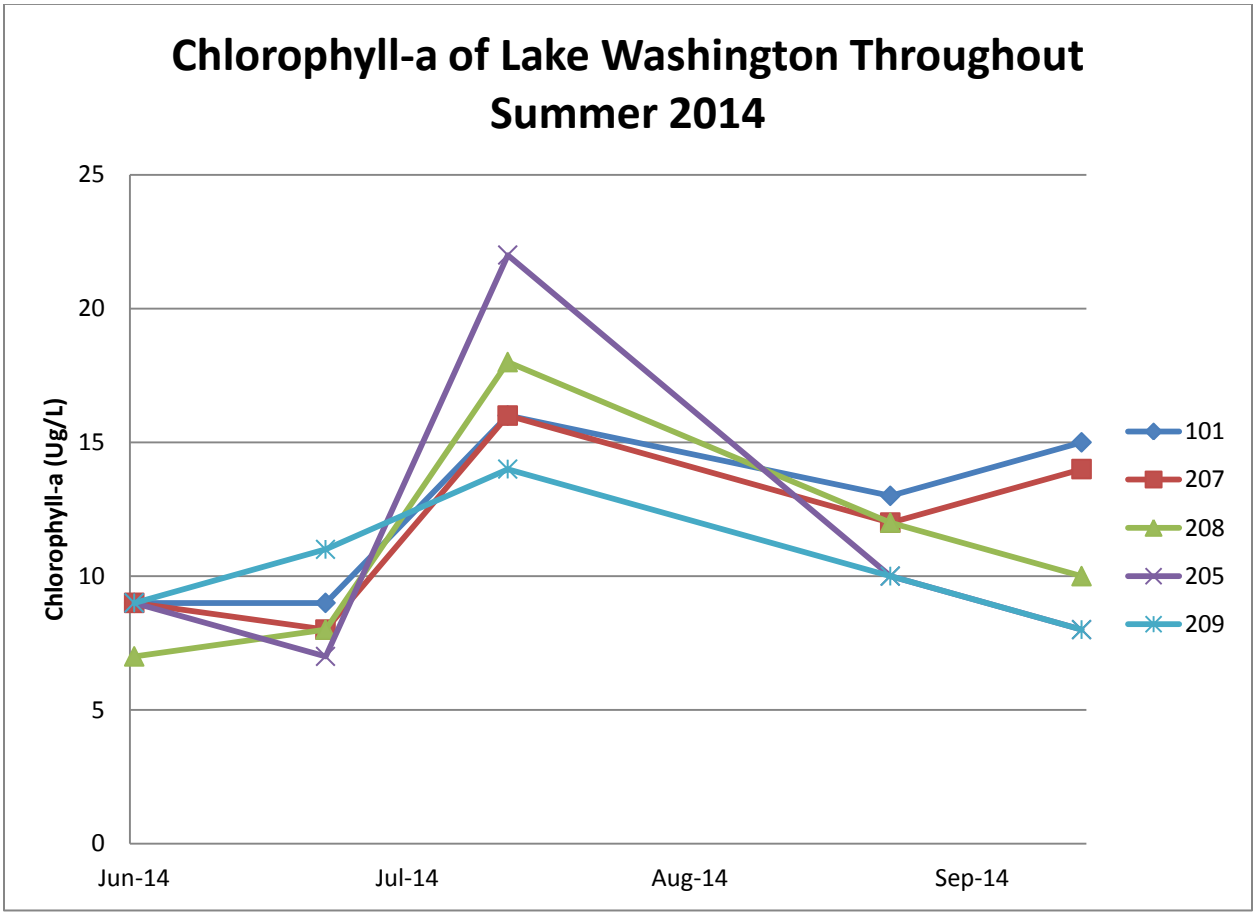
Clarity

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 ecoregionin which Lake Washington resides, are 1.5 meters to 3.2 meters. If water levels are low, this could contribute to the low clarity levels as can increased rainfall, because more sediment can be brought in and lower depths leave less room for deep secchi disk readings. Eurasian watermilfoil can also reduce clarity levels in lakes. Clarity can be used to indicate the trophic status of a lake as can total phosphorus, which will be explained in the TSI section of this report.



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. Readings for the lake's ecoregion should be between five and 22.



Total Suspended Solids

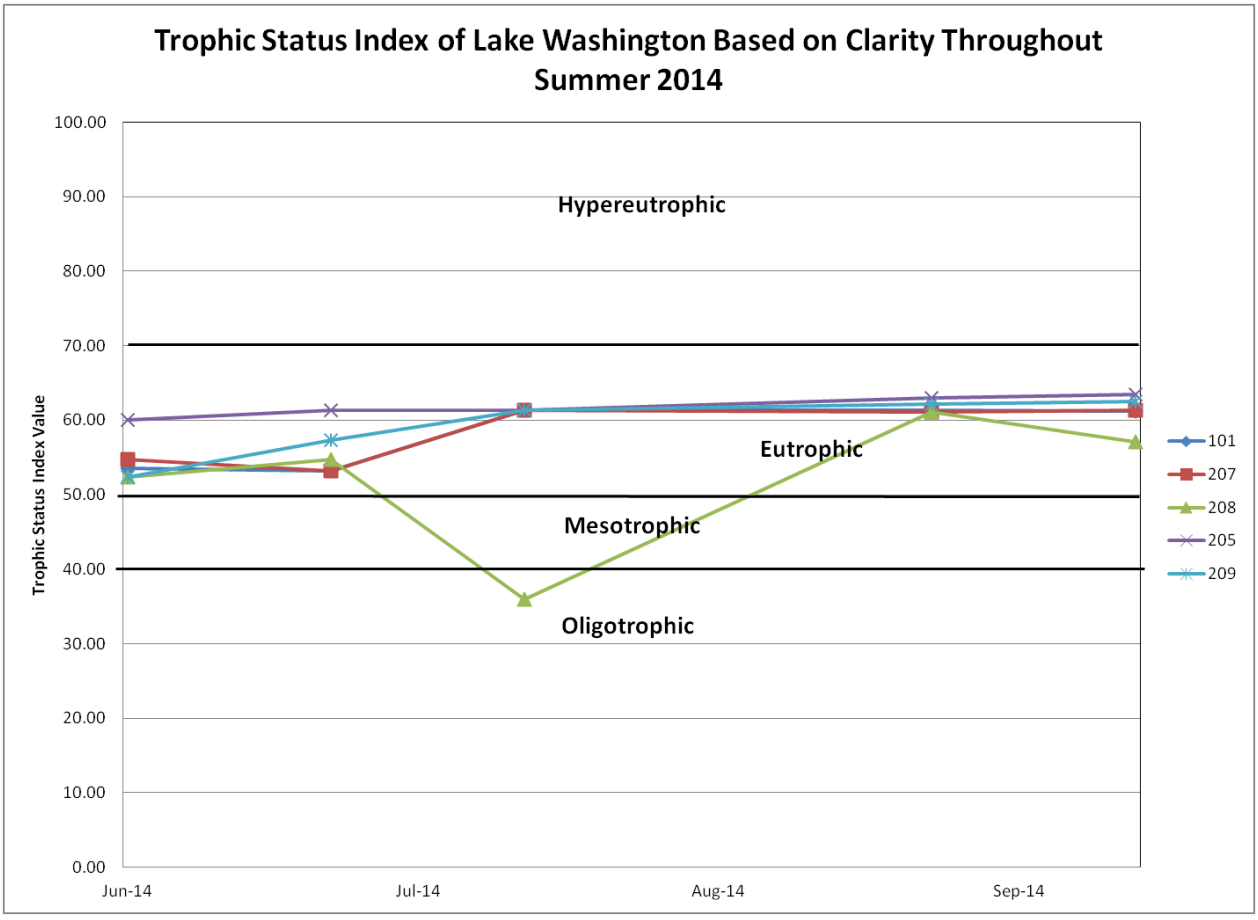
Suspended solids include soil, industrial waste, dead plant or animal material, live organisms, and sewage. Too many suspended solids can decrease water clarity, as well as light availability necessary for growth of aquatic plants, and harm fish and other aquatic organisms. Sediment can clog fish gills 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 inside this range with a reading of 4mg/L in early June, 4mg/L in June and outside the range with a reading of 7 mg/L in September.

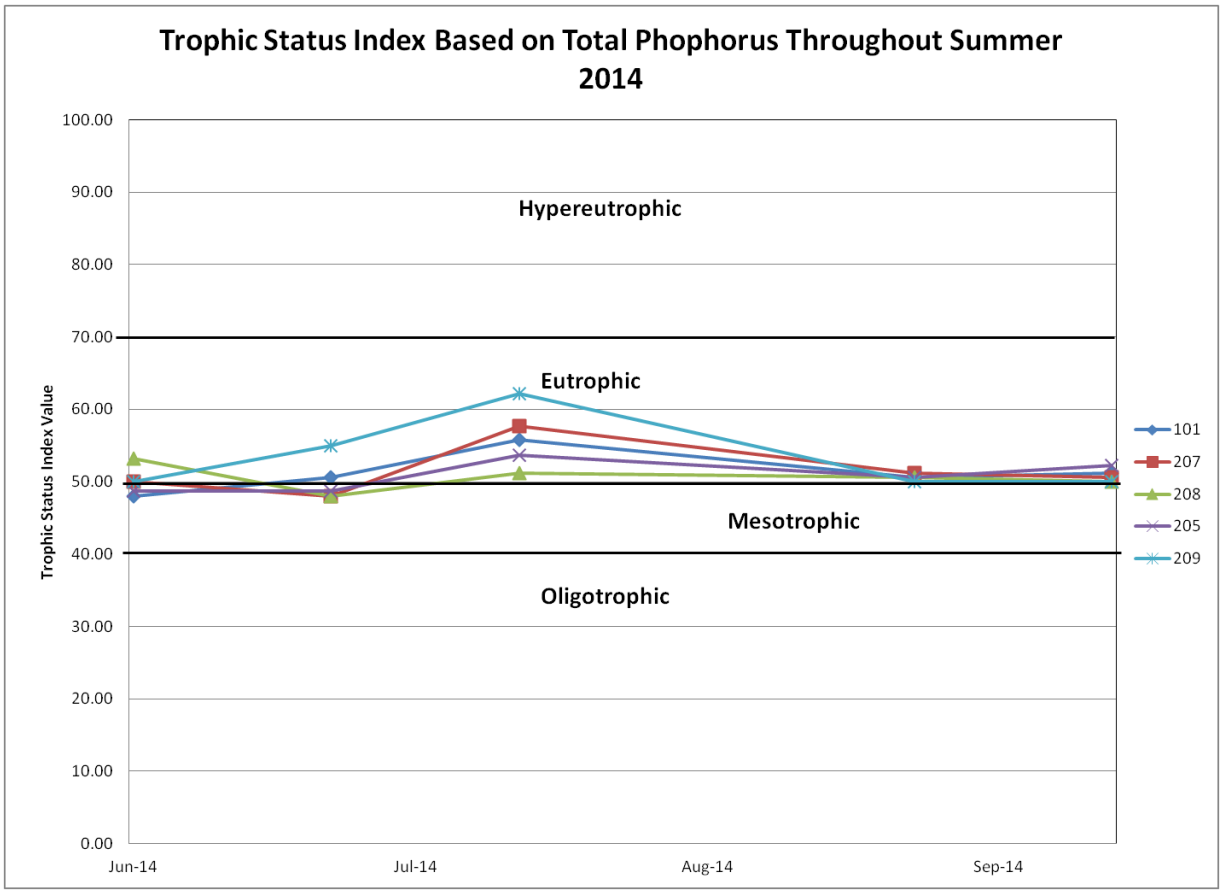
Total Dissolved Solids

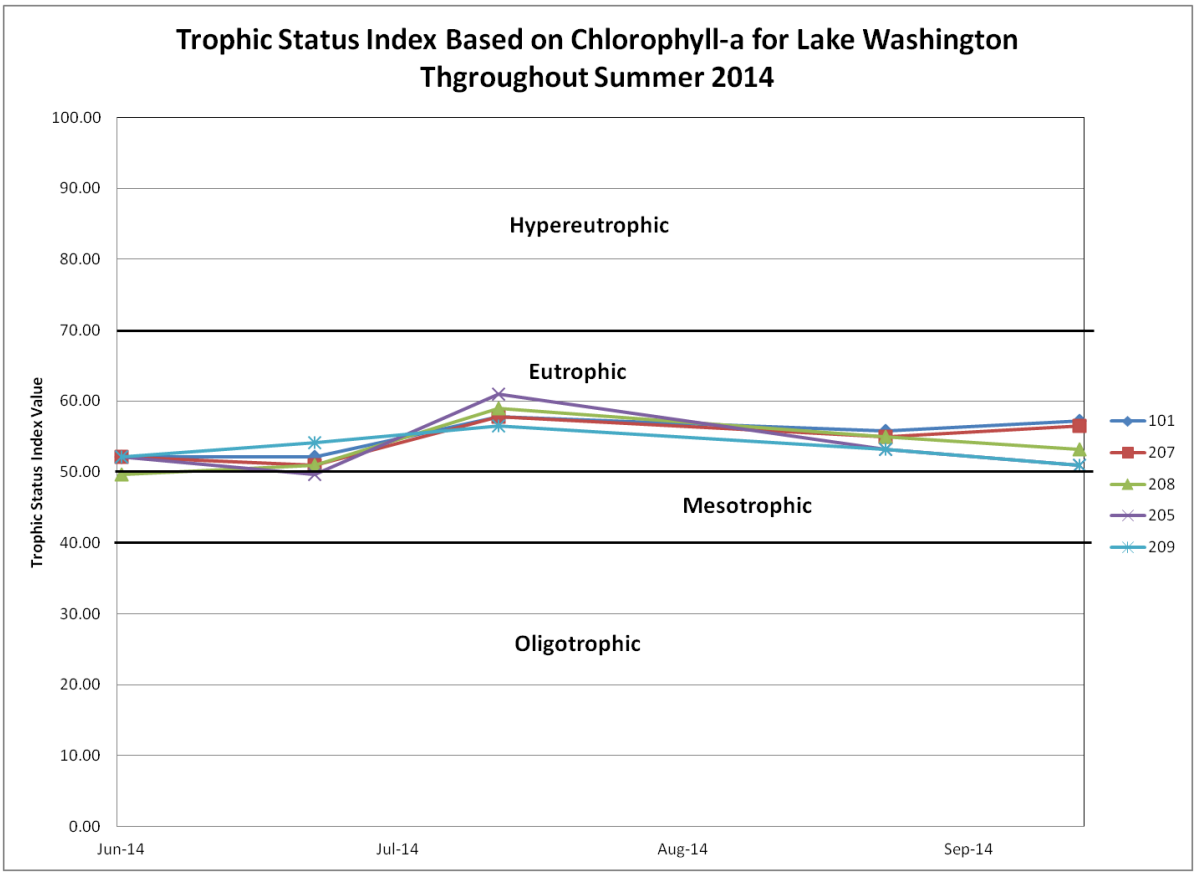
Total dissolved solids come from sources such as agricultural runoff, leaching of soil contamination and water pollution industrial or sewage treatment plants. The chemicals associated with TDS are calcium, phosphates, nitrates, sodium, potassium and chloride, which are found in nutrient and stormwater runoff, as well as runoff from roads were 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 212 mg/L.

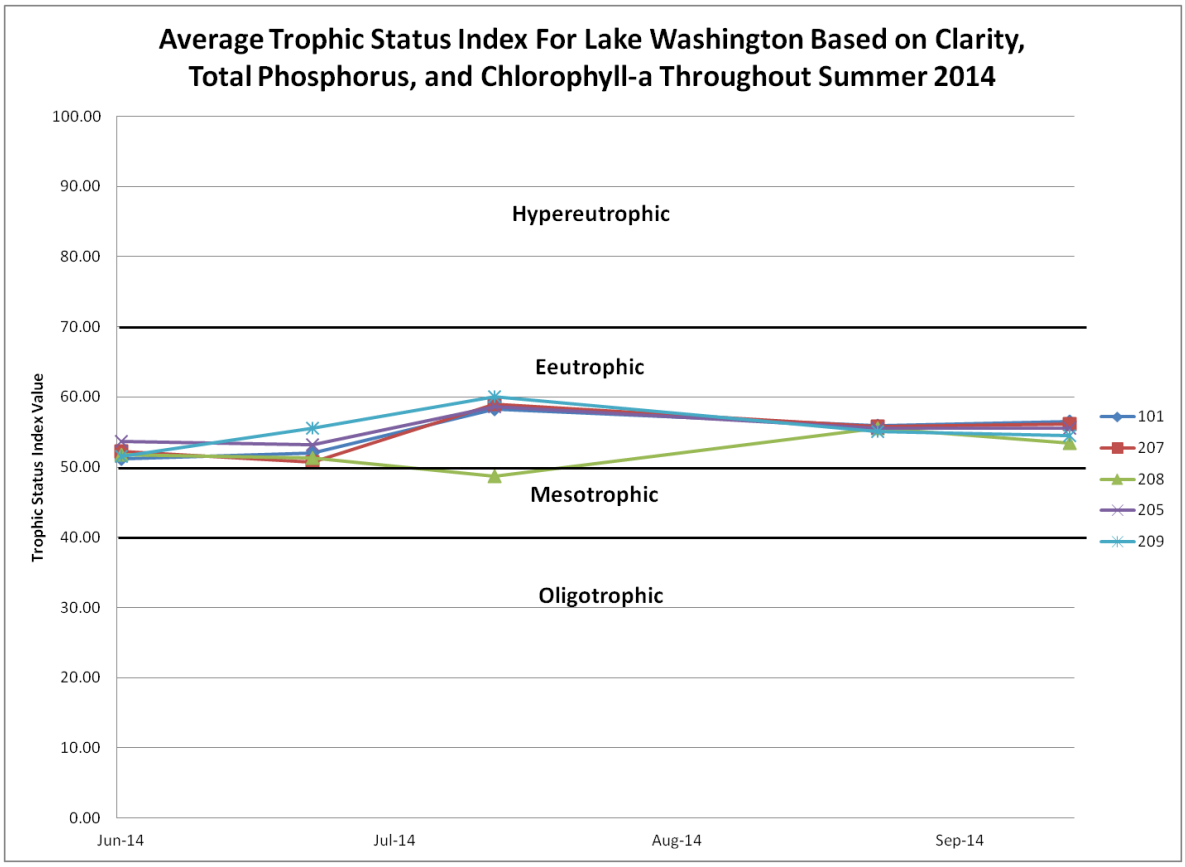
Trophic Status Index

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 for Lake Washington in 2014 using secchi disk readings, total phosphorus readings, and chlorophyll-a readings.

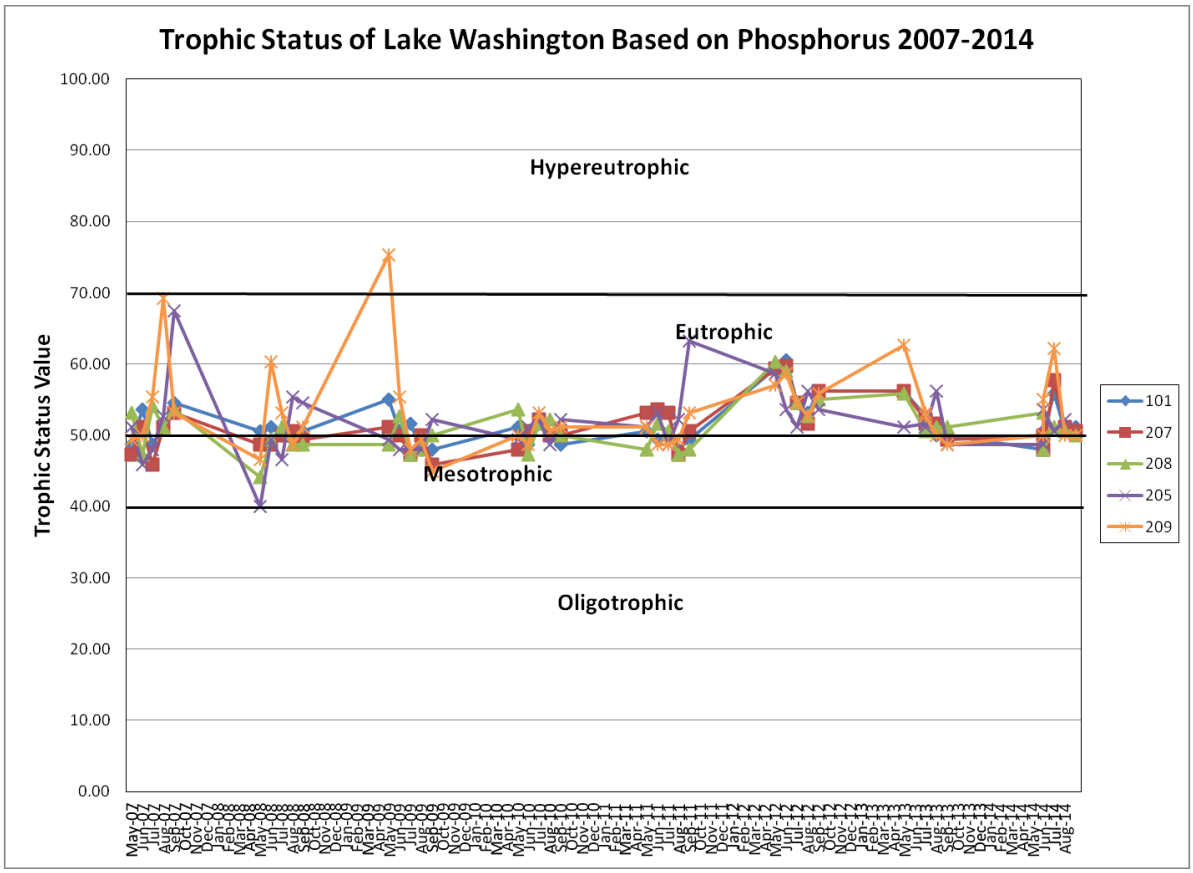


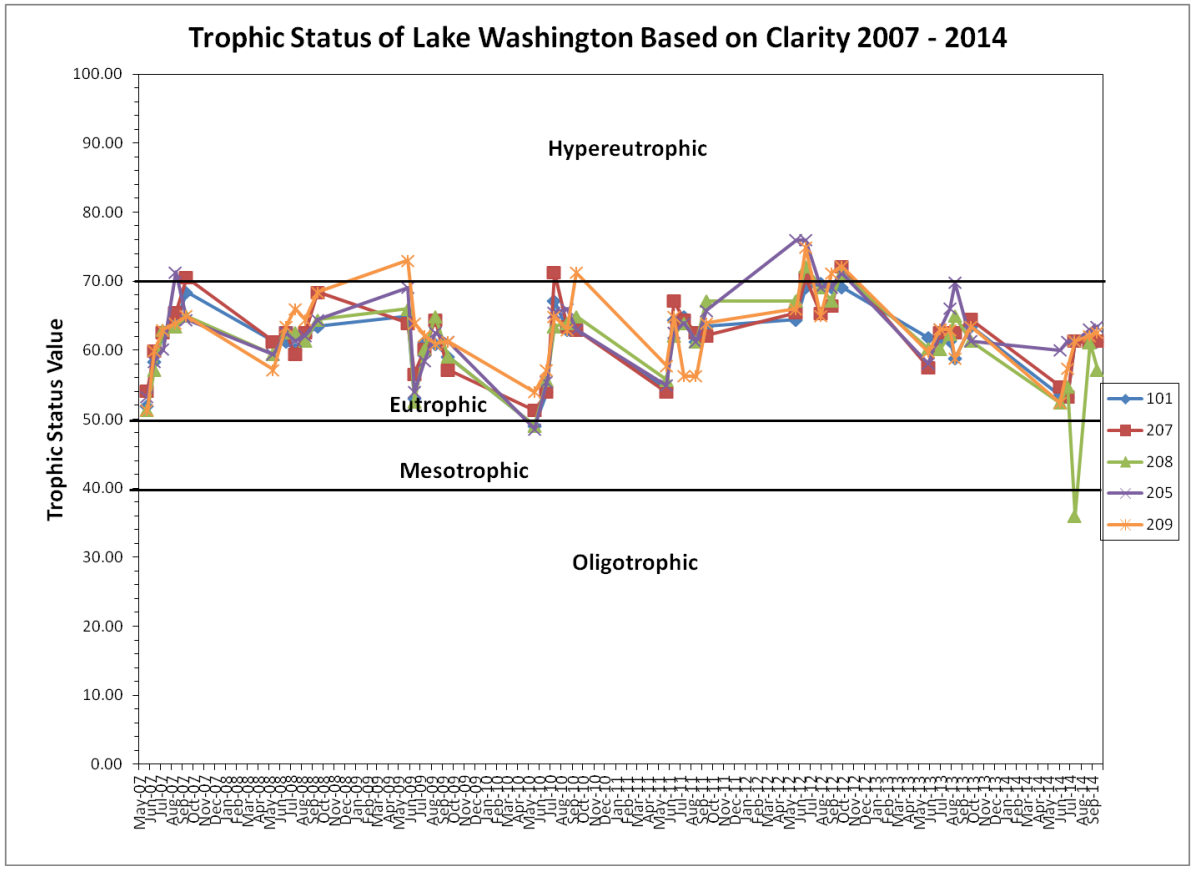

Trophic Status Index Based on Total Phophorus Throughout Summer 2014
Trophic Status Index Value
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
Jun-14
Jul-14
Aug-14
Sep-14
101
207
208
205
209

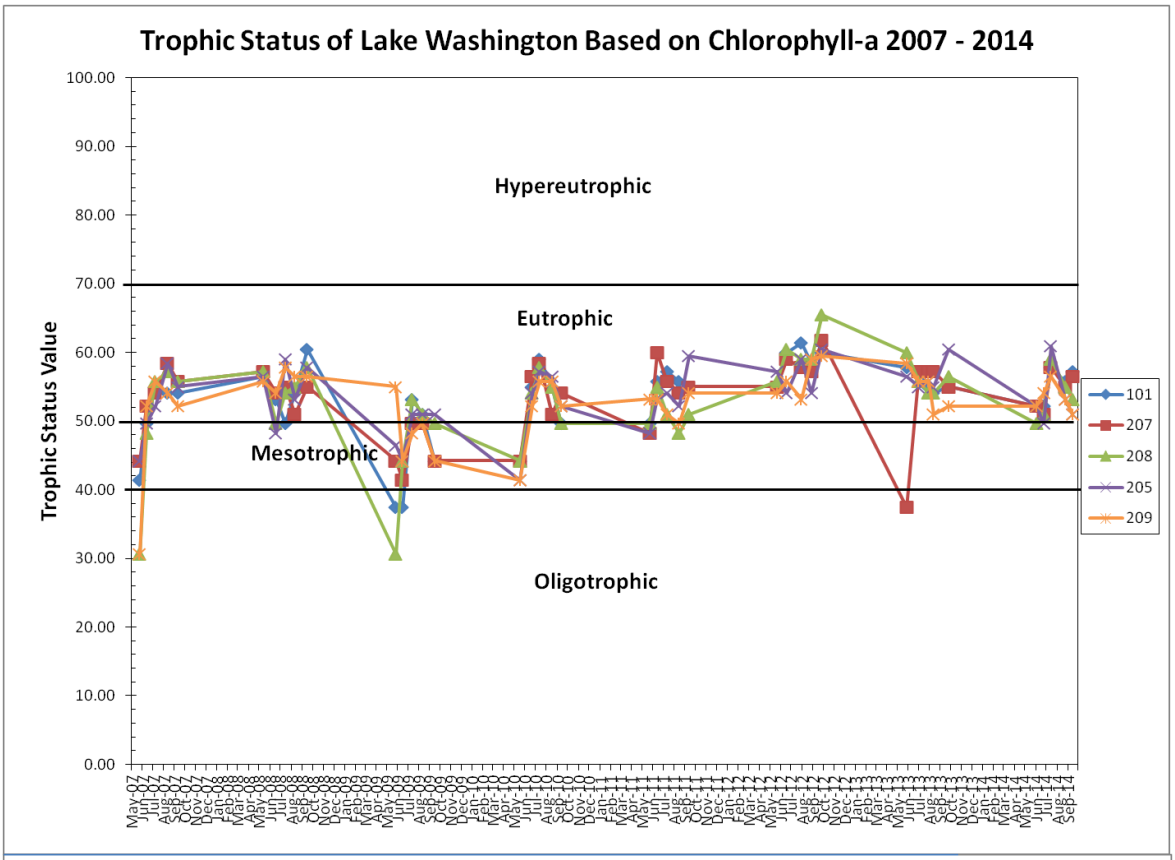

Trophic Status Index Based on Chlorophyll-a for Lake Washington Thgroughout Summer 2014
Trophic Status Index Value
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
Jun-14
Jul-14
Aug-14
Sep-14
101
207
208
205
209

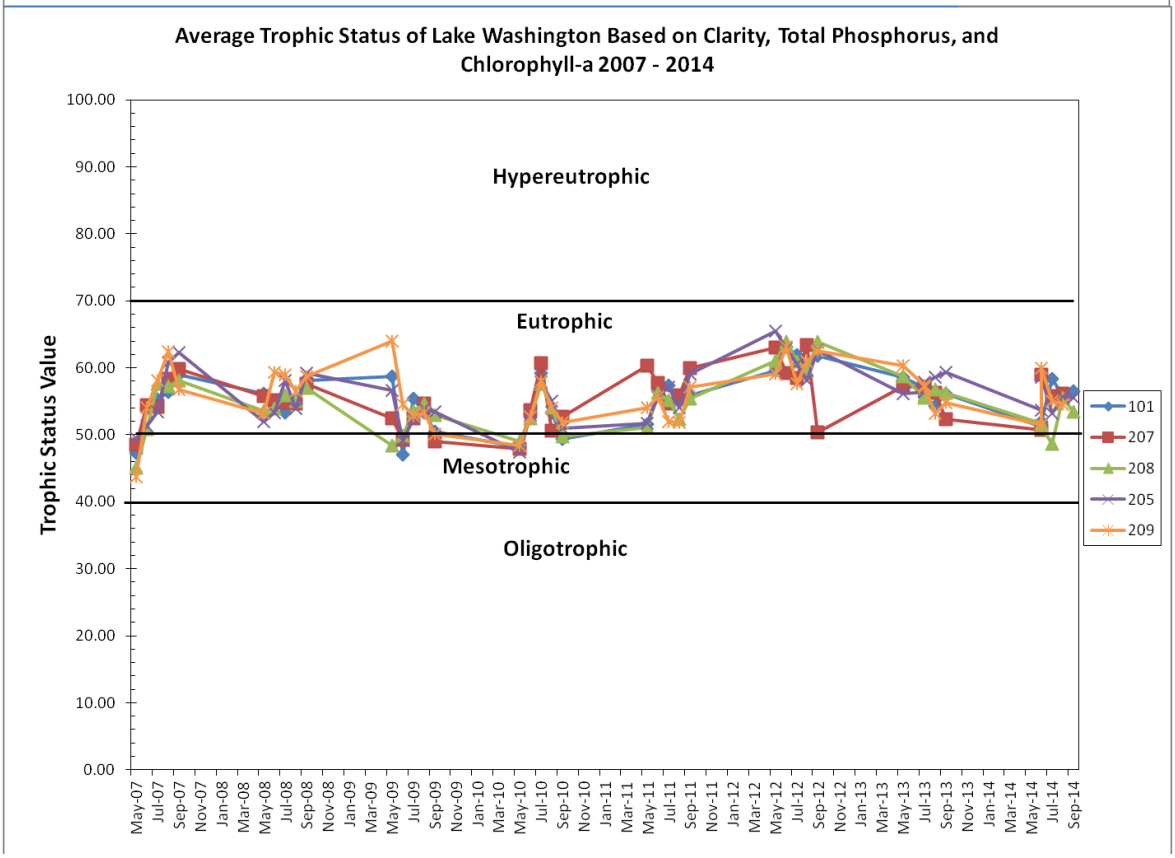


In order to see true results of management and monitoring practices on a lake, the lake must be monitored for multiple years. The following graphs compare trophic status index values from 2007 to 2014. When the TSI data from all years is compared as seen in the following graphs, indications can be made that the lake has improved in some areas and other area it has not. Data also indicates that for the most part the water quality has not gotten any worse as far as the health of the lake is concerned.


Trophic Status of Lake Washington Based on Phosphorus 2007-2014
Trophic Status Value
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
101
207
208
205
209


Trophic Status of Lake Washington Based on Clarity 2007 - 2014
Trophic Status Value
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
101
207
208
205
209


Trophic Status of Lake Washington Based on Chlorophyll-a 2007 - 2014
Trophic Status Value
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
101
207
208
205
209


Average Trophic Status of Lake Washington Based on Clarity, Total Phosphorus, and Chlorophyll-a 2007 - 2014
Trophic Status Value
Hypereutrophic
Eutrophic
Mesotrophic
Oligotrophic
101
207
208
205
209

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. When comparing TSI data from 2007 through 2014, readings seem to be relatively the same. The lake seems to be showing similar patterns each year, with no signs of sudden problems. Continuous monitoring of the lake each year and years to come will help track problem areas and add to the improvement of the lake.