LITTLE LAKE MARTHA

REPORT DESCRIPTION

This report is an update on the health of Little Lake Martha based on water quality data collected in 1995, 1996, and 2012 - 2016 by local volunteers and Snohomish County Surface Water Management (SWM) staff. For additional background on the information provided here, please visit www.lakes.surfacewater.info or call SWM at 425-388-3464.

LAKE DESCRIPTION

Little Lake Martha is a small bog lake located north of Lake Cassidy and just east of Highway 9. The lake covers 13.8 acres and has a maximum depth of about 6.1 meters (20 feet). The surrounding watershed, which is the land area that drains to the lake, is fairly large, covering 450 to 500 acres. Most of the land area near the lake is undeveloped, covered by forests and wetlands. However, there are several residential subdivisions west of Highway 9 that drain to the lake, as well as developing commercial areas around the intersections of Highway 9 and both 64th Street NE (SR 528) and 84th Street NE. There are no homes directly on the lake shore. Snohomish County Parks owns the land on the north side of the lake, but there is no developed public access to the lake.

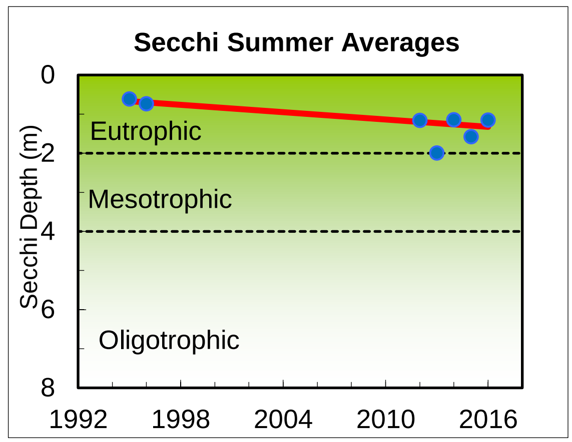
LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (shown in red) for water clarity and total phosphorus for Little Martha Lake. Please refer to the table at the end of the report for averages and ranges for water clarity, total phosphorus, and total nitrogen for Little Lake Martha.

Water Clarity

The water clarity of a lake, measured with a Secchi disk, is a reading of how far one can see into the water. Water clarity is affected by the amount of algae and sediment in the lake, as well as by water color. Lakes with high water clarity usually have low amounts of algae, while lakes with poor water clarity often have excessive amounts of algae.

Water clarity in Little Lake Martha is low, mainly because of the dark color of the water. The 2012 – 2016 long-term average is 1.2 meters (3.9 feet). The yearly averages in 2012 - 2016 were slightly clearer than water clarity averages in 1995 and 1996, which were 0.6 and 0.8 meters, respectively. However, there are not enough data on water clarity in Little Lake Martha to determine if the improved water clarity is just part of the natural fluctuation in lake conditions or affected by the limited data.



Water Color

The color of lake water affects water clarity and the depths at which algae and plants can grow. In many lakes, the water is naturally brown, orange, or yellow. This darker color comes from dissolved humic compounds from surrounding wetlands and does not harm water quality. This is the case with Little Lake Martha, which has a dark brown/yellow color to the water. Dark water color is the natural state for a bog lake such as Little Lake Martha.

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Temperature

The temperature of lake water changes with the seasons and varies with depth. During spring and summer, the sun warms the upper waters. Because warmer water is less dense, it floats above the cooler, denser water below. The temperature and density differences create distinct layers of water in the lake, and these layers do not mix easily. This process is called stratification and occurs during the warm months. The warm, upper water layer is called the epilimnion. The colder, darker bottom zone is called the hypolimnion. These layers will stay separated until the fall when the upper waters cool, the temperature differences decrease, and the entire lake mixes, or turns over.

From May through September 2015 (the most recent data available), temperature data were collected at each meter throughout the Little Martha Lake water column (see graph). Temperature profiles for 2015 show that throughout the sampling season the lake was strongly thermally stratified. This means that there was a large temperature difference between the warm upper waters and the cool bottom waters, and mixing did not occur between these layers. In May, the upper waters measured about 64˚F (18°C) in temperature, and by August had reached their peak at 77°F (25°C). At the same time, bottom water temperatures changed only a little and remained around 43-50°F (6-10°C). Each fall the surface waters will continue to cool until the temperatures are almost equal from top to bottom. As stratification weakens, the lake water will turn over (or mix). The lake will stay mixed during the winter until springtime, when the upper waters begin to warm again.

Dissolved Oxygen

Oxygen dissolved in the water is essential for life in a lake. Most of the dissolved oxygen comes from the atmosphere. Like temperature, dissolved oxygen levels vary over time and with depth. During the warm months, the upper waters receive oxygen from the atmosphere, but the lower waters cannot be replenished with oxygen because of the separation between water layers. Meanwhile, bacteria in the lake bottom are consuming oxygen as they decompose organic matter. Eventually oxygen is depleted in the bottom waters. Low dissolved oxygen in the bottom waters can lead to a release of nutrients from the lake sediments.

Dissolved oxygen was also measured at every meter throughout the Little Martha Lake water column from May to September in 2015 (see graph). Oxygen levels were relatively high in the upper waters from May through September, although the levels were slightly lower in the hottest months because warm water cannot hold as much dissolved oxygen as colder water. In July, there was a sharp increase in dissolved oxygen levels about 7 feet deep. This indicates vigorous algae growth at that depth which added oxygen to the water. Meanwhile, the bottom waters contained little to no dissolved oxygen. There was virtually no dissolved oxygen in the lake below about 8 feet. During the summer period, oxygen in the lower waters is consumed by the decomposition of organic material within the lake. When the lake is stratified, the oxygen is not replenished by the overlying oxygen-rich upper waters or the atmosphere. Very low dissolved oxygen levels in the bottom waters can lead to a release of phosphorus from the lake sediments that can result in increased algae growth in late summer and fall or the next spring. The bottom of the lake will remain devoid of oxygen until the lake mixes (typically in late October/early November). The lake then remains mixed through the winter until springtime when the upper waters begin to warm and dissolved oxygen begins to decline in the bottom.

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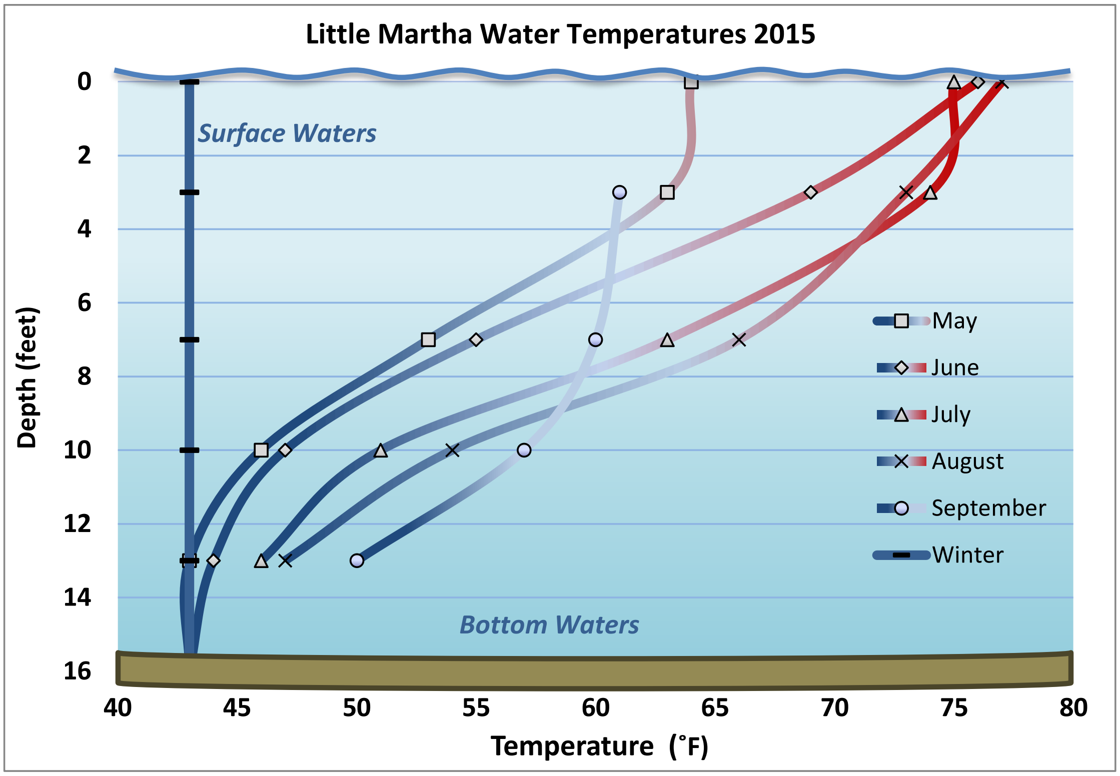

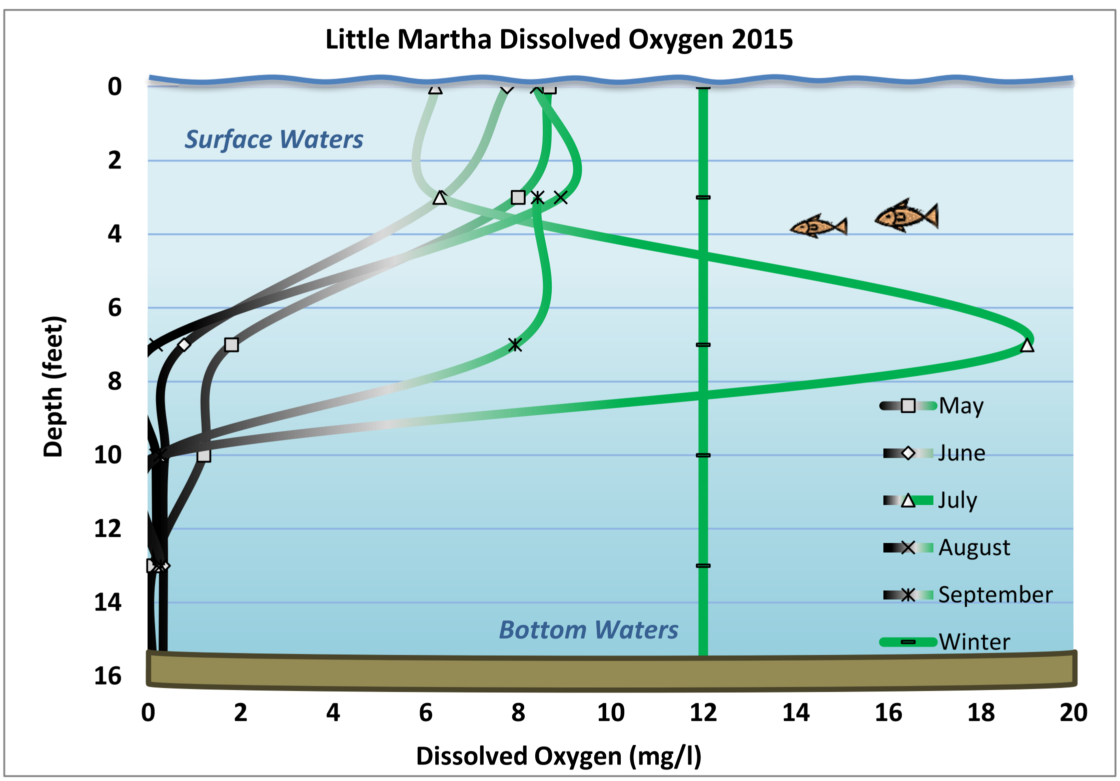

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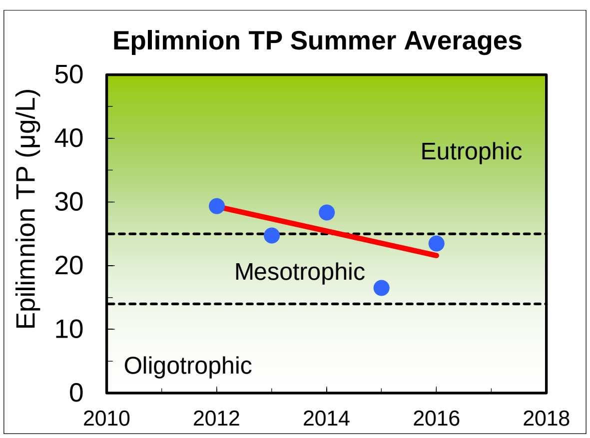
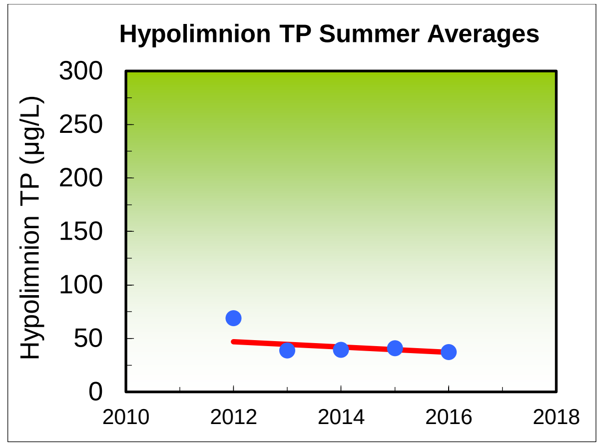
Phosphorus (key nutrient for algae)

Nutrients are essential for the growth of algae, fish, and aquatic plants in a lake. However, too many nutrients, especially phosphorus, can pollute a lake and lead to unpleasant algae growth. Nutrients enter the lake through stormwater runoff or from streams flowing into the lake. Sources of nutrients include fertilizers, pet and animal wastes, poorly-maintained septic systems and erosion from land clearing and construction. Monitoring of phosphorus levels over time helps to identify changes in nutrient pollution.

Total phosphorus concentrations in the epilimnion (upper waters) are moderately high in Little Lake Martha from 2012 through 2016, with a long term summer average of 24 µg/L (micrograms per liter, which is equivalent to parts per billion). There is adequate phosphorus in the upper waters to result in occasional algae blooms. Future monitoring will be needed to asses if there are any long-term trends.



Total phosphorus averages in the hypolimnion (bottom waters) were also moderately high from 2012 to 2016, with an overall summer average of 45 µg/L. The levels of phosphorus in the bottom waters increased throughout the summer months, especially in 2012. This may indicate that phosphorus is being released from the bottom sediments during the time of year when dissolved oxygen levels drop in the bottom waters.



Chlorophyll a (Algae)

Algae are tiny plant-like organisms that are essential for a healthy lake. Fish and other lake life depend on algae as the basis for their food supply. However, excessive growths of algae, called algae blooms, can cloud the water, form unsightly scums, and sometimes release toxins. Excess nutrients, such as phosphorus, are the main cause of nuisance algae growth in a lake. Chlorophyll *a* measurements are one method for tracking the amount of algae in a lake.

Chlorophyll *a* measurements for Little Lake Martha were taken in 2016, with a summer average of 7.4 µg/L. This level is relatively high and indicates that minor algae blooms do occur in the lake from time to time.

Nitrogen (another essential nutrient for algae)

Nitrogen is another important nutrient for plant and algae growth. Similar to phosphorus, lakes with high levels of nitrogen typically have more aquatic plants and algae. From 2014 - 2016, Little Martha Lake had high levels of total nitrogen (summer average of 736 µg/L). This would be consistent with a shallow, eutrophic lake that has occasional algae blooms.

The relative abundance of nitrogen and phosphorus can also be a useful indicator of lake conditions. This is referred to as the nitrogen to phosphorus ratio or N:P ratio. When lakes have low N:P ratios (typically less than 20), algae growth is often high and harmful blue-green algae blooms may be a problem. Low N:P ratios may also indicate that fertilizers, septic systems, polluted runoff from developed areas, and release of phosphorus from the lake bottom sediments are contributing most of the nutrients to the lake.

In contrast, when lakes have higher N:P ratios (greater than 20), algae growth will be limited by the amount of phosphorus available, and blue-green algae are usually less of a problem. Little Lake Martha had a moderate average N:P ratio of 32, and blue green algae blooms were not a problem in 2016.

SUMMARY

Trophic State

All lakes go through a process of enrichment by nutrients and sediment. In this process, known as eutrophication, nutrients and sediment contribute to the ever-increasing growth of algae and aquatic plants. Over thousands of years, lakes will gradually fill up with organic matter and sediments.

Lakes can be classified by their degree of eutrophication, also known as their trophic state. There are three primary trophic states for lakes—oligotrophic, mesotrophic, and eutrophic—as well as intermediate states. Oligotrophic lakes are usually deep, with clear water, low nutrient concentrations, and few aquatic plants and algae. Mesotrophic lakes are richer in nutrients and produce more algae and aquatic plants. Eutrophic lakes are often shallow and characterized by abundant algae and plants, high nutrient concentrations, limited water clarity, and low dissolved oxygen in the bottom waters.

The trophic state classification of a lake does not necessarily indicate good or bad water quality because eutrophication is a natural process. However, human activities that contribute sediment and excess nutrients to a lake can dramatically accelerate the eutrophication process and result in declining water quality.

Based on the limited monitoring data available, Little Lake Martha may be classified as eutrophic because of low water clarity and moderately high phosphorus and algae concentrations. The lake is capable of producing significant amounts of both plants and algae, although growth is limited by the dark water color. This eutrophic condition is likely the natural state for a bog lake.

Condition

Overall, Little Lake Martha appears to be in satisfactory condition. Additional monitoring is needed to determine if the 2012-2016 conditions are typical for the lake.

The primary threat to the water quality of Little Lake Martha is the potential impacts from additional development in its very large watershed, especially near Highway 9. Land clearing and development increase the amount of nutrients that wash into the lake during rain events. Fortunately, the surrounding forests and wetlands help to filter out pollution before it can reach the lake. To find out more about ways to protect lake water quality and for information on the causes and problems of elevated lake nutrient levels visit www.lakes.surfacewater.info.

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DATA SUMMARY FOR LITTLE MARTHA LAKE						
Source	**Date**	**Water Clarity (Secchi depth in meters)**	**Total Phosphorus (µg/L)**		**Total Nitrogen (µg/L)**	**Chlorophyll *a* (µg/L)**
			Surface	**Bottom**	**Surface**	**Surface**
SWM Staff or Volunteer	**1995**	0.4 - 0.8 (0.6) *n = 3*	-	-	-	-
Volunteer	**1996**	0.7 - 0.8 (0.8) *n = 2*	-	-	-	-
Volunteer	**2012**	0.8 - 1.4 (1.2) *n = 4*	17 - 29 (24) *n = 3*	32 - 153 (74) *n = 3*	-	-
Volunteer	**2013**	2 (2.0) *n = 1*	21 - 31 (25) *n = 4*	27 - 48 (39) *n = 4*	-	-
Volunteer	**2014**	*1.1 - 1.2 (1.1) n = 6*	*21 - 36 (28) n = 3*	*26 - 57 (39) n = 3*	*754 - 927 (841) n = 3*	-
Volunteer	**2015**	*1.4 - 1.9 (1.6) n = 6*	*12 - 20 (17) n = 4*	*27 - 56 (41) n = 4*	*515 - 686 (622) n = 4*	-
Volunteer	**2016**	1.1 - 1.3 (1.2) *n = 6*	14 - 34 (24) *n = 4*	24 - 49 (37) *n = 4*	625 - 927 (771) *n = 4*	2.7 - 12 (7.4) *n = 4*
Long Term Avg		**1.2 (2012-2016)**	**24 (2012-2016)**	**45 (2012-2016)**	**736 (2014-2016)**	**7.4 2016**
TRENDS		**None**	**NA**	**NA**	**NA**	**NA**

NOTES

- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in ( ) and number of samples (*n*).
- Total phosphorus data are from samples taken at discrete depths only.
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.