

BC Lake Stewardship and Monitoring Program

Green Lake 2005

*A partnership between the BC Lake Stewardship Society (BCLSS)
and the Ministry of Environment*



The Importance of Green Lake & its Watershed

British Columbians want lakes to provide good water quality, aesthetics, and recreational opportunities. When these features are not apparent in our local lakes, people begin to wonder why. Concerns often include whether the water quality is getting worse, if the lake has been impacted by land development or other human activities, and what conditions will result from more development within the watershed.

The BC Lake Stewardship Society (BCLSS), in collaboration with the Ministry of Environment, has designed a program, entitled *The BC Lake Stewardship and Monitoring Program*, to address these concerns. Through regular water sample collections, we can come to understand a lake's current water quality, identify the preferred uses for a given lake, and monitor water quality changes resulting from land development within the lake's watershed. There are different levels of lake monitoring and assessment. The level appropriate for a particular lake depends on the funding and human resources available. In some cases, data collected as part of a Level I or II program can point to the need for a more in-depth Level III program. This report gives the results of a Level I program for Green Lake for the first year of monitoring.

The BCLSS can provide communities with both lake-specific monitoring results and educational materials on general lake protection issues. This useful information can help communities play a more active role in the protection of the lake resource. Finally, this program allows government to use its limited resources efficiently with the help of local volunteers and BCLSS.

A **watershed** is defined as the entire area of land that moves the water it receives into a common waterbody. The term watershed is misused when describing only the land immediately around a waterbody or the waterbody itself. The true definition represents a much larger area than most people normally consider.

Watersheds are where much of the hydrologic cycle occurs and play a crucial role in the purification of water. Although no "new" water is ever made, it is continuously recycled as it moves through watersheds and other hydrologic compartments. The quality of the water resource is largely determined by a watershed's capacity to buffer impacts and absorb pollution.

Every component of a watershed (vegetation, soil, wildlife, etc.) has an important function in maintaining good water quality and a healthy aquatic environment. It is a common misconception that detrimental land use practices will not impact water quality if they are kept away from the area immediately surrounding a waterbody. Poor land use practices in a watershed can eventually impact the water quality of the downstream environment.



Green Lake is located in the Coastal Mountain region and falls within Resort Municipality of Whistler boundaries. The lake has a surface area of 205.18 ha, shoreline perimeter of 10,897 m and lies at an elevation of 634 m. The average depth of Green Lake is 14.2 m, while the deepest spot is 40.2 m. Only about 20% of the lake is deeper than 20 m. The inputs to Green Lake are three main creeks near the west end of the lake. The lake contains bull

trout, kokanee, prickly sculpin, stickleback, and rainbow trout. Both kokanee and rainbow trout populations have been augmented with hatchery stocks. The lake is bound on the northeast side by Highway 99 and on the southwest side by the CN railway. There are two subdivisions along Green Lake, Emerald Estates along the northern edge and Nicklaus North at the southern tip. At Nicklaus North there is a golf course between residences and the lakefront. It is difficult to determine the number of year-round or strictly seasonal residents as Whistler often serves as a second home/vacation property for many and has a large transient community.

What's Going on Inside Green Lake?

Temperature

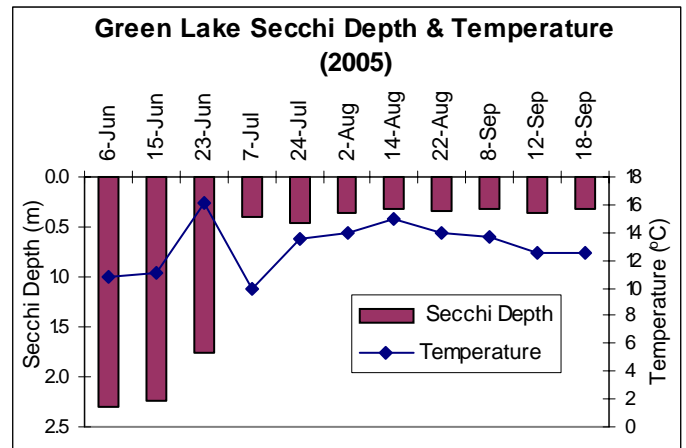
Lakes show a variety of annual temperature patterns based on their location and depth. Most interior lakes, such as Green Lake, form layers (stratify), with the coldest water at the bottom. Because colder water is more dense, it resists mixing into the warmer upper layer for much of the summer. In spring and fall, these lakes usually mix from top to bottom (overturn) as wind energy overcomes the reduced temperature and density differences between surface and bottom waters. In the winter, lakes re-stratify under ice with the densest water (4°C) near the bottom. These lakes are called dimictic lakes because they turn over twice per year. They are the most common type of lake in British Columbia.

Coastal lakes in BC are more often termed warm monomictic lakes because they turn over once per year. These lakes have temperatures that do not fall below 4°C. Warm monomictic lakes generally do not freeze and circulate freely in the winter at or above 4°C, and stratify only in the summer.

Ice-on and ice-off dates for BC lakes are important data for climate change research. Local residents report that Green Lake freezes every year. By comparing these dates to climate change trends, we can examine how global warming is affecting our lakes.

Surface temperature readings serve as an important indicator of the effects of climate change. By measuring surface temperature, we can record and compare readings from season to season and year to year. Surface temperature also helps to determine much of the seasonal oxygen, phosphorus, and algal conditions.

Temperature and Secchi depth were measured at one location on Green Lake. The graph above illustrates the Green Lake Secchi depth and temperature for 2005.

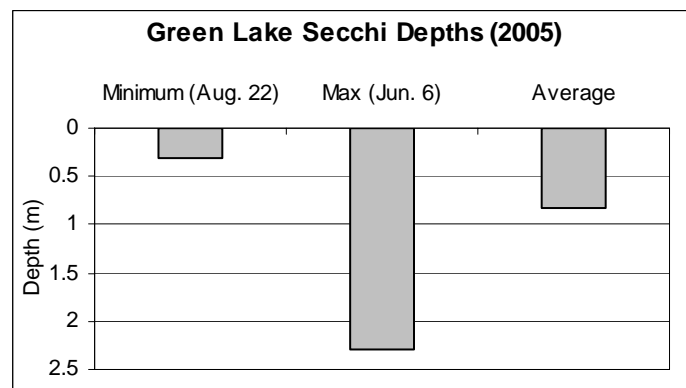


The maximum surface temperature was 16.2 °C (June 23rd) and the minimum surface temperature was 10.0 °C (July 7th). The temperature varied throughout the season, although readings change little from July 24th on.

Trophic Status and Water Clarity

The term *trophic status* is used to describe a lake's level of productivity and depends on the amount of nutrients available for plant growth, including tiny floating algae called phytoplankton. Algae are important to the overall ecology of the lake because they are food for zooplankton, which in turn are food for other organisms, including fish. In most lakes, phosphorus is the nutrient in shortest supply and thus acts to limit the production of aquatic life. When in excess, phosphorus accelerates growth and may artificially age a lake. Total phosphorus (TP) in a lake can be greatly influenced by human activities.

One measure of productivity is water clarity. The more productive a lake, the higher the algal growth and, therefore, the less clear the water becomes. The clarity of the water can be evaluated by using a Secchi disk, a black and white disk that measures the depth of light penetration.



Natural variation and trends in Secchi depth and temperature not only occur between years, but also throughout one season. For example, the upper graph indicates that the Secchi depth varied throughout the season. Further monitoring of the lake will provide a better interpretation of data.

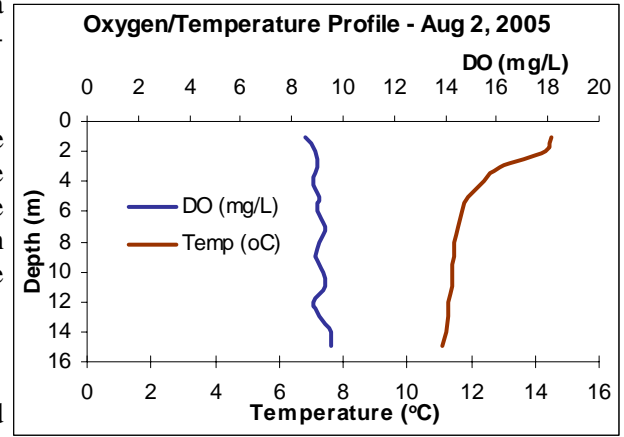
The above graph illustrates that the highest Secchi reading occurred in June (2.3 m) and the lowest reading occurred in August (0.3 m). The average Secchi reading for Green Lake was 0.8 m. Notes in the sampling data indicate that Green Lake had a change in water level in early July due to large rainfall, which increased the sediment input from Fitzsimmons Creek, in addition to glacial run-off in July and August. Previous water quality reports on Green Lake mention that there are large water inputs and suspended fines originating from the glacial headwaters of Fitzsimmons Creek, contributing to high turbidity during the summer months (McKean and Nordin 1982, Schiefer 2004). This corresponds to the 2005 sampling notes and likely accounts for the low Secchi depths in July and August. Schiefer (2004) notes that Secchi depths for Green Lake are greatest (deepest) during early spring and fall. It was also noted that phosphorus levels are high in Green Lake due to the same large

water and suspended fines inputs. Despite these high levels of phosphorus, Green Lake experiences low productivity of plankton due to the high turbidity levels in the summer, and thus retains its oligotrophic status. A single summer of Secchi depth provides only a snapshot of water quality within a lake. In order to get an overall idea of the health of an individual lake, the Secchi disk readings should be compared consistently over a number of years.

The flushing rate is another factor that affects water quality. The flushing rate is the rate of water replacement in a lake. The flushing rate depends on the amount of inflow and outflow of a lake. Relative to its volume, Green Lake likely has a high flushing rate and, therefore, may be less sensitive to human impact. The higher the flushing rate, the more quickly excess nutrients can be removed from the system.

Dissolved Oxygen

Oxygen is essential to life in lakes. It enters lake water from the air by wind action and also through plant photosynthesis. Oxygen is consumed by respiration of animals and plants, including the decomposition of dead organisms by bacteria. A great deal can be learned about the health of a lake by studying oxygen patterns and levels. Lakes that are less productive (oligotrophic) will have sufficient oxygen to support life at all depths throughout the year. The dissolved oxygen (DO) profiles for Green Lake show that temperature and DO are uniform at all depths and that DO is high. This reinforces the oligotrophic status as there is little phytoplankton growth, resulting in minor decomposition and, therefore, little oxygen demand. The profiles for all sample dates are similar, with uniform DO and temperature, indicating that Green Lake did not stratify due to the large inflows throughout the summer.



Land Use and Pollution Sources

Human activities that impact water bodies range from small, widespread and numerous *non-point* sources throughout the watershed to large *point* sources of concentrated pollution (e.g. outfalls, spills, etc.). Undisturbed watersheds have the ability to purify water and repair small amounts of damage from pollution and alteration. However, modifications to the landscape and increased levels of pollution impair this ability.

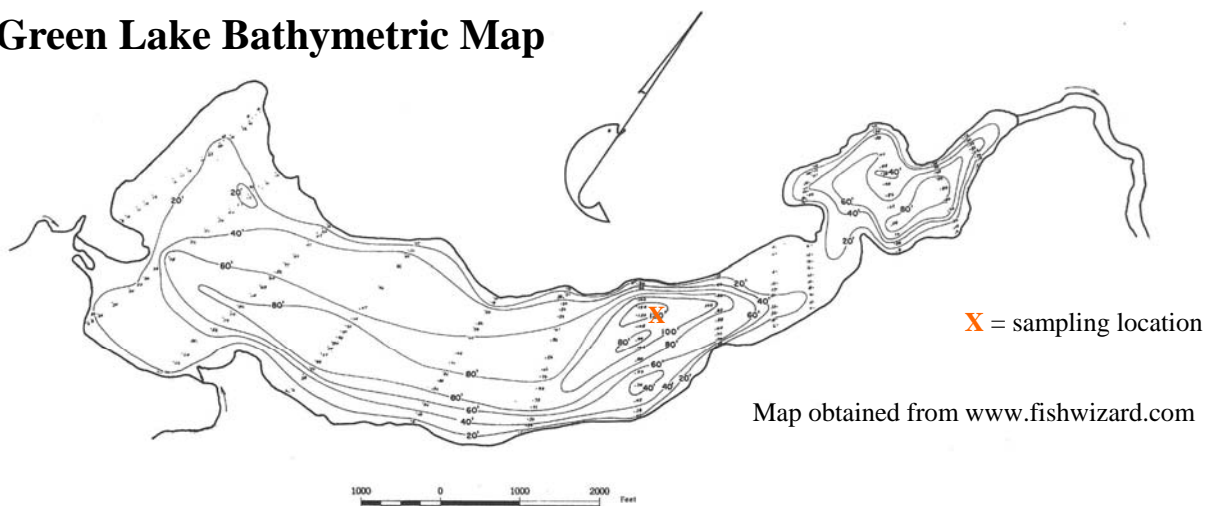
The Ministry of Environment believes the area immediately surrounding Green Lake is likely to have the most influence on the lake's water quality. With a golf course situated on the edge of Green Lake and the lake being bound by a highway on one side and railroad track on the other, there is potential for impact on Green Lake due to land uses. To minimize other potential impacts, local residents are encouraged to ensure their septic systems are up to standard and that their land use activities are following good environmental practices. Further information can be found on the following page.

Should Further Monitoring be Done on Green Lake?

The Ministry of Environment recommends a minimum of three years of monitoring to establish a water quality baseline. This time frame is preferred because if data is collected for only one or two years, there is the risk of only sampling during atypical weather or other environmental conditions that would not reflect the true nature of the water. In other words, three years of data helps take into account annual changes in local climate. Therefore, three years of consistently collected data is beneficial.

Local volunteer monitors are encouraged to record ice-on and ice-off dates for long term climate change records. This information is important for climate change research. If these dates have been recorded in the past, please send the information to BCLSS so that it can be incorporated into climate change studies..

Green Lake Bathymetric Map



Tips to Keep Green Lake Healthy

Onsite Sewage Systems

- Inspect your system yearly, and have the septic tank pumped every 2 to 5 years by a septic service company. Regular pumping is cheaper than having to rebuild a drain-field.
- Use phosphate-free soaps and detergents.
- Do not put toxic chemicals (paints, varnishes, thinners, waste oils, photographic solutions, or pesticides) down the drain because they can kill the bacteria at work in your onsite sewage system and can contaminate water-bodies.
- Conserve water: run the washing machine and dishwasher only when full and use only low-flow shower-heads and toilets.

Yard Maintenance, Landscaping and Gardening

- Minimize the disturbance of shoreline areas by maintaining natural vegetation cover.
- Minimize high-maintenance grassed areas.
- Replant lakeside grassed areas with native vegetation. Do not import fine fill.
- Use paving stones instead of pavement.
- Stop or limit the use of fertilizers and pesticides.
- Do not use fertilizers in areas where the potential for water contamination is high, such as sandy soils, steep slopes, or compacted soils.
- Do not apply fertilizers or pesticides before or during rain due to the likelihood of runoff.
- Hand pull weeds rather than using herbicides.
- Use natural insecticides such as diatomaceous earth. Prune infested vegetation and use natural predators to keep pests in check. Pesticides can kill beneficial and desirable insects, such as ladybugs, as well as pests.
- Compost yard and kitchen waste and use it to boost your garden's health as an alternative to chemical fertilizers.

Boating

- Do not throw trash overboard or use lakes or other water bodies as toilets.
- Use biodegradable, phosphate-free cleaners instead of harmful chemicals
- Conduct major maintenance chores on land.
- Keep motors well maintained and tuned to prevent fuel and lubricant leaks.
- Use absorbent bilge pads for minor leaks or spills.
- Recycle used lubricating oil and left over paints.
- Check for and remove all aquatic plant fragments from boats and trailers before entering or leaving a lake.
- Do not use metal drums in dock construction. They rust, sink and become unwanted debris. Use Styrofoam or washed plastic barrel floats. All floats should be labelled with the owner's name, phone number and confirmation that barrels have been properly maintained

Who to Contact for More Information

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BC Lake Stewardship Society

Photo Credit:

www.sharphooks.com

Additional Resources

McKean, C.J.P., and R.N. Nordin. 1982. Water quality data summary for Green Lake, near Whistler Mountain. APD Bulletin 30. British Columbia Ministry of Environment Assessment and Planning Division, Victoria, BC.

Schiefer, Erik. 2004. Contemporary Sedimentation Patterns Within Green Lake, Southern Coast Mountains, British Columbia. PhD Thesis. University of British Columbia, Department of Geography.