BC Lake Stewardship and Monitoring Program

Quamichan Lake 2008 - 2011

A partnership between the BC Lake Stewardship Society and the Ministry of Environment

The Importance of Quamichan 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 (MoE), 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 2008 - 2011 results of a modified Level I program for Quamichan Lake.

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 the 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.

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

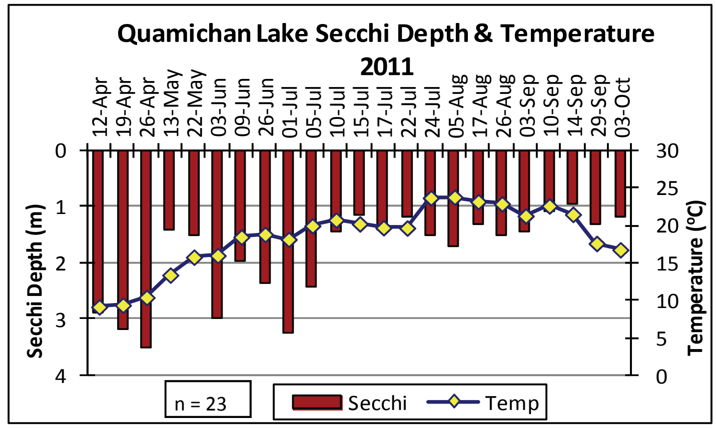
Quamichan Lake has a perimeter of 8348 m and lies at an elevation of 26 m. The surface area of the lake is 3.13 km^2 and the maximum depth is 8 m (FISS, 2011). Although technically situated in the Municipality of North Cowichan, most people consider the lake to be located in Duncan, BC (Hert 2012, Pers. Comm.). The lake is popular for fishing, kayaking, canoeing and waterskiing, however this is limited in the summer months due to algal blooms (Hert 2012, Pers. Comm.).

The main inflow into Quamichan Lake, McIntyre Creek, is located at the northeast end of the lake and flows through a low-lying grassy field before entering the lake. There are also a number of small seasonal surface inflows, which include small ditches and creeks that pass through various properties and culverts before entering the lake (Crawford, 2008). The lake only has one outflow, Quamichan Creek, which drains out of the south east end of the lake into the Cowichan River (Crawford, 2008). Historically, Quamichan Lake was important to the local Cowichan First Nation people, as it provided an abundance of salmon and potable water (Varga, 2009).

The lake contains prickly sculpin, cutthroat trout, rainbow trout, coho salmon, brown catfish (formerly brown bullhead) and threespine stickleback. The lake has been stocked with rainbow trout for the last 3 years and cutthroat trout for the last 5 years. (FISS, 2011). Recently, catchable sized yearlings and adults, as well as triploid (non-reproducing) female fish have been stocked, enabling fish to be caught sooner in the season before water conditions deteriorate (Epps 2012, Pers. Comm.).

What's Going on Inside Quamichan Lake?

Temperature



Lakes show a variety of annual temperature patterns based on their location and depth. Most interior lakes 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.

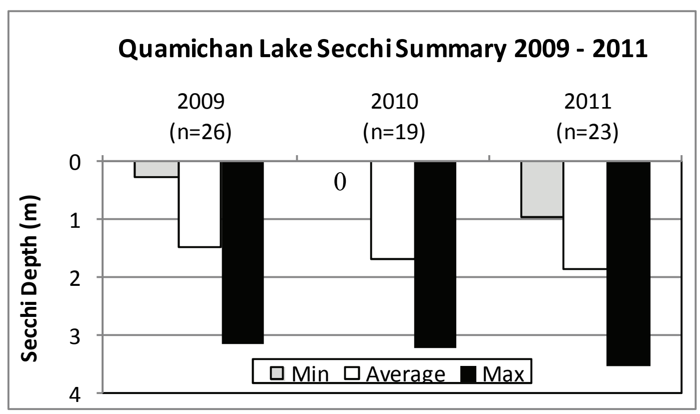
Coastal lakes in BC are more often termed warm monomictic lakes because they turn over once per year. These lakes have temperatures that do not fall below 4°C. Warm monomictic lakes generally do not freeze and circulate freely in the winter at or above 4°C, and stratify only in the summer. Quamichan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

Ice-on and ice-off dates for BC lakes are important data for climate change research. By comparing these dates to climate change trends, we can examine how global warming is affecting our lakes. Local volunteers estimate that every second year, approximately one-third of Quamichan Lake forms skim ice for several days (Hert, 2012).

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

Temperature and Secchi depth (water clarity) were measured at the deep site on Quamichan Lake from 2008-2011. Please note that the 2008 Secchi data are not included in this report as they do not fall within the historical average summer Secchi range (McPherson, 2006) and are likely inaccurate (Epps 2012, Pers. Comm.). Minimum and maximum Secchi and temperature readings varied between sampling years, likely due to the effect of seasonal weather conditions on the shallow lake. The majority of the Secchi readings in all sampling years were taken outside of the standard 10 am - 2 pm window, and as a result the readings may not accurately represent true clarity. The adjacent graph illustrates the 2011 Secchi and temperature data for Quamichan Lake, as well as the number of readings (n). The maximum surface temperature was 23.8°C (Aug. 5th) and the minimum surface temperature was 9.2°C (Apr. 12th). The maximum surface temperatures measured in 2008, 2009 and 2010 were 23.5°C (Jul. 13th), 27.5°C (Jul. 30th) and 24.8°C (Jul. 10th, 27th), respectively. Minimum surface temperatures were 8.0°C (Apr. 1st), 12.0°C (Apr. 20th) and 14.0°C (May 14th) in 2008, 2009 and 2010 respectively.

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.

Lakes of low productivity are referred to as ***oligotrophic***, meaning they are typically clear water lakes with low nutrient levels, sparse plant life and low fish production. Lakes of high productivity are ***eutrophic***. They have abundant plant life because of higher nutrient levels. Lakes with an intermediate productivity are called ***mesotrophic*** and generally combine the qualities of oligotrophic and eutrophic lakes.

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 disc, a 20 cm diameter black and white disc that measures the depth of light penetration.

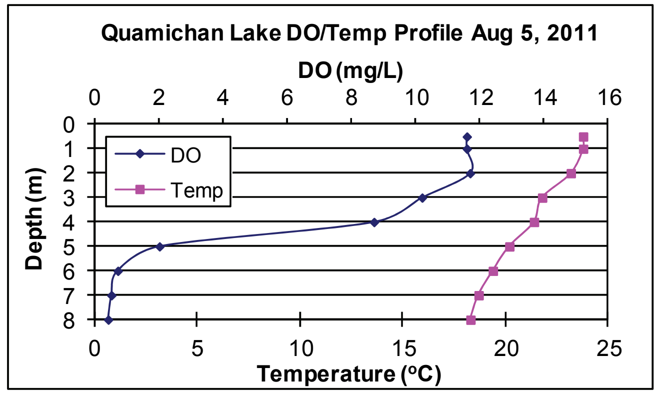
Natural variation and trends in Secchi depth and temperature not only occur between years, but also throughout one season. In general, as temperatures increase during the summer months, Secchi depth decreases. As the temperature of the lake increases, so do some species of algae. Due to the increase in algae, the water clarity can decrease. This general trend is apparent in the 2011 data (as seen in the Secchi depth/temperature graph above). The volunteers' field notes indicate that Quamichan Lake experiences heavy algal blooms throughout the sampling season, which volunteers believe to be the cause of fish distress and mortality in 2009.

The previous graph illustrates the minimum, average and maximum Secchi readings from 2009 to 2011, as well as the number of readings per year (n). The maximum reading for all sampling years, 3.5 m, occurred on Apr. 26th 2011. The lowest Secchi depth measured was 0 m on Aug. 26th, 2010 during an algal bloom. The average Secchi values ranged between 1.48 m (2009) and 1.85 m (2011) throughout the four years sampled. Based on the average summer Secchi values, Quamichan Lake was exhibiting eutrophic conditions between 2009 and 2011 (Nordin, 1985).

The flushing rate, another factor that affects water quality, is the rate of water replacement in a lake and depends on the amount of inflow and outflow of a lake. The higher the flushing rate, the more quickly excess nutrients can be removed from the system. The flushing rate for Quamichan Lake is approximately 0.98 (i.e. water is completely replaced every 1.02 years) (Crawford, 2008).

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 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.



Dissolved oxygen (DO) and temperature (T) readings were collected on Quamichan Lake from 2009 - 2011, however the 2010 readings are not included in this report as there was likely a malfunction in the equipment (Epps 2012, Pers. Comm.). The majority of DO profiles in 2009 show a slight increase in DO within several meters of the surface, likely due to photosynthetic algae producing oxygen just below the surface, followed by a decline to anoxic conditions in the bottom waters. Surface DO concentrations in 2011 were higher and the average surface temperature was slightly lower than previous years, which may be a result of a cooler summer weather conditions. The graph on the right shows DO (blue line, refer to top axis for values) was 11.6 mg/L at the surface and 0.4 mg/L at 8 m on Aug. 5, 2011. T (pink line, refer to bottom axis for values) was 23.8 °C at the surface and 18.3 °C at 8 m. Field notes indicate there was an algae bloom on Aug. 5th, which may explain the higher levels of DO at the surface (due to photosynthesis of the algae). If deep-water oxygen becomes depleted, a chemical shift can occur in bottom sediments. This shift causes sediment to release phosphorus to overlying waters. This *internal loading* of phosphorus can be natural but is often the result of phosphorus pollution. Lakes displaying internal loading have elevated algal levels and generally lack recreational appeal. Quamichan Lake suffers from internal loading, likely due to continuous deposition of decaying biomass (i.e. algae) (Crawford, 2008).

Land Use and Pollution Sources

Quamichan Lake is surrounded by agricultural and rural development on the north and west sides, while the east side of the lake is predominately urban and residential development (Crawford, 2008). The majority of the agriculture consists of dairy and hobby farming, as well as some food crops (Hert, 2012). The Phosphorus Loading Study for Quamichan Lake in Duncan, BC (Crawford, 2008) report concluded that the primary nutrient concern for this lake is phosphorus, which is related to the deteriorating water quality from algal blooms and periodic fish kills. The report also found that roughly 55% of the phosphorus loading originates from external stream flow and 30% is generated from internal phosphorus loading. Nilsen (2012, Pers. Comm.) stated that portions of the eastern side of the lake were upgraded from septic to municipal sewer in 2010, with two more areas at the southwest end of the lake to be upgraded in 2011 and 2012.

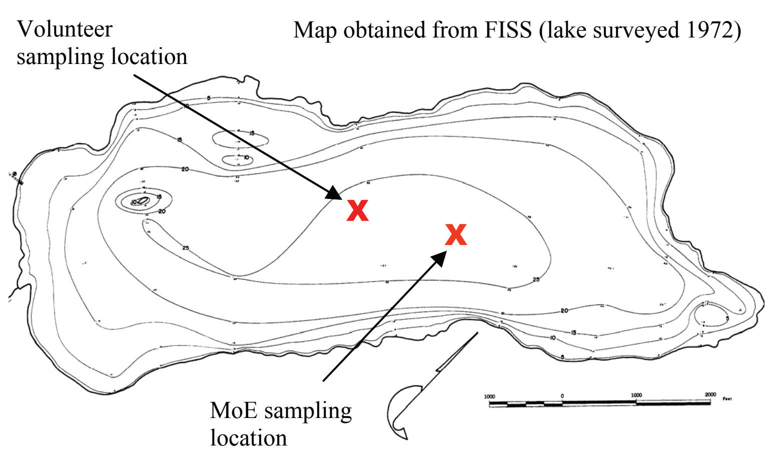
Local residents are encouraged to ensure their septic systems are up to standard and that their land use activities are following good environmental practices. Recreational users of the lake are encouraged to ensure their boats and equipment are properly maintained. Further information on keeping Quamichan Lake healthy can be found on the following page.

Should Further Monitoring be Done on Quamichan Lake?

The data collected on Quamichan Lake from 2009 to 2011 indicate that the water quality has remained relatively stable over the sampling years. The Ministry of Environment collected total phosphorus (TP) and chlorophyll *a* (a measure of the density of photosynthetic algae) data in Feb. 2007, Feb. 2008, Mar. 2009 and Feb. 2010, which also indicate eutrophic conditions (Epps 2012, Pers. Comm.). Continued monitoring at a Level 1 (min. 12 evenly spaced readings between 10 am and 2 pm from ice-off through September), as well as ongoing collection of DO/T profiles would help to monitor any changes in water quality over time.

All residents and land developers within the watershed are advised to continue to practice good land management so that nutrient migration to the lake and its tributaries are minimized.

Quamichan Lake Bathymetric Map



Tips to Keep Quamichan 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.
- Make sure that your system meets local requirements before installing, repairing, or upgrading an onsite sewage system.
- 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 waterbodies.
- Conserve water: run the washing machine and dishwasher only when full and use only low-flow showerheads 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 blue or pink closed-cell extruded polystyrene billets 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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Quamichan Stewards

http://www.quamichanlake.ca/

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Report Reviewed by: Deb Epps, Ministry of Environment

Photo Credit: Adam Hert

Bathymetric Map: Fisheries Information Summary System (FISS)

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