*BC Lake Stewardship and Monitoring Program*

# Cowichan Lake 2004 - 2013

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

## The Importance of Cowichan 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 2004-2013 results of a Level I program for Cowichan Lake. The MOE, working with the Cowichan Lake and River Stewardship Society (CLRSS), developed water quality objectives for Cowichan Lake in 2011, based on water quality data collected in 2008 and 2009. Furthermore, water quality attainment monitoring, to determine if the water quality objectives were being met, was conducted in 2013 and 2014 by both MOE and the CLRSS, however the data were not yet analyzed when this lake report was published.

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.

Cowichan Lake is located 31 km west of Duncan, in the Cowichan Valley, on Vancouver Island. The Cowichan Lake region includes the villages of Honeymoon Bay, Youbou, Marble Bay, Caycuse, Mesachie Lake and the town of Lake Cowichan. Lake Cowichan has approximately 3000 residents and there are estimated to be another 3000 in the surrounding communities. Cowichan Lake has been described as 'in transition' between a forest management area to a residential and recreational area. and is facing development pressure.

Cowichan Lake is the second largest lake on Vancouver Island and supplies drinking water to the town of Lake Cowichan and the Cowichan Valley Regional District (Epps, 2011). There are also numerous domestic drinking water licenses for both Cowichan Lake and the Cowichan River (Epps & Phippen, 2011). The lake has a surface area of 6,204 ha, a perimeter of 109.7 km and lies at an elevation of 164 m. The average depth of the lake is 50.1 m and the maximum depth is 152 m (Habitat Wizard, 2014). Cowichan Lake is a deep lake framed by steep mountains, resulting in rocky steep shoreline areas that provide little cover for fish species.

Cowichan Lake has 80 inlet streams and one outlet, the Cowichan River (Thom, 2014). The lake contains brown catfish (formerly brown bullhead), brown trout (only in Cowichan River), chinook salmon, coho salmon, cutthroat trout, cutthroat/rainbow hybrids, dolly varden char, kokanee, pacific lamprey, prickly sculpin, rainbow trout, steelhead, threespine stickleback, and Vancouver (a.k.a lake) lamprey (Michalski & Habitat Wizard, 2014). Chum salmon have also been recorded as occurring in the lake (Epps, 2011). Vancouver lamprey are only known to occupy two lakes, Cowichan and Mesachie, and are considered threatened under the Species at Risk Act (SARA) (DFO, 2014). Historically the lake was stocked with rainbow trout, brown trout, steelhead, cutthroat trout, cutthroat/rainbow cross, brook trout and atlantic salmon but lake stocking hasn't occurred since 1939. However, Cowichan River has been stocked with steelhead as recently as 2008 (Epps, 2011).

# What's Going on Inside Cowichan Lake?

## *Temperature*

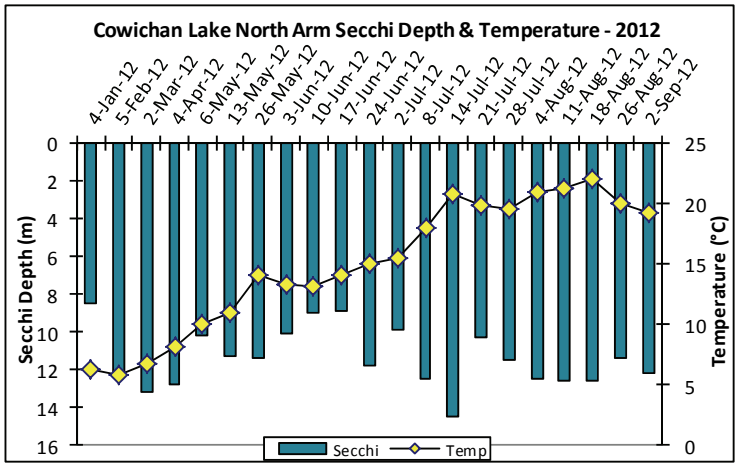
Lakes show a variety of annual temperature patterns based on their location and depth. Most interior lakes form layers (stratify), with the coldest water at the bottom. Because colder water is more dense, it resists mixing into the warmer upper layer for much of the summer. In spring and fall, these 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. Cowichan 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 residents report that Cowichan Lake rarely freezes.

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.

Surface temperature (T) and Secchi depth (water clarity) were measured in both the North Arm and South Arm (sites marked on map on p. 3) of Cowichan Lake in 2005 and from 2008-2013. Only the North Arm was sampled in 2004, 2006 & 2007. Minimum data requirements were met in all sampling years except in 2004 (North Arm) and 2005 (South Arm), therefore those data have not been included here. The adjacent graph illustrates the 2012 Secchi and T data from the North Arm. The maximum T was 22.0°C (Aug 18th) and the minimum T was 5.8°C (Feb 5th). For the North Arm, the minimum T between 2005-2013 ranged from 6.5°C (2006) to 15.0°C (2009) and the maximum T ranged from 13.7°C (2006) to 24.0°C (2009). For the South Arm, the minimum T between 2008-2013 ranged from 10.0°C (2012) to 15.0°C (2009) and the maximum T ranged from 21.0°C (2008) to 24.0°C (2009).

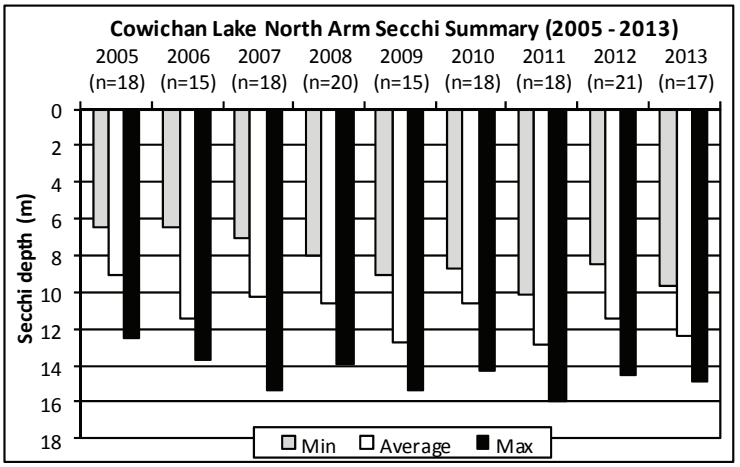



## *Trophic Status and Water Clarity*

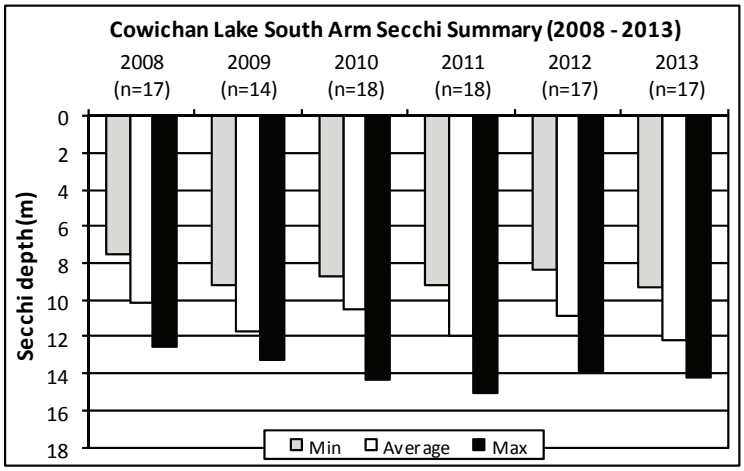
The term *trophic status* is used to describe a lake's level of productivity and depends on the amount of nutrients available for plant growth, including tiny floating algae called phytoplankton. Algae are important to the overall ecology of the lake because they are food for zooplankton, which in turn 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 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 not apparent in the data for Cowichan Lake.




The adjacent graphs show the minimum, average and maximum Secchi readings for the North Arm from 2005-2013 (upper graph) and the South Arm from 2008-2013 (lower graph), as well as the number of readings for each year (n). The maximum reading for the North Arm was 16.0m (2011) and the minimum was 6.5 m (2005 & 2006). The maximum reading for the South Arm was 15.0 m (2011) and the minimum was 7.5 m (2008). The average Secchi readings for the North Arm ranged from 9.1 m (2005) to 12.9 m (2011) and for the South Arm from 10.1 m (2008) to 12.1 m (2013). Based on these summer average Secchi values, Cowichan Lake was exhibiting oligotrophic (>6 m) conditions (Nordin, 1985). Data show that Cowichan Lake has remained stable throughout the sampling period.




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. The higher the flushing rate, the more quickly excess nutrients can be removed from the system. The flushing rate for Cowichan Lake is 2.2 years (Ptolemy, 2008). The short flushing period and high average lake depth (50.1 m) suggests Cowichan Lake does not retain a large proportion of the nutrients that enter it.

# 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 Cowichan River watershed is 1227 $km^2$. Water levels in Cowichan Lake are controlled by Catalyst Paper Crofton Division's weir on the east end of the lake. Provincial and federal fisheries agencies are in partnership with Catalyst Paper and the BC Ministry of Forests, Lands and Natural Resource Operations to release water from the weir for low flow fisheries concerns. DFO also holds water licenses for conservation purposes (Epps, 2011).

Almost all of the land surrounding Cowichan Lake is privately owned. Land use activities at Cowichan Lake include residential, recreational and logging. The communities of Lake Cowichan, Youbou and Honeymoon Bay rely on tourism to support their economies. A number of campgrounds are located along the shores of Cowichan Lake. Additionally the Cowichan Lake Outdoor Education and Conference Centre is located on 44 hectares of forested foreshore west of the town of Lake Cowichan. The lake is popular for camping, fishing, swimming and boating (power boats, canoes and kayaks) (Epps, 2011). Logging activities take place throughout much of the upper Cowichan Lake watershed, mostly on private lands (Epps, 2011). While Cowichan Lake is not a designated community watershed (under the *forest and Range Practices Act*), the MOE uses other tools, such as water quality objectives, and legislation, such as *Private Managed Forest Land Act* and the *Drinking Water Protection Act*, to ensure that all watersheds and/or water supplies are managed in a consistent matter and to protect water quality (Epps & Phippen, 2011).

The Cowichan Watershed can be characterised as having high precipitation/recharge, high storage, and low population/demand in the western and upper half of the watershed, contrasted with low precipitation, low storage, and high population and high demand in the eastern and lower half. Supply and demand are not matched regionally and the supply-demand gap is pushed to extremes in the late summer and early fall. (Cowichan Watershed Board, 2014) Because of the seasonal pattern of high precipitation in winter and low precipitation in summer and limited ability to increase water storage on the lake without affecting lakeshore properties, providing sufficient flows in the downstream Cowichan River during the summer and autumn for salmonid passage, habitat maintenance and spawning access, has become a major issue (Nordin 2014, Pers. Comm.).

In order to maintain and protect the water quality in Cowichan Lake, ambient water quality objectives were set for temperature, dissolved oxygen, water clarity (Secchi depth), total phosphorus, chlorophyll *a*, turbidity, total organic carbon, and *E. coli*. In addition, turbidity and total suspended solids objectives were recommended for the tributaries to Cowichan Lake. (Epps & Phippen, 2011)

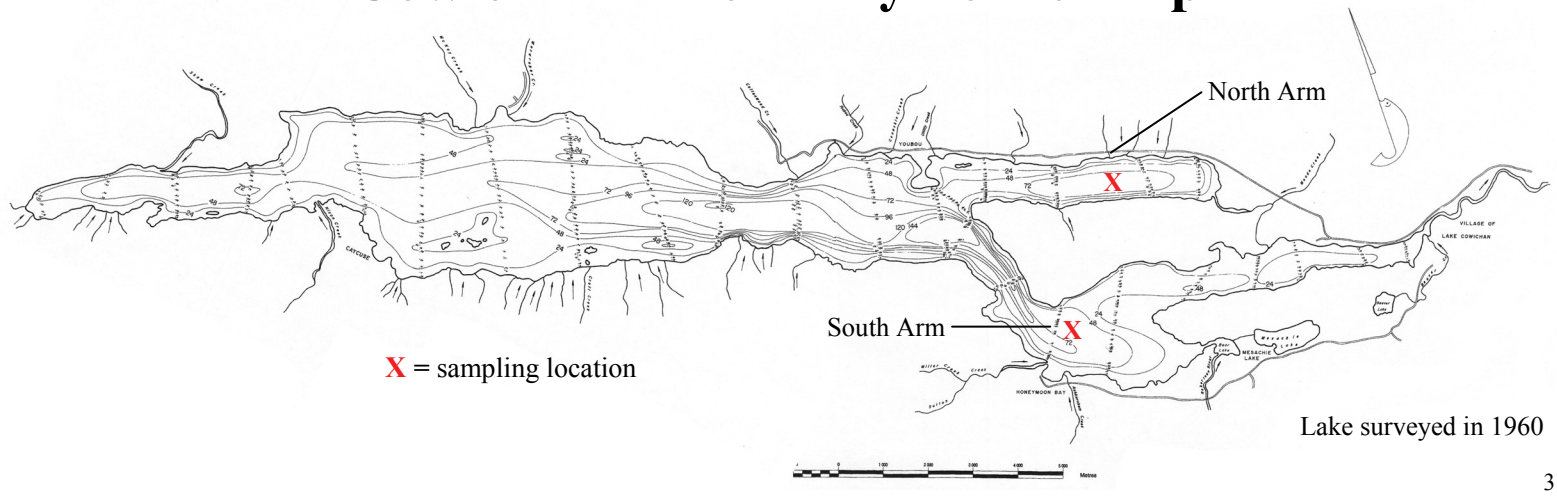
Local residents are encouraged to ensure their septic systems are up to standard and that their land use activities are following good environmental practices. Further information on keeping Cowichan Lake healthy can be found on the following page.

# Should Further Monitoring be Done on Cowichan Lake?

Generally, trophic status is based on a combination of parameters such as Secchi, nutrients and chlorophyll *a*. The data collected on Cowichan Lake from 2005-2013 indicate that the water quality has remained stable throughout the sampling years. Average annual Secchi readings place the lake in the oligotrophic classification. The CLRSS participated in attainment sampling conducted in 2013 and 2014 and are continuing to monitor Secchi depth and surface temperature from spring to fall, annually.

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.

# Cowichan Lake Bathymetric Map




Lake surveyed in 1960

# Tips to Keep Cowichan 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 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.
- Pick up after your pets as pet waste can lead to bacterial contamination of lake water.

### 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.
- Leading by example is often the best method of improving practices - help educate fellow boaters.

# Who to Contact for More Information

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### Bathymetric Map:

FISS (Fisheries Inventory Summary System)


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