BC Lake Stewardship and Monitoring Program

Watch Lake 2001-2004

A partnership between the BC Lake Stewardship Society and the Ministry of Water, Land, and Air Protection

The Importance of Watch Lake & its Watershed

British Columbians want lakes to possess good water quality, aesthetics and recreational opportunity. When these features are not apparent in recreational lakes, questions begin to be raised. People begin to wonder if the water quality is getting worse, if the lake has been polluted by land development, and what conditions will result from more development within the watershed.

The BC Lake Stewardship Society, in partnership with the Ministry of Water, Land, and Air Protection, has designed a program, entitled the BC Lake Stewardship and Monitoring Program to help answer these questions. Through regular water sample collections, we can begin 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 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 provides the results for 2001-2004 of a Level II program for Watch Lake.

Through regular status reports, this program can provide communities with monitoring results specific to their local lake and with educational material on lake protection issues in general. 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 thanks to the help of area volunteers and the BC Lake Stewardship Society.

The watershed area of Watch Lake is slightly less than 84 km^2. A **watershed** is defined as the entire area of land that moves the water it receives to 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. The watershed area of Watch Lake is shown on the next page.

Watersheds are where much of the ongoing hydrological cycle takes place 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 water body. Poor land-use practices anywhere in a watershed can eventually impact the water quality of the down stream 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 alteration. However, modifications to the landscape and increased levels of pollution impair this ability.

Size & Attributes of the Watershed

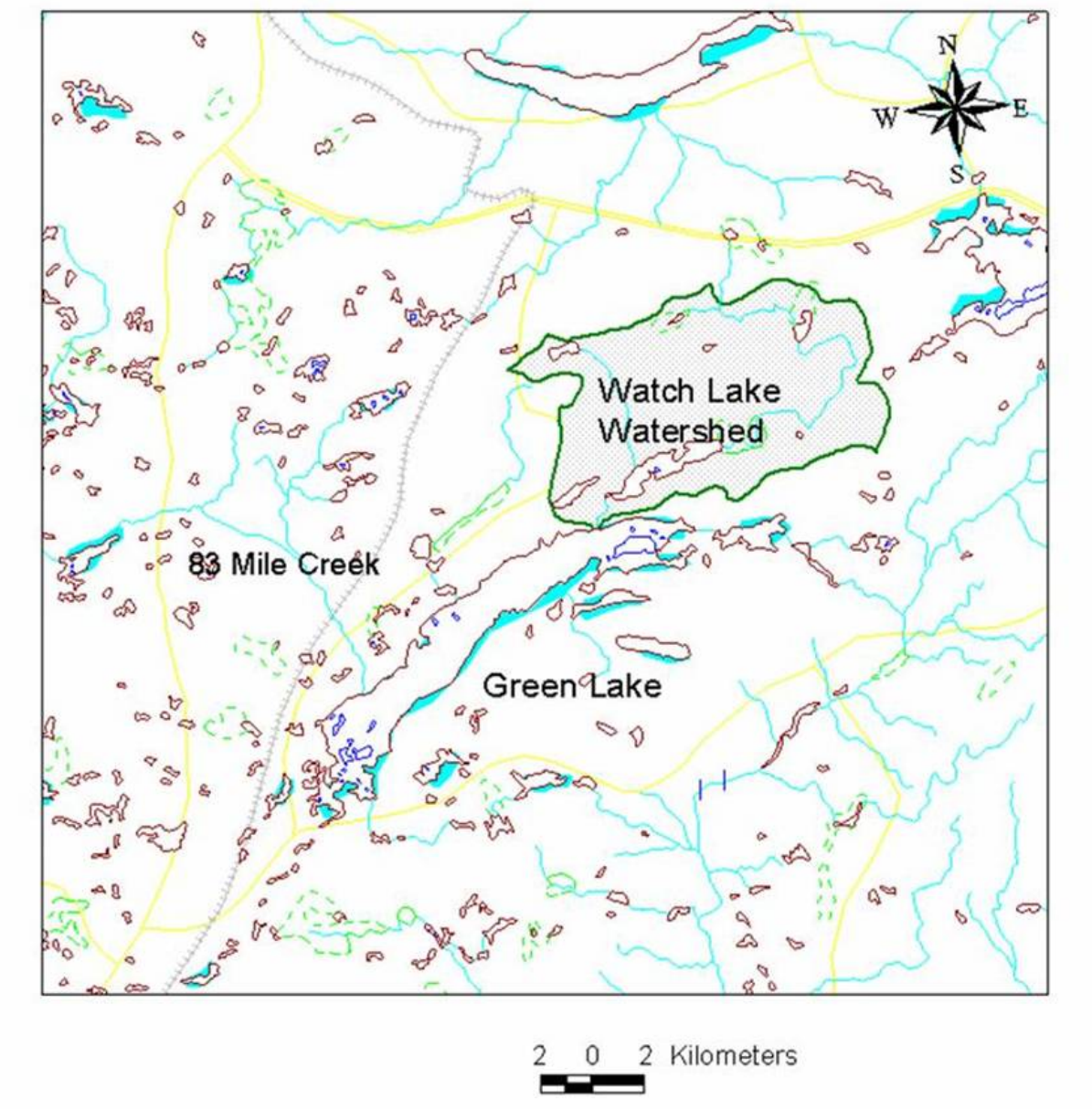
Watch Lake is located approximately 36 km northeast of 70 Mile House off Highway #97 along North Bonaparte Road or approximately 13 km south of Highway #24 at Lone Butte. The lake is roughly 5 km long, with its widest point being 800m and the narrowest, 200m. The lake contains Rainbow Trout, Longnose Dace and Suckers. Land use in the watershed is open range-land and mixed forests of Aspen and Lodgepole pine typical of the Cariboo Region's landscape. There is substantial residential development around the lake. The lake is used for general recreational purposes with limited public access to the shoreline. The greatest challenge to the lake is phosphorus (nutrient) loading. This loading may promote summer algal blooms and the spread of aquatic plants.

Watch Lake Watershed Characteristics

Area: 83.985 km^2

Land Usage:

10% Residential/Developed
20% Agricultural
40% Forestry
30% Undisturbed



Non-Point Source Pollution and Watch Lake

Point source pollution originates from municipal or industrial effluent outfalls. Other pollution sources exist over broader areas and may be hard to isolate as distinct effluents. These are referred to as non-point sources of pollution (NPS). Shoreline modification, urban stormwater runoff, onsite septic systems, agriculture, and forestry are common contributors to NPS pollution. One of the most detrimental effects of NPS pollution is phosphorus loading to water bodies. The amount of total phosphorus (TP) in a lake can be greatly influenced by human activities. If local soils and vegetation do not retain this phosphorus, it will enter watercourses where it will become available for algal production.

Stormwater Runoff

Over-fertilizing of lawns and gardens, oil and fuel leaks from vehicles, sedimentation, road salt, and litter are all washed by rain and snowmelt from our yards and streets. Pavement increases runoff of surface water and the amount of contaminants entering water bodies. Pavement collects contaminants during dry weather, and prevents water from soaking into the ground during storm events.

Onsite Septic Systems and Grey Water

Onsite septic systems effectively treat wastewater as long as the system is properly located, designed, installed, and maintained. When these systems fail they become significant sources of nutrients, pathogens and organic material. Other wash water is also a source of these contaminants and must be disposed of properly.

Agriculture

Agriculture is economically and culturally important. When practices are improperly managed, however, there can be significant NPS impacts, such as nutrients and pathogens from manure and damage to shorelines from livestock access.

Forestry

Forestry, which includes clear cutting, road building and other land disturbances is essential to the economy, however it can increase sediment & phosphorous, and alter water flow.

Boating

Oil and fuel leaks are the main concerns of boat operation on small lakes. With larger boats, sewage and grey water discharges are issues. Other problems include the spread of aquatic plants and the dumping of litter. In shallow water operations, the churning up of bottom sediments and nutrients is a serious concern.

Watch Lake Bathymetric Map

Map obtained from
www.fishwizard.com (2004)

What's Going on Inside Watch Lake?

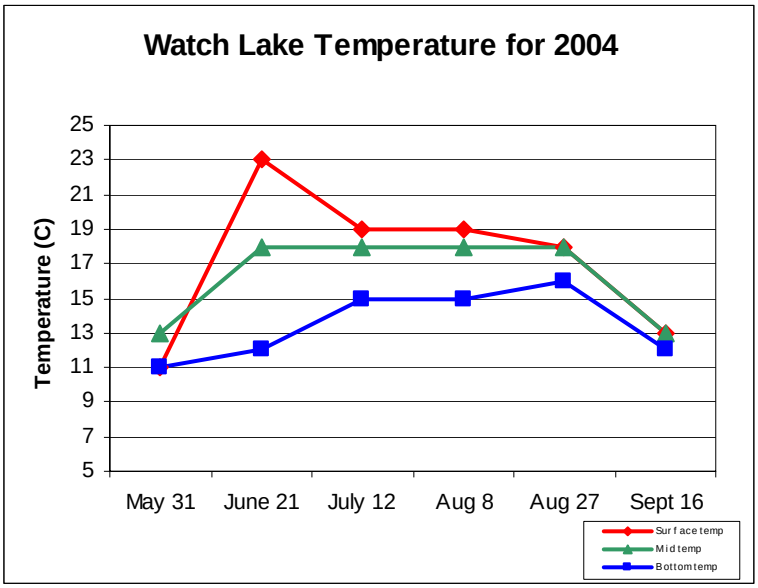
Temperature

BC lakes can show a variety of annual temperature patterns based on their location and depth. Most interior lakes form layers (stratify), with the coldest water near the bottom. Because colder water is more dense, it resists mixing into the warmer, upper layer for much of the summer. When the warmer oxygen rich surface water distinctly separates from the cold oxygen poor water in the deeper parts of the lake, it is said to create a thermocline, a region of rapid temperature change between the two layers.

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 floating ice with the warmest water (4°C) near the bottom. Lakes that stratify twice a year are called dimictic lakes. These are the most common type of lake in British Columbia.

Coastal lakes in BC are more often termed warm monomictic lakes. These lakes turn over once per year. Warm monomictic lakes have temperatures that do not fall below 4°C in the winter and stratify in the summer.

The timing of freeze up and break up of BC lakes is important information for climate change research. BCLSS is interested in this information. 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.



Temperature stratification patterns are very important to lake water quality. They determine much of the seasonal oxygen, phosphorus, and algal conditions. Continuously monitored surface temperature can provide us with information not only on algal blooms, but also provide important data to climate change studies.

The preceding temperature diagram shows the temperatures at the surface, mid-depth and bottom waters in Watch Lake for 2004. The surface temperature reached a high of 23°C. Late June saw the clearest differences between the top and bottom temperatures, indicating that stratification (layering) was strongly present. In mid-September, the three depths had nearly identical temperatures, signifying that fall overturn had begun.

In 2001 and 2003, temperature readings were similar to those of 2004, with the highest reading recorded in July 2003 at 22°C. Stratification was clearly indicated at approximately the same point in the sampling season for each of the years, beginning in early June and ending with turnover in later September. Readings taken in 2002 could not be considered due to instrument malfunction.

Trophic Status

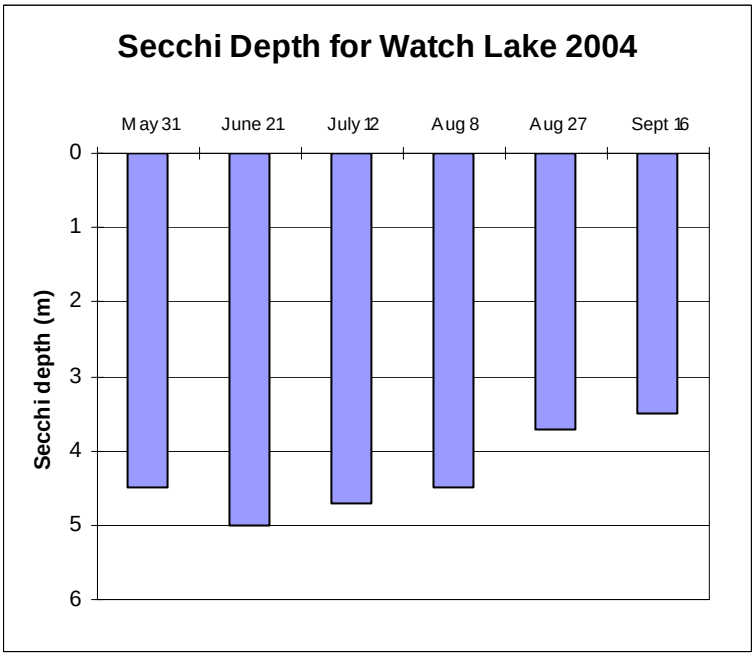
The term *trophic status* is used to describe a lake's level of productivity and depends on the amount of nutrients available for plant growth, including tiny floating algae called phytoplankton. Algae are important to the overall ecology of the lake because they are the food for zooplankton, which in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

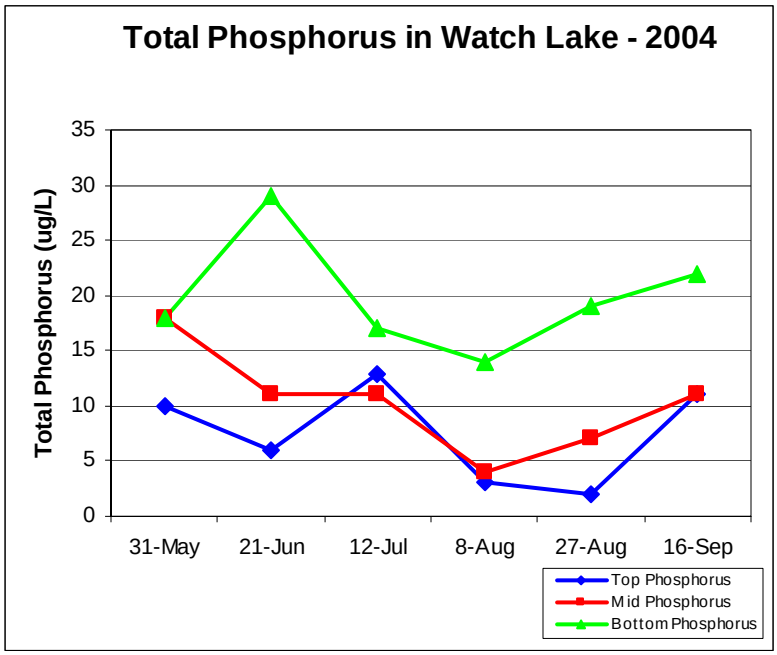
Lakes of low productivity are referred to as ***oligotrophic***, meaning they are typically clear lakes with low nutrient levels (1-10 *u*g/L TP), sparse plant life, and low fish production. Lakes of high productivity are ***eutrophic***. They have abundant plant life, including algae, because of higher nutrient levels (>30*u*g/L TP), and, at times, high fish production, provided that dissolved oxygen depletion is not severe. Lakes with an intermediate productivity are called ***mesotrophic*** (10-30 *u*g/L TP) and generally combine the qualities of oligotrophic and eutrophic lakes.

Water Clarity

One way to determine productivity is by measuring water clarity. The more productive a lake is the higher the algal growth and therefore the less clear the water becomes. ***Secchi depth*** is an indicator of water clarity and is measured using a ***Secchi disk***, a black and white disk that measures the depth of light penetration. The greater the Secchi depth the greater the water clarity.

As seen in the following graph, Secchi depth measurements in Watch Lake for 2004 were the highest in June at 5 meters and decreased down to 3.5 meters in September.
Secchi depths recorded in 2004 are very similar to those from 2001 to 2003. The average Secchi depth in 2004 was identical





to the average depths for 2001 and 2003, at 4.3 meters. 2002 had an average depth of 4.8 meters. In all four years, the measured depths stayed within the range of 3.5 to 5.5 meters (with the exception of one 6.5 m reading in 2002), which could indicate that Watch Lake is mesotrophic, or a lake of intermediate productivity. However, due to the minimal number of samples taken each summer and the high level of variability in the data, it is difficult to interpret the Secchi results. More frequent sampling should be considered for Watch Lake.

Phosphorus

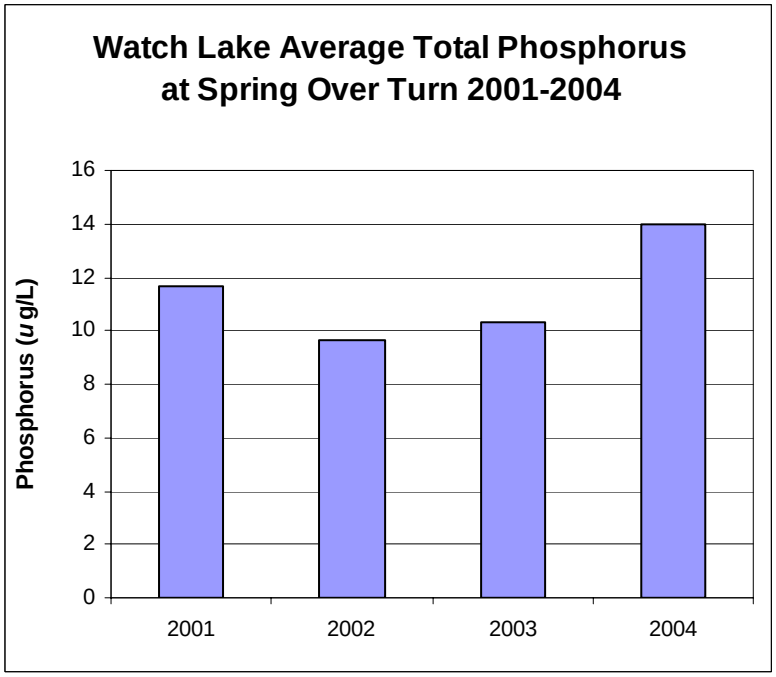
Productivity can also be determined by measuring nutrient (i.e. phosphorus) levels and chlorophyll A (the green photosynthetic pigment of algae). Phosphorus concentrations measured during spring overturn can be used to predict summer algal productivity.

Activities around a lake can alter its trophic status by increasing the amount of nutrients in the lake. In some cases, plant growth in the lake is increased to the point where it inhibits the recreational use of the lake.

Lake sediments themselves can be a major source of phosphorus. If deep-water oxygen becomes depleted, a chemical shift occurs in bottom sediments. This shift causes a 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.

As shown in the following graph, in 2004, Watch Lake surface and mid depth TP ranged from 2-18 *u*g/L, while the TP at the bottom ranged from 14-29 *u*g/L. These results predominantly fall within the range for mesotrophic lakes (10-30 *u*g/L).

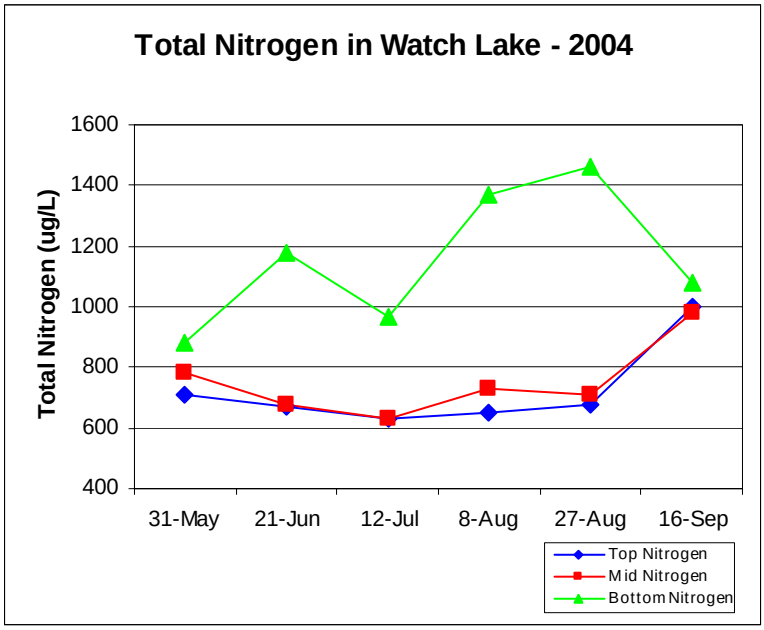
The following graph shows an increase in overturn phosphorus concentrations in 2004 relative to previous years, however, there is no real discernable trend over the years to indicate whether or not phosphorus concentrations are actually increasing. Further monitoring should be done, with care taken to ensure sampling occurs during spring overturn, to better understand the levels of total phosphorus in Watch Lake.



Nitrogen

Nitrogen is the second most important nutrient involved in lake productivity. In B.C. lakes, nitrogen is rarely the limiting nutrient for algae growth. In most lakes, the ratio of nitrogen to phosphorus is well over 15:1, meaning excess nitrogen is present. In lakes where the N:P is less than 5:1 nitrogen be-

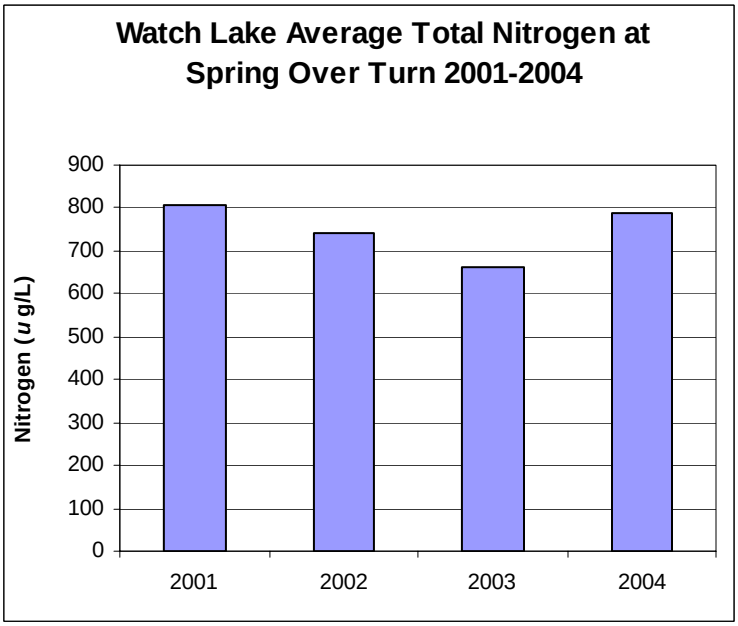
comes limiting to algae growth and can have major impacts on the amount of algae and the species present.



Total nitrogen concentrations within Watch Lake were relatively constant and similar at surface and middle depths, varying from 630µg/L-1000µg/L (see above graph). Nitrogen near the bottom was higher than the surface or mid-depth water, varying from 880µg/l to 1460µg/l. This trend is expected as a result of thermal stratification and subsequently, the isolation of the deeper water, and release of nitrogen from the bottom sediments.

There appears to be a slight fluctuation in the average nitrogen concentrations at overturn from 2001-2004 (see following graph).

The N:P ratio at spring overturn in 2004 is approximately 56:1 which means that the lake is a phosphorus-limited system for the growth of algae. As the summer season progresses, algae take up phosphorus in the surface water (epilimnion), then sink to the bottom of the lake (hypolimnion) when they die, decreasing the amount of available phosphorus in the epilimnion.



As expected, when analyzing the total phosphorus in the epilimnion, a gradual decrease is observed over the course of the summer season. However, further examination of the epilimnion N:P ratio throughout the summer season, reveals that the ratio never falls below the spring overturn ratio, indicating the lake is not nitrogen limited. Therefore, an increase in nitrogen would not increase the amount of algae, although the species present could change, possibly to a less desirable species. Nevertheless, this high concentration of nitrogen would mean any increase in phosphorus concentrations would result in increased algae biomass and its many associated problems. Therefore nitrogen should be closely monitored.

This year's VLMP suggests that Watch Lake water quality has not deteriorated significantly since 2001, although there is a small increase in phosphorus concentrations. To ensure continuing water quality all residents and land developments within the watershed are advised to practice good land management such that nutrient migration to the lake and its tributaries are minimized.

Should Further Monitoring Be Done On Watch Lake?

The Ministry of Water, Land and Air Protection has been collecting data on Watch Lake under the VLMP since 1994. Given the substantial residential development around the lake and its high recreational value, monitoring should be continued. The apparent trend of increasing phosphorus concentrations in the lake is also of concern, and further monitoring should be conducted in order to determine whether phosphorus levels will increase over the long term.

Testing for dissolved oxygen at multiple depths is recommended. These measurements would provide additional information on lake trophic status and determine habitat availability for rainbow trout.

In addition to continued monitoring, ice-on and ice-off dates should be recorded for climate change studies.

Tips to Keep Watch Lake Healthy

Yard Maintenance, Landscaping & 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 lady bugs, as well as pests.
- Compost yard and kitchen waste and use it to boost your garden's health as an alternative to chemical fertilizers.

Agriculture

- Locate confined animal facilities away from waterbodies. Divert incoming water and treat outgoing effluent from these facilities.
- Limit the use of fertilizers and pesticides.
- Construct adequate manure storage facilities.
- Do not spread manure during wet weather, on frozen ground, in low-lying areas prone to flooding, within 3 m of ditches, 5 m of streams, 30 m of wells, or on land where runoff is likely to occur.
- Install barrier fencing to prevent livestock from grazing on streambanks and lakeshore.
- If livestock cross streams, provide graveled or hardened access points.
- Provide alternate watering systems, such as troughs, dugouts, or nose pumps for livestock.
- Maintain or create a buffer zone of vegetation along a streambank, river or lakeshore and avoid planting crops right up to the edge of a waterbody.

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.
- Don't 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.

Auto Maintenance

- Use a drop cloth if you fix problems yourself.
- Recycle used motor oil, antifreeze, and batteries.
- Use phosphate-free biodegradable products to clean your car. Wash your car over gravel or grassy areas, but not over sewage systems.

Boating

- Do not throw trash overboard or use lakes or other waterbodies as toilets.
- Use biodegradable, phosphate-free cleaners instead of harmful chemicals.
- Conduct major maintenance chores on land.
- Use absorbent bilge pads to soak up minor leaks or spills.
- Check for and remove all aquatic plant fragments from boats and trailers before entering or leaving a lake. Eurasian milfoil is an aggressive, invasive aquatic weed. Be sure to familiarize yourself with this plant and remove and discard any fragments.
- 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 labeled with the owner's name, phone number and confirmation that barrels have been properly emptied and washed.

Who to Contact for More Information

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BC Adventure Network website (bcadventure.com)

Bathymetric Map:
Fish Wizard (www.fishwizard.com)