Nita Lake 2006-2012, 2021-2023
BC Lake Stewardship and Monitoring Program
Summary Report

The BC Lake Stewardship Society (BCLSS) and the Ministry of Environment and Parks (ENV) partner with local volunteers and stewardship groups to characterize lake water quality through the *BC Lake Stewardship and Monitoring Program* (BCLSMP). The BCLSMP's focus is on understanding water clarity, temperature, oxygen, and nutrients because these factors contribute to the basic understanding of lake processes which influence biological productivity. Concerns about productivity are common, specifically because high productivity can negatively impact recreation, drinking water and aquatic health due to harmful algal blooms. For more information about the BCLSMP please visit www.gov.bc.ca/lakestewardshipmonitoring.

Photo 1. Photo of Nita Lake

Background

Nita Lake has a surface area of 11.37 ha, a perimeter of 1737 m, and lies at an elevation of 638 m. The lake's average depth is 8.8 m, while the deepest spot is 21.6 m. Located only 5 km from Whistler Village, Nita Lake is a deep lake framed by the steep coastal mountains of the Whistler area. Land use surrounding Nita Lake consists of mixed residential and commercial development, and the watershed is approximately 65% forested. The CN railway follows the northwest shore of Nita Lake, while the Valley Trail follows the northeast side of the lake. Residential housing also lines the northeastern shore, and the Nita Lake Lodge sits at the south end of Nita Lake (Clark, 2024; Rebellato, 2005). However, on December 5, 2023, Whistler Council issued a development permit for a 3.91-hectare (ha) parcel of primarily forested land on Nita Lake's west side.

Nita Lake flows into Alpha Lake via Jordan Creek and eventually enters the Cheakamus River. Two significant tributaries flow into Nita Lake — Whistler Creek from the southeast and Gebhart Creek from the northwest. Originally, flow from Alta Lake discharged both into Nita Lake and into Alta Creek towards Green Lake. However, development at the South end of Alta Lake stopped the flow into Nita (Epps and Phippen, 2016). The primary inflow into Nita Lake is from Whistler Creek, which passes through the ski area and Creekside neighborhood.

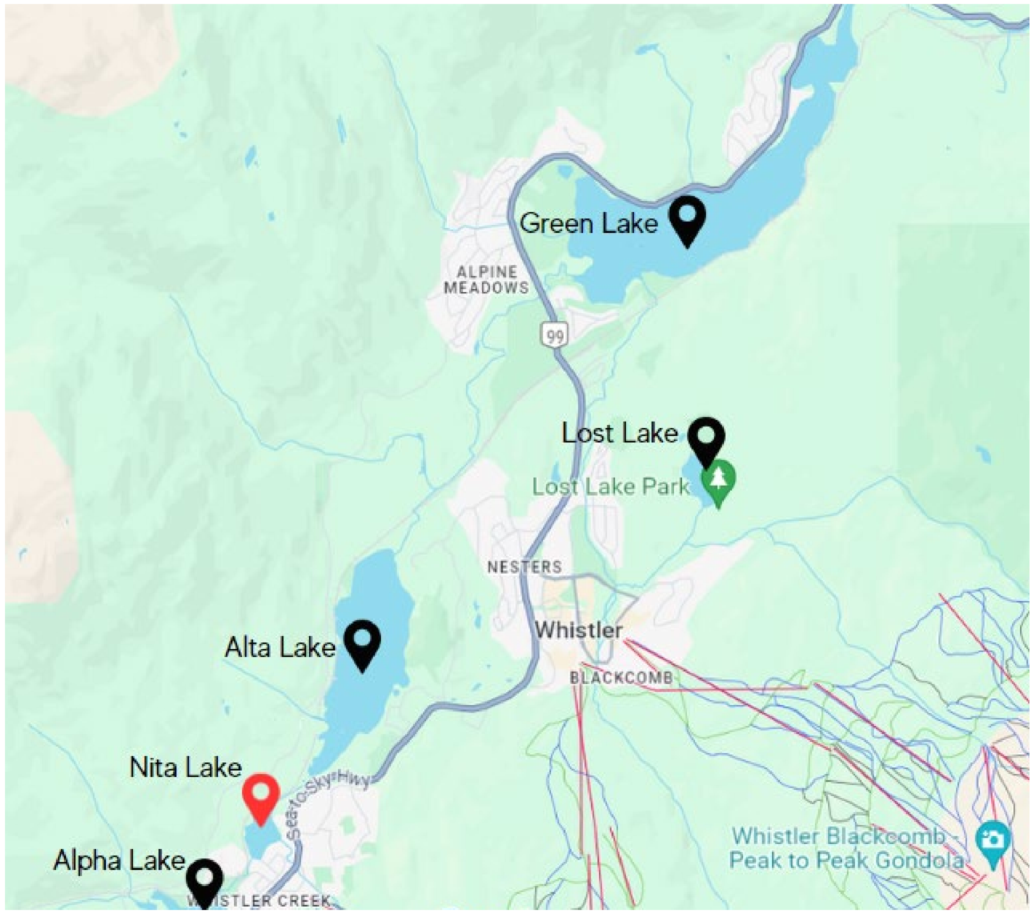


Figure 1. Google Maps view of the location of Nita Lake in relation to other Whistler Lakes

Reports have indicated that the hydrology in the area is mainly snowmelt-driven, with occasional fall water level peaks due to large rain events (Epps and Phippen, 2016). The British Columbia Ministry of Environment and Parks (ENV), in partnership with the Resort Municipality of Whistler (RMOW), have conducted water quality monitoring programs during stormwater events (October 2007) and snowmelt runoff periods (May 2008). This study found that Whistler Creek receives non-point source pollution primarily caused by high suspended sediment and turbidity levels from periods of high runoff (Bull, 2009). The same study also looked at the impact of snowmelt on creeks in Whistler and found that snowmelt runoff contributed to elevated levels of chloride, some metals, and turbidity in creeks, especially in urban areas (Bull, 2009). The report by Bull (2009) offered recommendations to mitigate these impacts, and all recommendations pertaining to the Resort Municipality of Whistler (RMOW) have been actioned as part of the RMOW's environmental procedures and programs (Burhenne, 2024). "The RMOW continually monitors and manages stormwater to minimize impacts and to comply with legal regulations and BMP [best management practices]" (Burhenne, 2024). Some of the ways the RMOW addresses the impacts discussed by Bull (2009) include requiring all new developments to take stormwater impacts into account and working to limit road salt inputs into streams and lakes by requiring the roads team to submit road salt amounts regularly and by maintaining compliance with recommended levels (Burhenne, 2024).

Nita Lake has been annually stocked with triploid (sterile) rainbow trout since 2001. Between 2001-2008 Nita was stocked with 500 or less trout each year. Since 2009, the lake has been stocked with 1500 triploid rainbows annually (FFSBC, 2023). The study by Bull (2009) looked to provide some analysis of the impacts of the high turbidity levels that Whistler Creek experienced during significant rain events during the study and how those turbidity levels were likely to impact clear water fishes. Turbidity measurements were taken from a downstream site on Whistler Creek (close to the inflow into Nita Lake) by Bull (2009). These were compared to the Severity-of-ill-effect (SEV) scale and potential effects of turbidity on clear water fishes from Newcombe (2003), and it was determined that the 'moderate' turbidity events during the study (October 2, 7, and 9-10th, 2007) suggested that conditions in the creek were significantly impaired for fish (Bull, 2009). The impacts of these conditions can include reduced fish growth and survival, decreased spawning habitat and invertebrate food resources, while longer-term impacts could result in declining fish populations and reduced fishing opportunities in Nita Lake (Bull, 2009).

Epps and Phippen (2016) began work on a *Water Quality Assessment and Objectives for Alta Lake, Alpha Lake, Lost Lake And Nita Lake: Resort Municipality Of Whistler, BC*. However, this water quality assessment report was never finalized and is still in the draft stage. The draft report is referenced in various sections of this report, however, it is important to note that the sample site used for the 2016 ENV WQMO study differed from the sample site used through the historic and current BCLSMP project. Please see **Figure 2** for a bathymetric map of Nita, which illustrates the location of both sample sites, as well as the location of inflowing and outflowing streams.

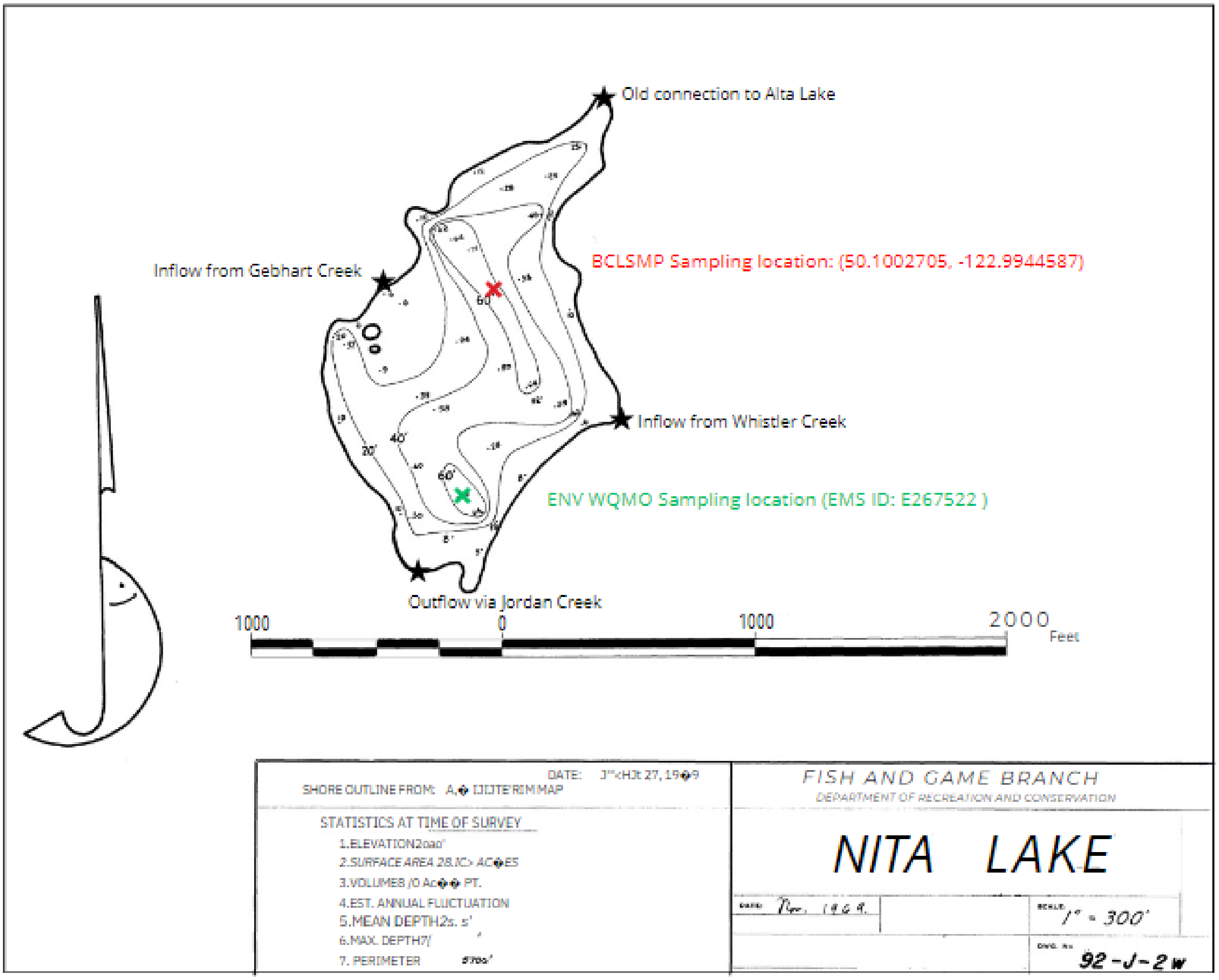
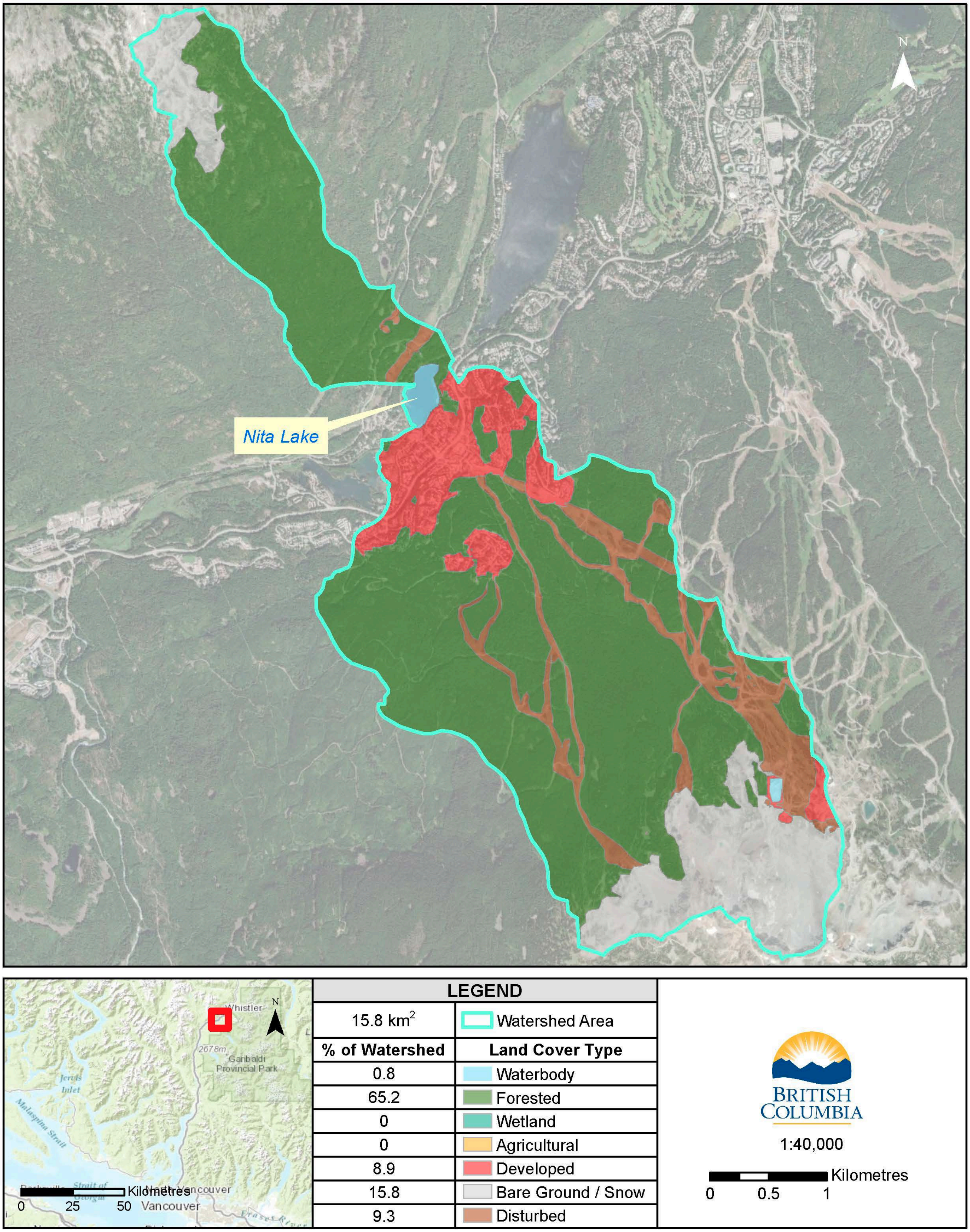


Figure 2. Bathymetric map of Nita Lake, including BCLSMP Deep Station sampling site identified by the **red x**.

Monitoring Approach

This report summarizes Level 1 Study data collected by volunteers from the Whistler Lakes Conservation Foundation from 2021 to 2023. Volunteers also collected Level 1 BCLSMP Study data between 2006 and 2012, which is included in this report for longer-term temporal comparison. A Level 1 BCLSMP Study collects information from the lake location that best represents the entire lake, such as the centre or deepest point, and includes monitoring of surface temperature and water clarity (Secchi depth). In addition to surface temperature and clarity, in some years, volunteers were able to take temperature and dissolved oxygen profiles at depth intervals in Nita Lake. Years that include profiles are 2023, one in the fall of 2022, and in the summers of 2006-2008. Information on these parameters is recommended to be collected at least twelve times during the open water season, ideally for three consecutive years to characterize the temporal variability typical of lake systems. This data provides valuable baseline and background information that helps us in understanding what is happening in aquatic environments and observe long-term trends.

Level 1 BCLSMP water quality information was collected from Nita Lake Deep Station between April and November during 17 sampling events in 2021, 14 in 2022, and 15 in 2023. Secchi depth and surface temperature were collected at each outing, and full temperature and dissolved oxygen profiles (i.e., measured at 1 m intervals throughout the water column) were also collected during each sampling event in 2023.



Map By: B.C. Ministry of Environment and Climate Change Strategy Date Saved: 2024-02-27 4:57:57 PM Coordinate System: NAD 1983 UTM Zone 10N Datum: Transverse Mercator
Land Cover Type based on Sentinel-2 10m land cover time series of the world. Produced by Impact Observatory, Microsoft, and Esri. Orthophoto credit Esri basemaps

Figure 3. Nita Lake watershed and associated land uses

Surface Temperature

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. Volunteers collected surface temperature readings throughout the 2006-2012 and 2021-2023 monitoring seasons. It should be noted that the minimum data requirements of 12 readings spread over the sampling season were not met in 2007, and that the spread of measurements is not evenly distributed from spring through fall from 2006-2012. During this period, no measurements were taken before June or after September, and sampling in these months was not consistent. The number of readings in the months of June and September varies significantly over the historical years, with some years having no readings or as little as one reading in either of the months. The later years (2021-2023) have a better spread of data from spring through fall and met minimum data requirements. The variation in the spread of the data significantly impacts the comparisons of yearly mean and minimum surface temperatures between historical and current data.

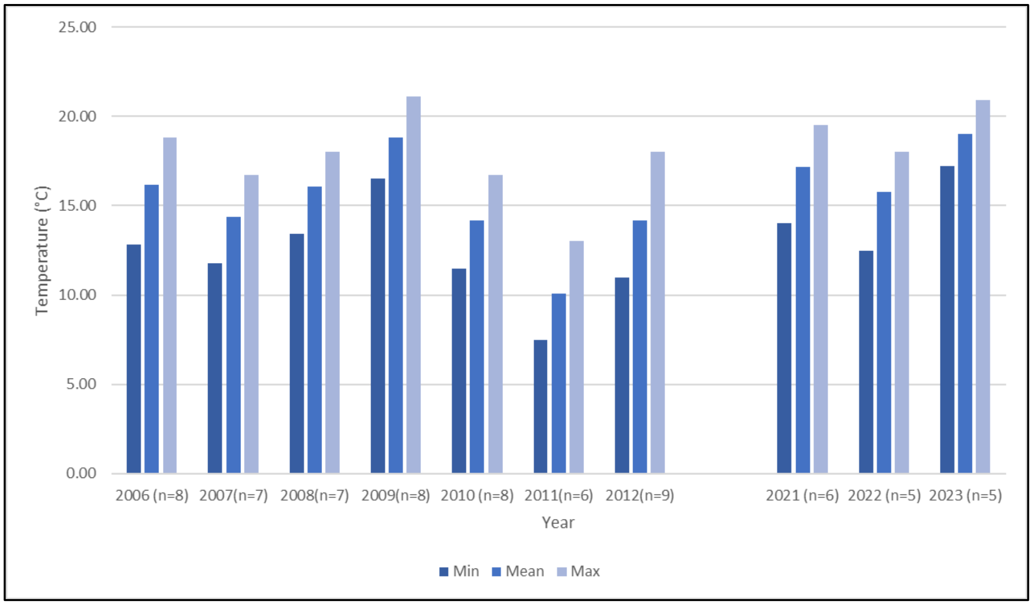


Figure 4 *Nita Lake July and August Surface Temperature Summary 2006-2012, 2021-2023*

In order to better assess if temperatures have changed significantly, **Figure 4** shows a July and August surface temperature summary from Nita Lake, as well as the number of observations (n) in those months for each year. All years of monitoring had observations from July and August that typically spanned a good portion of both months, so comparing the minimum and means of these months will give us a better understanding of potentially significant changes.

Figure 4 shows that surface temperature is variable from year to year, and there is no clear evidence showing a significant change between historical and current surface temperatures on Nita Lake. The maximum surface temperature reading for July and August was 21.1°C (recorded on July 31, 2009). 2023 had the second-highest July and August maximum at 20.9°C (recorded on August 18, 2023). The minimum surface temperature recorded was 7.5°C (recorded on July 4, 2011). The three years with the highest average surface temperatures in July and August are 2023 (average of 19.0 °C), 2009 (average of 18.8 °C), and 2021 (average of 17.2 °C). Further monitoring of temperature would be valuable going forward.

Temperature and Dissolved Oxygen

In addition to surface temperature, in some years, volunteers were able to collect temperature and dissolved oxygen profiles on Nita Lake. Temperature and dissolved oxygen (DO) strongly influence a lakes' physical, chemical and biological processes. Annual temperature and oxygen patterns vary depending on local climate, lake shape, prevailing wind direction and lake depth (BCLSS, 2022). Water is most dense and therefore heavier at 4ºC and less dense (i.e., lighter) at both colder and warmer temperatures. During the summer, lakes usually experience a layering effect called stratification, with the warmer, less dense water sitting on top of the cooler and heavier water. Stratification keeps bottom cool water isolated from top warmer water, which traps nutrients released from bottom sediments until the layers mix in the fall. This mixing is also called lake overturn and can occur one to multiple times per year. During the mixing process, the bottom waters get recharged with oxygen, and nutrients are brought up to the surface

Temperature Profiles

Years that include dissolved oxygen and temperature profiles are through the summer from 2006-2008, one in the fall of 2022, and then consistently throughout the sampling season in 2023. **Figure 5** depicts representative temperature profiles taken during the 2023 monitoring period. The first sampling event on May 5, 2023, captured Nita Lake, closest to its spring mixed state. The upper layer (epilimnion) warmed into the summer, stratifying the lake. The August 18th profile shows the lake was stratified with warm water in the epilimnion and cool water below the thermocline (thermocline is between 7-10 m) in the lower layer (hypolimnion). A previous report (Epps & Phippen, 2016) stated that the thermocline depth in Nita is between five to ten meters deep, which is supported by the 2023 profiles. The lake remained stratified throughout the summer months.

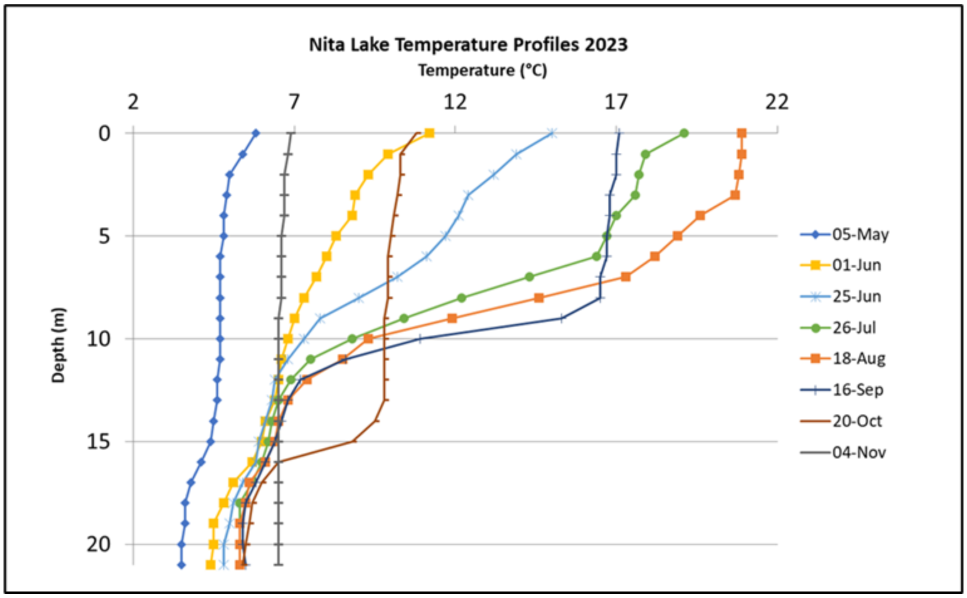


Figure 5 *Nita Lake Temperature Profiles 2023*

Figure 6 depicts representative temperature profiles taken in 2006. The profiles reach a maximum depth of 15 meters versus 20 meters in 2023. It is believed that the shallower depth of readings in the early profiles is due to the length of the instrument's cord being a limiting factor. The thermocline is located around the same depth (7-10 m) between 2006 and 2023.

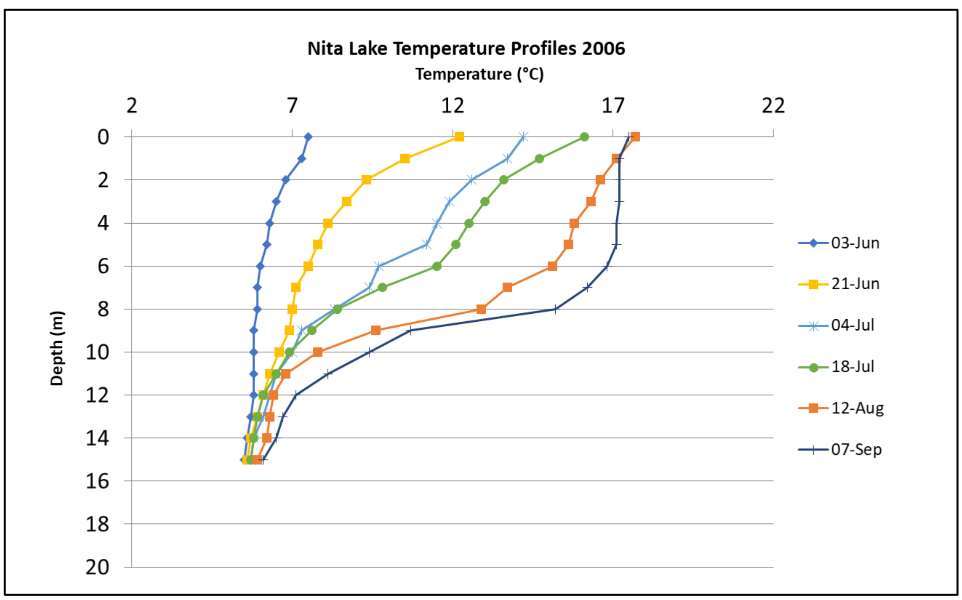


Figure 6 *Nita Lake Temperature Profiles 2006*

When comparing the spring profiles of Nita between 2006 and 2023, it is clear that Nita began to stratify earlier in 2023 than in 2006. The June 3, 2006 profile shows that Nita was still mixed in early June, with surface waters only slightly warmer. However, the lake had clearly begun to stratify by the June 1st profile from 2023. Higher spring temperatures likely drove this early stratification in 2023, so it would be necessary to compare historical profiles from other years to determine if this early stratification in 2023 is indeed an anomaly driven by higher-than-usual spring temperatures or if Nita Lake is exhibiting a pattern of earlier summer stratification. Unfortunately, it is not possible to determine if this later stratification was typical for early years as the profiles from 2007 and 2008 start in mid-July and late June, respectively, so spring turnover was not captured for these years. This underscores the need for profiles to begin earlier in the season.

The 2023 profiles show that Nita was in the process of turning over in October and had completely turned over by the final profile on November 4, 2023. As with spring turnover, it is also difficult to compare the timing of fall turnover between the historical and current profiles. This is because the latest profile taken between 2006-2008 for the BCLSMP program was on September 23, 2008, which showed that Nita was beginning to turn over at the time of the profile. However, complete fall turnover was never captured in the historic BCLSMP profiles.

For subsequent years of data collection, it is recommended that profiles continue to be conducted as soon as possible from ice-off and continue at least biweekly until complete turnover is caught in the fall. This is important to determine if Nita Lake's stratification pattern is changing over time. One of the impacts of climate change on lakes in BC is that stratification may occur for longer periods, which can have extensive implications on dissolved oxygen levels, nutrient cycling, and habitat availability for salmonid species (Ashley, 2024). Lakes will vary in how they respond to a warmer climate, which supports the need to collect as much data as possible on Nita Lake as well as other BC lakes.

An analysis by Collins (2024) suggests that stream inflows likely have a strong influence on both temperature and dissolved oxygen profiles in Nita Lake (Collins, 2024). Collins points out that " *in both the 2023 and 2006 temperature profiles the large increases in temperature through time is in the 6-10m depth range. Most of this depth range is in the thermocline where there's supposedly no vertical movement of heat. The heating couldn't be solar because it's below the depth where solar is already practically completely absorbed. The heat couldn't be driven there by turbulence from surface wind because the relatively continuous temperature gradients in the upper 5 m tell us the water's not circulating vertically there either. The heat's most likely transported there by cool-water inflows that descend to the depth where lake temperature equals inflow temperature".*

Dissolved Oxygen Profiles

Dissolved oxygen (DO) is essential to aquatic life in lakes. Oxygen from the atmosphere dissolves and mixes into the water's surface and is also released from plants and algae during 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.

Generally, lakes that are lower in nutrients and algae production will have sufficient DO to support life at all depths throughout the year. As lakes become more nutrient and algae rich there is increased plant and animal respiration and decay, resulting in more oxygen consumption. This is especially true near the bottom of the lake where dead organisms can accumulate, and oxygen is depleted more rapidly. Stratified lakes with low oxygen concentrations in the isolated bottom layer can impact the behaviors and locations of fish residing within the lake. Salmonid species can become stressed when oxygen concentrations fall below 4 mg/L (Truelson, 1997) and begin to move up the water column to areas with higher DO concentration. Fish kills can occur when decomposing or respiring plants and algae use up the oxygen supply. In summer, this can happen on calm nights after an algal bloom, but most fish kills occur during late winter or at initial spring mixing.

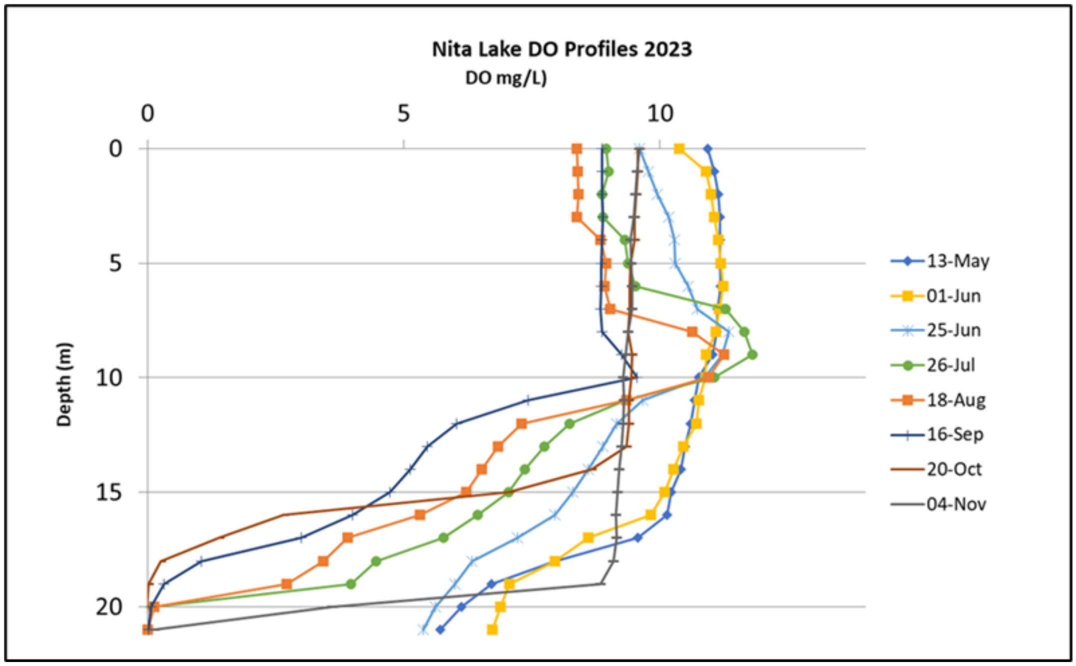


Figure 7 *Nita Lake 2023 Dissolved Oxygen Profiles*

Because of the extensive impacts of dissolved oxygen changes on a lake, it is important to compare historical and current dissolved oxygen profiles to determine if dissolved oxygen levels have significantly changed within the water column. Unfortunately, the historical profiles on Nita stopped at 15 m depth, which makes comparing hypolimnetic oxygen levels difficult because the 2023 profiles (**See Figure 7**) show that oxygen depletion during stratified periods is only evident below 15 m depth. According to the recent profiles, it is likely that dissolved oxygen in the hypolimnion is replenished during turnover, which is supported by the 2023 November 4th profile. However, the last measurement in the profile still shows depleted DO levels that reach 0.13 mg/L at 21 m. Field notes from the November 4, 2023 visit (and other visits in 2023) noted erratic dissolved oxygen readings at this depth, which suggests the probe may have entered the sediment/water interface. This is likely the reason for the low DO readings and not due to incomplete turnover.

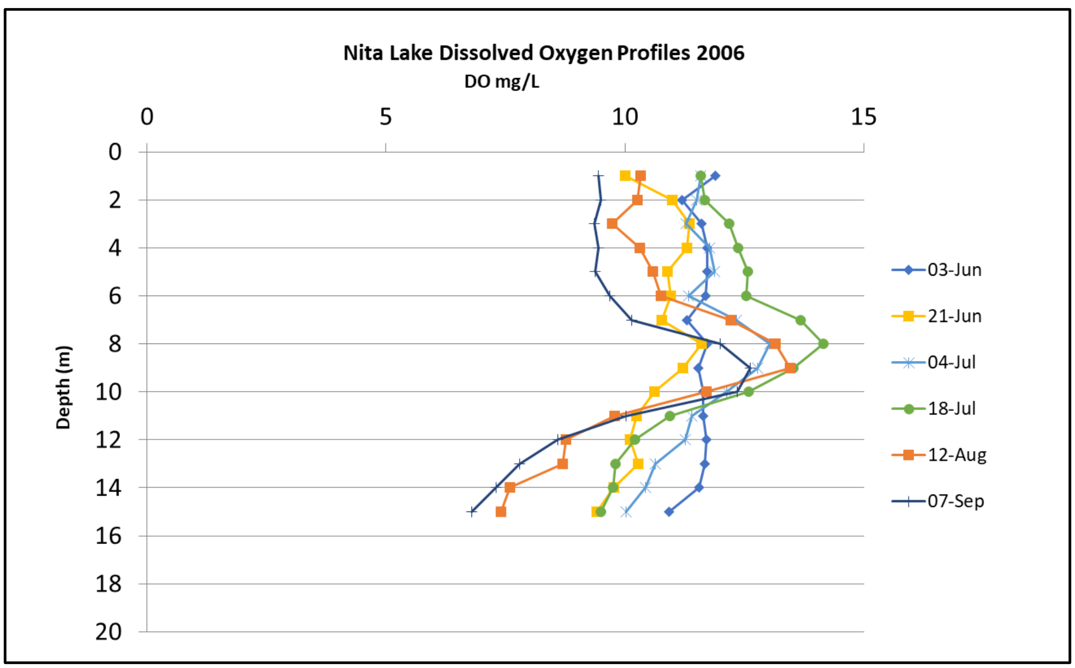


Figure 8 *Nita Lake 2006 dissolved oxygen profiles*

It is difficult to determine if oxygen depletion was also occurring at the same depths in 2006 due to the measurements only reaching a depth of 15m. The low dissolved oxygen levels below 15m depth in Nita Lake late in the 2023 stratified period can have implications for salmonid species and influence chemical changes in the sediment. Under aerobic (oxygenated) conditions, much of the phosphorus in a lake is bound to iron, manganese and/or calcium contained in lake bottom sediments. When bottom waters become anoxic, chemical changes occur in the sediments that result in phosphorus being released into the water column. When the lake begins to turn over, the phosphorus is mixed into the photic zone where algae and plants can utilize it, sometimes resulting in blooms. This phenomenon is known as internal loading. Iron, manganese, and hydrogen sulphide (H_2S) can also be released into the water during these anoxic periods (BCLSS, 2022).

Many fish species, especially salmonids, show signs of stress at temperatures greater than 18ºC and DO concentrations less than 4 mg/L (Truelson,1997). However, temperature and DO results show that despite the low oxygen levels and warm surface water conditions in the summer of 2023, much of the water column at Nita Lake Deep Station remained a suitable habitat for fish. It is worth noting the increase in dissolved oxygen at the thermocline visible throughout Nita's stratified periods in 2006 and 2023. This was also observed by Epps and Phippen (2016) and is referred to as a positive heterograde curve (BC Ministry of Environment, 1997). Typically, as temperature decreases, the solubility of oxygen increases, making cooler waters able to store more dissolved oxygen when mixing is occurring. A positive heterograde curve can occur when the thermocline lays within the photic zone and photosynthesis occurring in this area raises dissolved oxygen while the temperature gradient prevents mixing into the upper or lower waters. Epps and Phippen (2016) note that this characteristic in Nita Lake provides salmonid species with a low temperature and high oxygen refuge within their temperature and dissolved oxygen tolerance levels. This could become increasingly important as the climate warms in the future.

Figure 9 *Secchi readings in Nita Lake 2021-2023*

Water Clarity

Water clarity is an indicator of algae, suspended sediments, and other particles in the water. 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 typically decreases. This is due to algal growth patterns; as the temperature of the lake increases, so do some species of algae. Due to the increase in algae, the water clarity can decrease. However, there can be other influences on Secchi readings, such as suspended solids from turbid inflowing streams.

Water clarity was measured at the Nita Lake Deep Station by volunteers from 2006-2012 and from 2021-2023, shown above in **Figure 9**. The minimum data requirement of 12 readings over the sampling season was met each year, and the spread of measurements was relatively evenly distributed from spring through fall. In 2021 and 2022, July has the lowest Secchi reading of the year. This differs from 2023, where early spring and late fall both show shallower Secchi readings than July.

Previous reports have discussed that the hydrology of the area is mainly snowmelt-driven, with water levels starting to rise in May with peaks in mid-July, as well as occasional fall peaks driven by rain events (Epps & Phippen, 2016). This pattern likely significantly impacts Secchi readings, as low readings between May and July are likely linked to increasing turbidity due to snowmelt runoff. This statement corresponds to the low readings in July in 2021 and 2022. However, the pattern of low July Secchi readings is not apparent in 2023. The low readings in early 2023 are not thought to be linked to an algal bloom but likely linked to earlier-than-usual peak snowmelt due to warm spring temperatures. Volunteers and residents have supported this observation and agree that observed algae are not a problem in Nita Lake. However, brown or sediment-heavy water flowing into the lake is a regular occurrence (Clark, 2024).

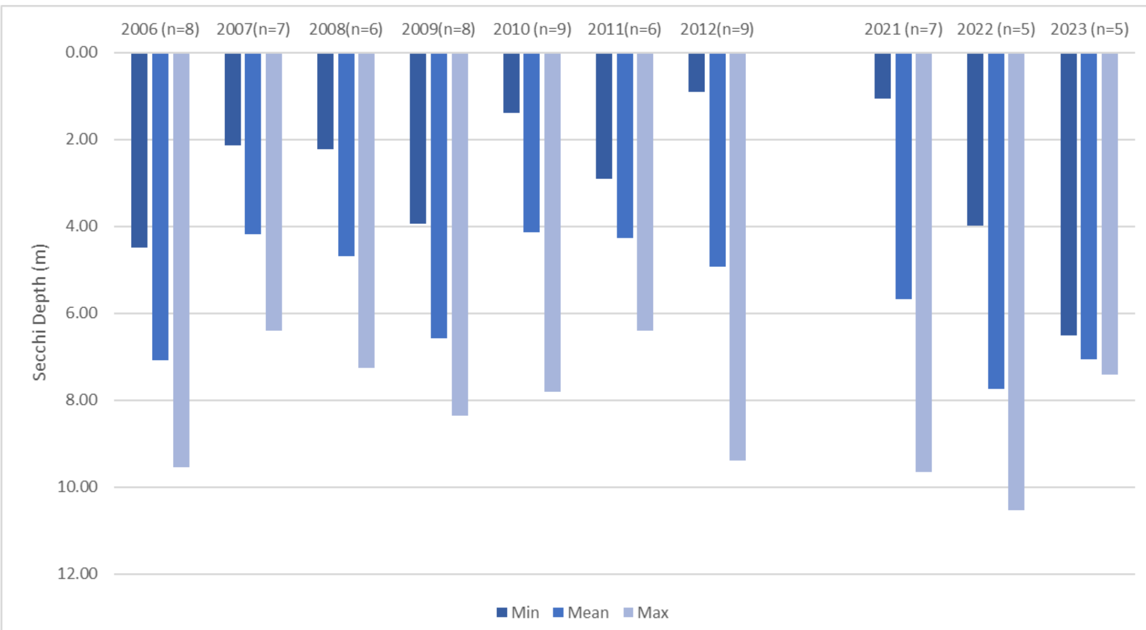


Figure 10 *Nita Lake July and August Secchi Summary 2006-2012, 2021-2023*

Bull (2009) also noted similar observations in Nita Lake in a 2007-2008 assessment entitled *Stormwater Quality and Snowmelt Runoff in Whistler Creeks*. Field notes from 2007 indicate that a large sediment plume was observed entering Nita from Whistler Creek on Oct 2 and 10th (Bull, 2009). The field notes indicated that by October 17, Whistler Creek was no longer adding additional turbidity to the lake, however, Nita was still quite turbid overall and pale in colour. By November 1, 2007, the field notes indicated that Nita was no longer experiencing the increased turbidity. The 2009 Nita Lake BCLMSP report states that in August 2007, ENV noted that upstream construction was causing sedimentation of Whistler Creek and Nita Lake, which explains the lower minimum Secchi values for 2007. Low Secchi values for 2008 might also be due to sedimentation from runoff through the ski hill and Creekside neighborhood areas, or from rain events occurring in the latter half of August" (BCLSS, 2009).

By comparing the average, maximum, and minimum Secchi readings from each year it is possible to assess whether the clarity of Nita has changed significantly over time. Because the timeframes of sampling differed for historical versus current years, with 2021-2023 having a much better spread of readings from spring through fall, as in the surface temperature section, we cannot compare overall summary statistics. Instead, we have compared only July and August Secchi summary statistics between years in **Figure 10**. Though all years had readings in July and August, it is extremely important to note that the early years of data collection did not meet the Secchi reading timeframe (readings should be collected between 10:00 a.m. -2:00 p.m.), which could have impacted the readings due to the angle of the sun and the ability of light to penetrate through the water column. However, there is no evidence of a clear trend in Secchi readings over the sampling years as indicated in **Figure 10** showing Secchi readings from July and August in Nita Lake which are highly variable from year to year. The average summer clarity does not appear to have declined over the past decade however, it is difficult to confirm this based on the available data. This indicates the need for further monitoring with more comprehensive field comments and observations of the condition of the inflowing streams at the time of sampling.

Information from previous reports and observations by residents and volunteers make it clear that the clarity of Nita Lake is significantly impacted by runoff, which directly impacts the interpretation of Secchi data. As a result, the Secchi data may not be directly correlated to algal growth in Nita Lake, and monitoring for chlorophyll-*a* should be considered for tracking any long-term changes to algal growth in Nita Lake.

Trophic Status

Trophic status describes the level of biological productivity within a water body and is measured by using Secchi depth, chlorophyll-*a*, and total phosphorus concentrations (Nordin, 1985). Low-productivity lakes are called *oligotrophic* and tend to have clear water and sufficient oxygen for aquatic life throughout the year. Lakes with moderate productivity are called *mesotrophic*. *Eutrophic* lakes have high productivity and often have high densities of aquatic plants and/or algae. Algal blooms may occur in these lakes frequently, reducing recreational opportunities and potentially impacting aquatic habitats.

The results show that Nita Lake ranges from low to low-moderate productivity depending on the time period and the trophic indicator (**Table 1**). Historic July and August water clarity (i.e., Secchi depth) collected through the BCLSMP between 2006-2012 suggests the lake is mesotrophic While the July and August water clarity readings collected from 2021-2023 indicate the lake is oligotrophic. As noted in the water clarity section, the clarity of Nita Lake has been strongly impacted by runoff, and therefore, Secchi depth is less useful in providing signs of trophic status. The average chlorophyll-*a* concentration monitored to advise the draft Water Quality Monitoring Objectives program document by Epps and

Table 1. Nita Lake trophic indicator results (as per Nordin, 1985).

Parameters	Trophic Categories			Nita Lake		
	Oligotrophic	Mesotrophic	Eutrophic	BCLSMP L1 (2006-2012)	ENV WQMO (2008-2010)	BCLSMP L1 (2021-2023)
Chlorophyll-*a* (µg/L)[3]	0 - 2	2 - 7	>7	-	1.16	-
Secchi Depth (m)[1]	>6.0	3.0 - 6.0	<3.0	5.12	-	6.83
Total Phosphorus (µg/L)[2]	1 - 10	10 - 30	>30	-	6	-

[1] Average of all years' July and August average Secchi depth, [2] Overall average of all years during spring mixed conditions, [3] Overall annual average over 3 years based on 2-3 samples per year.

Phippen (2016), taken between 2008-2010, places the trophic status of Nita Lake within the oligotrophic category. The total phosphorus concentrations during spring turnover samples through the same program also place Nita Lake in the oligotrophic range. Nita Lake is likely oligotrophic, and this is supported by the observations of longtime residents that the lake tends to be very clear in the summer months (Clark, 2024). Further monitoring, including chlorophyll-*a*, is warranted.

Flushing Rate

Flushing rate, also referred to as Water Exchange Rate, is the rate of water replacement in a lake. It's unit of measure is times/year. Lakes with high flushing rates are less sensitive to the impact of human caused nutrients from land uses or other development (BCLSS, 2022). The flushing rate of Nita Lake has been calculated by Collins (2024) to be approximately 15.8 times per year, and this is considered to be very high. Collins points out that "Such high flushing rates mean that algal nutrients arriving from the watersheds annually are not all there at once, and the algal populations that that grow on them will themselves experience rapid losses downstream"

Summary

Nita Lake is a small, fairly deep lake located in a developed watershed. The lake is extremely popular with recreation users for boating (electric motors only), paddling, swimming, and fishing. The WLCF sampled the lake under the BCLSMP Level 1 program over three years between 2021 and 2023. In 2023, the volunteers were able to obtain dissolved oxygen (DO) and temperature profiles on Nita Lake, which supported previous information that Nita is a dimictic lake as it experiences both spring and fall turnover and stable stratification in the summer. Temperature and DO results from 2023 show that despite the deep water low oxygen conditions during the late stratified period and warm surface water conditions during the summer, a large part of the water column at the Nita Lake Deep Station was suitable fish habitat. This is supported by the low temperature and relatively high oxygenated habitat due to the positive heterograde curve that the thermocline in Nita Lake exhibits.

Algal productivity, water clarity, and nutrient concentrations taken from different years and sampling programs suggest that Nita Lake is a low-productivity system (oligotrophic). However, clarity should not be relied on as the sole indicator of productivity for Nita Lake due to snowmelt and stormwater runoff potentially significantly impacting the lake's clarity. Comparing profiles between 2006 and 2023 shows that Nita began to stratify earlier in 2023, likely due to above-average temperatures that spring. Years when the lake surface is warmer for longer (i.e., earlier in the spring and/or later in the fall) will result in longer and stronger lake stratification, greater oxygen depletion at the bottom of the water column and more nutrients released from lake sediments.

Nita Lake has a high flushing rate and can be considered less sensitive to the impact of human-caused nutrients from land uses or other development. However, snowmelt and stormwater runoff are potentially significantly impacting the clarity of the lake. The associated organic sediment loading could be contributing to dissolved oxygen depletion in the bottom waters (Nordin, 2024).

Going Forward

The land use pressures within the Nita Lake watershed are relatively high due to development along the lake and its main tributary, Whistler Creek. With a new development going in along the West side of Nita Lake, development pressures will continue to increase. Studies have shown that stormwater runoff can impact Whistler Creeks (Bull, 2009). The Resort Municipality of Whistler plans to mitigate the impacts of increasing development pressures by requiring all new developments to take stormwater impacts into account as part of the development permit procedures (Burhenne, 2024). Adequate shoreline protections, including healthy riparian buffer zones, can mitigate development impacts on water quality and fish habitat (Dosskey et al., 2010). Local residents report observing the removal of tree branches and shore zone vegetation (WLCF, 2024) which is not considered good practice for the protection of the health of the lake (BC Government, n.d).

There is strong evidence that climate change is exacerbating existing issues in lakes and creating issues where issues did not previously exist, whether expected or unexpected. This will make the management of BC's water resources more challenging. One climate change impact already observed in many northern hemisphere lakes is reduced oxygen concentrations and earlier onset and longer periods of stratification, which will make internal nutrient loading more problematic (Woolway et al., 2020). If there is volunteer interest and capacity, continued monitoring should be done through an Enhanced Level 1 BCLSMP program: Secchi depth, dissolved oxygen (DO) and temperature profiles at Nita Lake Deep Station from spring to fall overturn is recommended. The WLCF have purchased their own temperature and DO meter and water column profiling for these two parameters on a regular basis between spring and fall mixed periods will provide extremely valuable information. These data are important for long-term lake condition records and will provide early warning signs of deterioration in water quality. Specific conductance profiling would also be valuable in providing information on road salt inputs into the lake.

Considering the clarity of Nita Lake appears to be highly linked to sedimentation and increased turbidity levels during rainfall and snowmelt events, designing a chlorophyll-*a* sampling program to complement the program recommended above would provide a better indication of algal growth and trophic status in Nita Lake. This should be accompanied by observations of sediment entering via the tributary streams and in the lake itself during monitoring events.
These data are important for long-term lake condition records and will provide early warning signs of deterioration in water quality.

It is also recommended that the WLCF include monitoring of ice-on and off dates, which can be submitted online through the BC Ice Reporting Tool (https://arcg.is/qy1e5). This data is important for tracking climate change impacts on BC lakes.

Tips for Keeping Nita Lake Healthy

- Local residents have reported that there has been considerable removal of shoreline vegetation by the Resort Municipality of Whistler (Clark, 2024). Protecting and enhancing natural shoreline vegetation will likely be important for mitigating impacts from increased development on Nita Lake. Tree branches and riparian zone vegetation should remain intact whenever possible because high-quality riparian areas are key for supporting good water quality and healthy fish populations. "The vegetation in riparian areas directly influences and provides important fish habitat, it builds and stabilizes stream banks and channels, provides cool water through shade, and provides shelter for fish. The leaves and insects that fall into the water are also a source of food for fish" (BC Government, n.d).

- Continue to monitor road salt usage to avoid applying more salt than needed. Road salts are known to end up in waterways and can impact water quality (ECCC, 2018).

Other Tips for Keeping Nita Lake Healthy:

See link under Monitoring Resources on: www.gov.bc.ca/lakestewardshipmonitoring
BCLSS's LakeKeepers Manual: https://www.bclss.org/programs#lake-keepers-manual

Who to Contact for More Information

The Ministry of Environment and Parks	**The BC Lake Stewardship Society**
3rd Floor, 1011-4th Ave Prince George, BC V2L 3H9 Email: volunteerlakes@gov.bc.ca Website: www.gov.bc.ca/lakestewardshipmonitoring	Box 110, 5505 Jacobson Road, Big Lake Ranch, BC, V0L 1G0 Email: info@bclss.org Website: www.bclss.org

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