Hutchinson
Environmental Sciences Ltd.

Lake Assessment Study

Lake Nosbonsing

Prepared for: Municipality of East Ferris
Job #: J200065

March 12, 2020

1-5 Chancery Lane, Bracebridge ON P1L 2E3 | 705-645-0021

Hutchinson
Environmental Sciences Ltd.

1-5 Chancery Lane, Bracebridge, ON P1L 2E3 │705-645-0021
www.environmentalsciences.ca

March 12, 2021 HESL Job #: J200065

Mr. Greg Kirton
Manager of Planning and Economic Development
Municipality of East Ferris
390 Hwy 94,
Corbeil, ON. P0H 1K0

re: Lake Assessment Study – Lake Nosbonsing – Final Report

Dear Mr. Kirton;

I am pleased to present this final report that summarizes existing water quality in Lake Nosbonsing, provides estimates of development capacity derived by three methods and recommendations for a) additional monitoring and b) Best Management Practices to maintain water quality in the lake. The data on water quality provided through the MECP "Lake Partner" program and through monitoring by the NBMCA were invaluable to preparing this report. I have addressed the comments provided by yourself and the NBMCA on our draft report in the appropriate sections and revised Figure 1 to better illustrate the basin and subwatershed distinctions.

I thank you for the opportunity to work with you on this project and look forward to future collaboration.

Sincerely,
per: Hutchinson Environmental Sciences Ltd.

Neil J Hutchinson

Neil Hutchinson, Principal Scientist
Hutchinson Environmental Sciences Ltd.
Neil.hutchinson@environmentalsciences.ca

Executive Summary

In September of 2020, Hutchinson Environmental Sciences Ltd. (HESL) was retained to complete a Lake Assessment Study for Lake Nosbonsing. Nuisance algal growths in the lake have been reported to the North Bay Health Unit and residents have expressed concerns regarding development pressures on the East Basin. The Municipality of East Ferris had previously placed a moratorium on any new lot severances in the West Basin of the lake because of concerns with water quality and need to know whether a similar moratorium may be required for the East Basin.

Our study summarized watershed reports prepared in the 1990s by the NBMCA, current water quality data provided by the MECP "Lake Partner" program and the NBMCA, development counts provided by the municipality, reports on algal blooms from the North Bay Health Unit and used the Province of Ontario "Lakecap" model to describe current water quality and assess the capacity of the lake to support additional development.

Water quality in Lake Nosbonsing has been a matter of management concern since, at least, 1975 when the Ontario Ministry of Environment, Conservation and Parks (then Ministry of the Environment) began sampling the lake. Numerous other studies were undertaken and a comprehensive watershed management plan was completed by the NBMCA in 1993.

The conclusions and recommendations over the years have been consistent. While the lake is located within the Precambrian Shield, it is not a typical deep, cold and non-productive Shield lake. It is heavily developed, shallow, the waters are nutrient rich (meso trophic to eutrophic) and oxygen is reduced to zero (anoxic) or near zero (hypoxic) in the bottom waters of the lake by mid summer. The lake supports a warm-water fish community and an important recreational fishery has developed, which shows some symptoms of over exploitation. Lake Nosbonsing is a regional focus for recreational use, and recent years have seen an increasing population of year-round residents. The watershed was heavily logged in the 19th and early 20th centuries and the extensive glacial deposits supported agriculture, which has declined in more recent years. Much of the present-day shoreline development has an urbanized character, with cleared land, lawns and shoreline modifications while other portions have a more mixed recreational – urban character.

The nutrient enrichment in Lake Nosbonsing is, in large part, natural, as the rich soils around the lake increase nutrient concentrations in the runoff to the lake. The lake may also have a substantial "internal load" of the algal nutrient phosphorus that is released from lake sediments to the water column under anoxic conditions. Hypolimnetic anoxia was documented in past studies and confirmed in this study but there is no direct confirmation of internal loading.

Total phosphorus concentrations indicate that the main basin of the lake is mesotrophic while the Astorville Basin is enriched and slightly eutrophic. Total phosphorus concentrations in the Astorville and West Basins decreased from 22-25 µg/L in 1975-1980 to ~18 µg/L in 1990, and from ~ 18 µg/L to ~ 12 µg/L in the Main (East) Basin (NBMCA 1992). Some of this decline may only be apparent, an artifact of improved analytical methods but the decreasing trends continued between 2003 and 2019 after current analysis techniques were introduced.

There is a strong oxygen demand in Lake Nosbonsing which is a result of the lake productivity and resultant decomposition of algae in the hypolimnion. The moderate depth and small hypolimnetic volume mean that the algal decomposition consumes the available dissolved oxygen and the hypolimnion is anoxic by early summer. Although the lake turns over in the autumn and oxygen is restored, the lake characteristics suggest that also occurs at depth in the winter, when ice cover impedes wind mixing and there is weak temperature stratification. Hypolimnetic anoxia allows for internal loading of phosphorus when the lake sediments lose oxygen and release phosphorus that is normally sequestered. The shallower depths and evidence of exchange between hypolimnetic and shallower waters over the summer suggests that some of this internal load is available to algae. In addition, some species of cyanobacteria (blue-green algae) are able to migrate vertically, to sink to the bottom and take up internally loaded phosphorus and then rise back up to the euphotic zone where available sunlight allows photosynthesis.

Recommendation - The potential for internal phosphorus loading in Lake Nosbonsing and its role in the phosphorus budget (Section 5.1) and algal growth should be investigated by completing lake surveys to:

a) document the phosphorus, nitrogen and total metal concentrations in the water column and at 1 meter above bottom from August to the end of September,

b) measure the oxygen profiles in the lake between early August and mid October to determine the intensity and extent of anoxia in all lake basins.

These surveys should be conducted once and the results reviewed to determine the need for any follow up.

Algal blooms were reported by lake residents in 2012, 2013, 2015, 2017, 2018, 2019 and 2020 and were most frequently made up of cyanobacteria (blue-green algae) that have the potential to be toxic. The cause of the blooms is not clear, but the nature of the blooms, and the vertical distribution of blue-green algae suggest a strong role of internal phosphorus loading.

Overall, Lake Nosbonsing showed a pattern of a significant spring algal bloom, as shown by high chlorophyll “a” concentrations in late May and early July. As the summer progressed and thermal stratification advanced, the pattern shifted to one of chlorophyll, and especially phycocyanin (blue-green algae), accumulation at the top of the thermocline at the 6-8m depth. This pattern was most pronounced in the Astorville Basin, the West Basin and the Bonfield Basin. Blooms of blue-green algae species were confirmed in the late summer of 2018, 2019 and 2020. This, plus the pattern of late summer anoxia, suggests that blue-green algae were preferentially accumulating where internal loading had increased phosphorus concentrations in the deeper waters.

Recommendation – The recurrence of blue-green blooms in Lake Nosbonsing suggests that the algal community should be monitored over the course of the summer to confirm the algal makeup. Samples should be taken as a euphotic zone composite (2X the Secchi Depth) and at the point of maximum phycocyanin fluorescence and community species composition determined by an algal taxonomist. These results, along with the measurement of internal loading (Section 4.5.1) will help determine the cause of the observed blooms. These surveys should be conducted once and the results reviewed to determine the need for any follow up.

Many factors can be considered when trying to establish a ”capacity’ - an acceptable limit to the amount of human development that a lake can sustain. Much depends on the uses that humans make of a lake. Uses such as recreational boating, wildlife habitat, wilderness aesthetic, peace and quiet or fishing capacity can all, in theory have capacities associated with them. The challenge lies in determining what uses are most desired in a lake (as some uses may conflict with other, equally valid uses), how capacity could be measured, what the capacity “limit’ would be, how much each user contributes to the capacity and finally, how to enforce any capacity limit.

The Ontario “Lakecap” model was used to estimate development capacity on the basis of water quality, along with two filters based on a) available lake surface area and b) available shoreline perimeter. Several adjustments of model inputs were required in order to produce acceptably accurate estimates of total phosphorus concentrations in the lake.

“Capacity” estimates for the three basins of Lake Nosbonsing were as derived using water quality (Background + 50%), surface area (1 lot/1.6ha) and perimeter (1 lot/60m) filters.

The Astorville Basin is clearly overdeveloped by all three criteria:

- TP concentrations are at Background + 71%,
- The 68 lots exceed the social filter of 39 lots – there are 0.93 ha for each lot vs 1.6 ha of water surface per lot,
- The 68 lots exceed the shoreline perimeter capacity of 64 lots at 60m per lot.

The existing development freeze on Astorville Bay is therefore warranted and should be maintained.

The West Basin is near or over capacity by two of three criteria:

- TP concentrations are at Background + 130%,
- The 189 lots are within the social filter of 237 lots allowing for 1.6 ha of water surface per lot and 0.8ha for each resort unit. An additional 48 lots would be allowed by this criterion
- The 176 lots are within the shoreline perimeter capacity of 576 lots at 60m per lot, allowing for an additional 3 lots. Many of the existing lots however, have <60m frontage and so available shoreline would exceed the 3 lots allowed by the physical filter.

Although TP in West Bay exceeded the Background + 50% criterion, the additional 3 lots allowed by the physical filter could be developed with no threat to water quality or to the social filter. Addition of the 48 lots allowed under the social filter is not warranted as a) the TP concentrations are well in excess of the TP criterion and b) there is only available shoreline for 3 lots.

The Main Basin has additional development capacity by all three criteria:

- TP concentrations are at Background + 12% and an additional 2246 seasonal lots could be accommodated within the water quality filter,
    - If all existing and vacant lots were occupied on a permanent basis TP concentrations would be increased to Background + 15% (12.06 µg/L) and an additional 2020 seasonal or 579 permanent lots could be accommodated within the water quality filter

- The 234 existing lots are well within the social filter of 1224 lots allowing for 1.6 ha of water surface per lot. An additional 973 lots would be allowed by this criterion
- The 234 lots are well within the shoreline perimeter capacity of 576 lots at 60m per lot, allowing for an additional 342 lots.

There is therefore available capacity in the Main Basin and the three filters tested do not support freezing additional lot creation. The shoreline perimeter is the most sensitive capacity determinant but the 342 lots calculated here would be reduced after considering those areas of the shoreline which were wetland or otherwise unsuitable for building.

Best Management Practices are encouraged for all future development and as voluntary stewardship initiatives for existing development. All attempts should be made to minimize the actual area disturbed along a shoreline – low profile vegetation will provide a buffer and still maintain a lake view and waterfront access should be maintained through disturbing no more than 25% of the existing frontage (15m of a 60m lot frontage). We recommend that any future development on Lake Nosbonsing include a 30m deep naturalized buffer along the shoreline with limited allowance of vegetation removal for access and views. Residents should be encouraged to take on shoreline naturalization programs as voluntary initiatives, working with either the Municipality or the NBMCA. Excellent resources can be found at the North Bay Mattawa Conservation Authority https://www.restoreyourshore.ca/ and the Muskoka Water Web: http://www.muskokawaterweb.ca/resources-by-topic#ab.

Table of Contents

List of Figures

List of Tables

List of Photos

1. Introduction

In September of 2020, Hutchinson Environmental Sciences Ltd. (HESL) was retained to complete a Lake Assessment Study for Lake Nosbonsing. Nuisance algal growths in the lake have been reported to the North Bay Health Unit and residents have expressed concerns regarding development pressures on the East Basin. The Municipality of East Ferris had previously placed a moratorium on any new lot severances in the West Basin of the lake because of concerns with water quality and need to know whether a similar moratorium may be required for the East Basin. The Municipality identified the following needs and questions to inform the study:

- An overall picture of the lake health relative to the development pressures on the lake.
- Has the lake health deteriorated?
- Are there additional measures that should be put in place to help improve the water quality such as stricter guidelines on shoreline restoration through the site plan control process etc.
- An assessment of the impact the current levels of development are having from a septic perspective and whether or not different types of septic systems could be used as a mitigating factor for development?
- Are there hotspots on the lake that are particularly impacted?
- The impact of the conversions of seasonal cottages to permanent residences over the last couple of decades.

The following tasks were identified as part of the Lake Assessment Study:

1. Review and summarize the conclusions of management reports that had been prepared by the North Bay Mattawa Conservation Authority (NBMCA) and the Ontario Ministry of Natural Resources (OMNR).
    a. NBMCA 1992. Lake Nosbonsing Watershed Management Study – Draft Inventory and Analysis Report. April 1992.
    b. NBMCA 1993. Lake Nosbonsing Watershed Management Plan – Summary Report and Implementation Plan. July 1993.
    c. NBMCA 1989. Lake Nosbonsing Watershed – A Need for Basin Management. August 1989.
    d. OMNR 1985. Lake Nosbonsing Watershed Study. Junior Conservationist Award Program.
2. Document land uses around the lake from NBMCA and OFAT (Ontario Flow Assessment Tool) mapping.
3. Summarize and interpret the existing data for total phosphorus, dissolved oxygen and other chemical parameters to provide an assessment of overall lake health, identify any spatial or temporal trends in water quality, and discuss potential causes.
4. Use the provincial "Lakecap" model to predict existing concentrations of Total Phosphorus (TP0 in each basin of the lake based on loading from natural and human (shoreline development) sources, compare the results to measured values and the Provincial Water Quality Objective for TP and assess the utility of the model in setting defensible development capacities.

5. Assessment of phosphorus mobility between the shoreline and the lake and the sensitivity of each basin to additional TP inputs using the model.
6. Summarize available Best Management Practices (BMPs, including septic abatement technologies) and planning tools for mitigating development impacts.
7. Document our findings in a report and recommendations to the Municipality of East Ferris and review our findings with the Municipality and the NBMCA via teleconference.

The outcome of the modelling was such that assessment of phosphorus mobility was not required in order to provide accurate estimates of total phosphorus concentrations in the lake. Instead, the model was run in a variety of scenarios reflecting urban and agricultural land uses, and explicit estimation of internal phosphorus load, in order to provide accurate modelling results.

2. Lake Nosbonsing – Watershed and Land Use

Lake Nosbonsing is located approximately 25 km southeast of the city of North Bay and occupies portions of the Municipality of East Ferris and the Townships of Bonfield and Chisholm. The lake has a surface area of 2401ha, with 3 basins; the Astorville Basin (63ha), the West Basin (380 ha) and the Main Basin (1958 ha) (Figure 1). The total watershed area is 16,661ha, with subwatershed areas of 837, 1,660 and 14,164ha respectively, for each of the three basins.[1] The major drainage to the lake is from Depot Creek, which discharges to a large wetland on the south shore of the Main Basin from a watershed area of 6,460ha. Lake Nosbonsing outlets to the Kaibuskong River by way of a control dam at Bonfield, and flows to Lake Talon, and ultimately to the Mattawa River and then the Ottawa river. The lake has an average depth of 5.5m (NBMCA 1992), with maximum depths of 6m in the Astorville Basin, 11m in the East and Main Basins and 14m in Maple Bay.

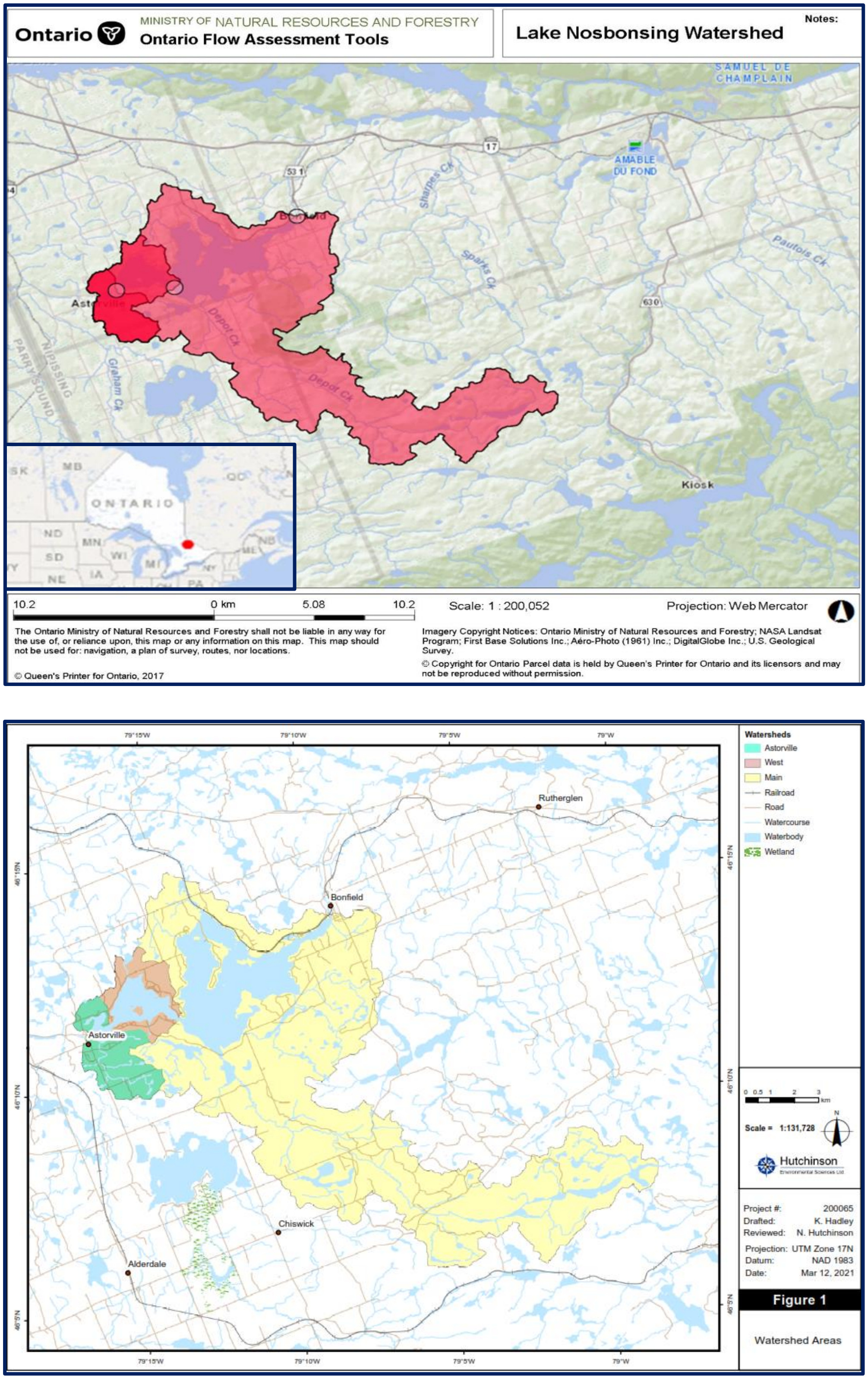
The watershed is predominantly forested with sparse tree cover, deciduous, mixed or coniferous forests making up 70% of the coverage. Open water (which includes lakes and nearshore wetlands) makes up 14.6%, inland bog 1.1% and bare bedrock 0.2% (Table 1). Agriculture and Rural/Urban areas make up 9.4% and ~5% of land cover was not classified in OFAT because of cloud cover or shadow.

The watershed is located on metamorphized igneous rocks of the PreCambrian Shield overlain with glacial outwash deposits which support the agricultural land uses. The watershed was logged in the 1880s and the cleared lands used for agriculture which was the dominant land use until the 1930s and 1940s. Low intensity agriculture is still practiced but shoreline recreational development has been the dominant land use since the end of WWII (NBMCA 1992).

---

[1] *All areas derived using the Ontario Flow Assessment Tool (OFAT) https://www.ontario.ca/page/watershed-flow-assessment-tool*

Figure 1. Lake Nosbonsing and Watershed – Location and Basin Delineation.



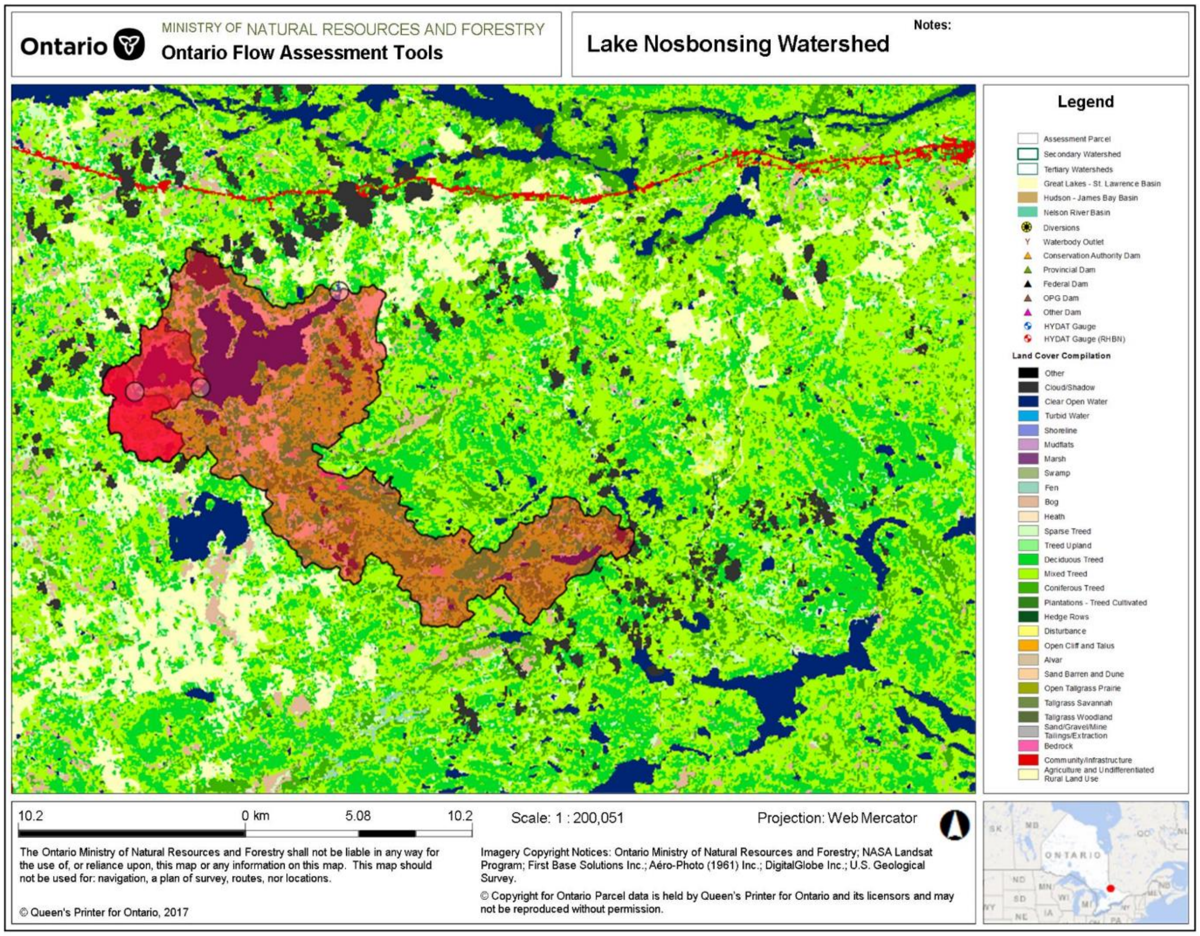
The Ontario Ministry of Natural Resources and Forestry shall not be liable in any way for the use of, or reliance upon, this map or any information on this map. This map should not be used for: navigation, a plan of survey, routes, nor locations.

Imagery Copyright Notices: Ontario Ministry of Natural Resources and Forestry; NASA Landsat Program; First Base Solutions Inc.; Aéro-Photo (1961) Inc.; DigitalGlobe Inc.; U.S. Geological Survey.

Table 1. Land Use Summary - Lake Nosbonsing Watershed.

	km^2	%
Open Water	20.4	14.6
Bog	1.5	1.1
Sparse Treed	6.1	4.4
Deciduous Treed	31.1	22.2
Mixed Treed	49.1	35
Coniferous Treed	11.9	8.5
Open Bedrock	0.39	0.23
Agriculture and Rural/Urban Land Use	13.16	9.4
Unclassified/Cloud Cover	6.59	4.7
Total	140	100

Figure 2. Land Cover in Lake Nosbonsing Watershed.



Much of the shoreline development has an urbanized character, with cleared land, lawns and shoreline modifications (Photo 1) while other portions have a more mixed recreational – urban character (Photo 2).

Photo 2. Urbanized shorelines of Lake Nosbonsing.

Photo 1. Mixed shoreline uses - Lake Nosbonsing.

3. Previous Studies

Water quality in Lake Nosbonsing has been a matter of management concern since, at least, 1975 when the Ontario Ministry of Environment, Conservation and Parks (then Ministry of the Environment) began sampling the lake[2]. Numerous other studies were undertaken and a comprehensive watershed management plan was completed by the NBMCA in 1993.

The conclusions and recommendations over the years have been consistent. While the lake is located within the Precambrian Shield, it is not a typical deep, cold and non-productive Shield lake. It is heavily developed, shallow, the waters are nutrient rich (meso trophic to eutrophic) and oxygen is reduced to zero (anoxic) or near zero (hypoxic) in the bottom waters of the lake by mid summer. The lake supports a warm-water fish community and an important recreational fishery has developed, which shows some symptoms of over exploitation. Lake Nosbonsing is a regional focus for recreational use, and recent years have seen an increasing population of year-round residents. The watershed was heavily logged in the 19th and early 20th centuries and the extensive glacial deposits supported agriculture, which has declined in more recent years.

The nutrient enrichment in Lake Nosbonsing is, in large part, natural, as the rich soils around the lake increase nutrient concentrations in the runoff to the lake. The lake may also have a substantial “internal load” of the algal nutrient phosphorus that is released from lake sediments to the water column under anoxic conditions. Hypolimnetic anoxia was documented in past studies (MOE data, 1990, in NBMCA 1992) and in recent surveys (Section 4.2) but there is no direct confirmation of internal loading.

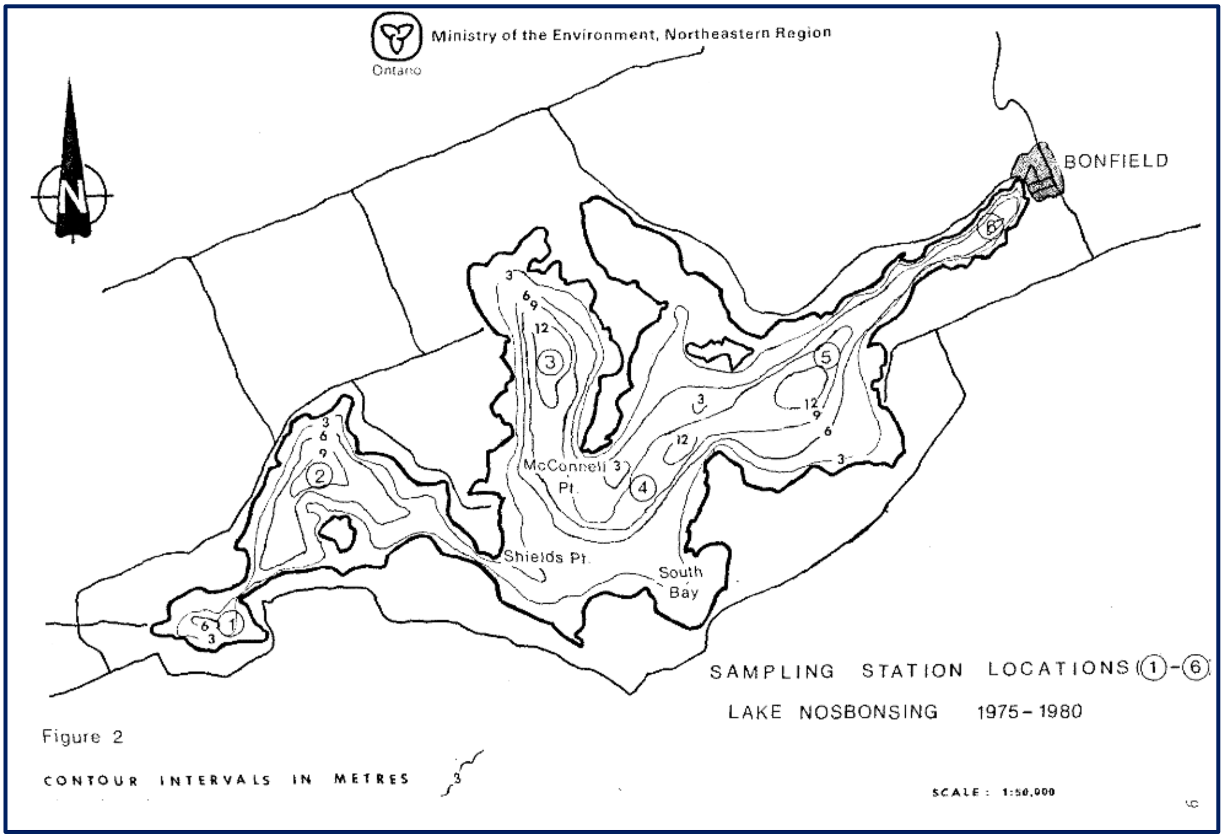
The anoxia is natural, a result of the shallower depth of the lake, but is enhanced in nutrient-rich waters. Lakes are well mixed by wind when the ice cover is lost in early spring and all depths of the lake are at the same temperature. As the water warms the lakes stratify, with warmer water of low density forming on top of cooler, more dense water, such that the two water masses do not mix in the summer. This thermal stratification means that the bottom waters (the “hypolimnion”) do not mix with the surface waters (the “epilimnion”). Summer algal production in the epilimnion settles to the hypolimnion, where microbes degrade it, and this oxygen demand consumes dissolved oxygen in the process. If the lake is deep, there is enough oxygen in the hypolimnion to last until the lake cools in the fall, turns over again and oxygen is replenished. In shallower lakes, however, the small hypolimnetic volume means that all of the oxygen is consumed. When the water and the surface of the lake sediment become anoxic, phosphorus is released back into the water as an “internal load”. The maximum depths in the main basin of Lake Nosbonsing are 12-14m (Figure 3) and so hypolimnetic anoxia is pronounced (see Section 4).

---

[2] *The MOE (1975) study was not available but was referenced in other source materials.*

In contrast, the Astorville Basin is shallower, (~6m) such that the entire water column warms and does not stratify to the same extent as the deeper portions of the lake. Wind induced mixing periodically restores the oxygen content. Therefore, the Astorville Basin remains “hypoxic” with a smaller internal load even though it is even more nutrient enriched than the rest of the lake (Section 4).

Figure 3. Bathymetric map of Lake Nosbonsing (NBMCA, 1989).



Human activities have also added phosphorus to the lake. The soils around the lake supported agriculture in the past although the intensity and scope of agricultural operations have decreased in recent times. Logging operations in the past opened up the watershed, exposing soils to increased runoff with fewer trees to take up phosphorus. The cessation of logging and regrowth of the forest, combined with reduced agricultural activities helps to explain the trend to reduced phosphorus concentrations in Lake Nosbonsing over the past 40 years.

Sampling of Lake Nosbonsing by the Ontario Ministry of the Environment (in NBMCA 1992) showed that TP concentrations in the Astorville and West Basins decreased from 22-25 µg/L in 1975-1980 to ~18 µg/L in 1990, and from ~ 18 µg/L to ~ 12 µg/L in the Main (East) Basin. Some of this decline may only be apparent, an artifact of improved analytical methods, but the decreasing trends continued between 2003 and 2019 after current analysis techniques were introduced (see Section 4).

The extent of shoreline development and its role in phosphorus enrichment to the lake are frequently documented in past studies of Lake Nosbonsing. Increased development along the lakeshore and increased occupancy (longer seasons and seasonal to permanent conversions) were linked to phosphorus enrichment in the 1993 NBMCA management plan, along with recommendations to reduce shoreline phosphorus loading. MNR (1985) reported runoff of sediment rich waters to the Astorville Basin and associated that input to land use practices. NBMCA (1993) estimated that shoreline development added 26%, 37% and 12% of the total phosphorus loadings to the Astorville, West and East/Main Basins of Lake Nosbonsing as part of the 1992 – 1993 management study[3]. A freeze on the creation of new lots and on conversion from seasonal to permanent occupancy west of Shields Point (Astorville Basin) was imposed by the Municipality of East Ferris in ~1993, over concerns regarding water quality, while a similar freeze east of Shields Point was relaxed. The need for a freeze on the Eastern (Main) Basin is currently being considered. NBMCA (1993) also reported bacterial counts in excess of guidelines at the Bonfield Beach and attributed these to stormwater runoff and septic system discharges to shallow groundwater.

Shoreline development and water quality are linked through a) increased overland runoff of phosphorus as forest is replaced with cleared areas and use of lawn fertilizers (~0.04 kg/lot/yr) and b) through the treatment of domestic sewage in shoreline septic systems and subsequent assumed movement of phosphorus through soils to the lake. MOEE (2010[4]) advise that all phosphorus from septic systems located within 300m of a lakeshore should be assumed to move to the lake. The septic load is calculated assuming that each person contributes 0.66 kg/yr of phosphorus to a septic system and accounting for the usage of each residence in a year – e.g.0.66 capita years/yr for seasonal usage and 2.56 capita years/yr for permanent usage.

Although the MOEE (2010) "Lakecap" approach assumes that all of the septic phosphorus load migrates to a lake, phosphorus has a strong affinity for soils and direct monitoring studies and mechanistic understanding of soil and phosphate interactions provide evidence that conflicts with the assumption. A recent review of 24 septic system investigations concluded that, in Precambrian Shield settings, as much as 97% of the septic system phosphorus may be sequestered in the soils around the tile field (Robertson et al 2019[5]). Modelling approaches also support the mechanistic and geochemical evidence. Dillon et al. (1994[6]) reported that only 26% of the potential loading of phosphorus from septic systems around Harp Lake, Muskoka, could be accounted for in the measured phosphorus budget of the lake. The authors attributed the variance between measured and modelled estimates of phosphorus to retention of septic phosphorus in thick tills in the catchment of Harp Lake. Any assessment of the influence of septic systems on phosphorus concentrations in Lake Nosbonsing must account for any role soils play in mitigating phosphorus movement between the septic system and the lake.

---

[3] *The coefficients used to estimate these loads are no longer current, and were superceded by the methods in the MOEE (2010) "Lakecap" approach used in this report.*

[4] *MOEE (2010) Ontario Ministry of the Environment. 2010. Lakeshore Capacity Assessment Handbook Protecting Water Quality in Inland Lakes on Ontario's Precambrian Shield. PIBS 7642e. Queens Printer for Ontario. 106pp*

[5] *Robertson, W.D., D.R. Van Stempvoort .and S.L.Schiff 2019. Review of phosphorus attenuation in groundwater plumes from 24 septic systems. Science of the Total Environment 692: 640-652*.

[6] *Dillon, P.J., W.A. Scheider, R.A. Reid and D.S. Jeffries. 1994. . Lakeshore Capacity Study : Part 1 – Test of effects of shoreline development on the trophic status of lakes. Lake and Reserv. Manage. 8 : 121 – 129.*

4. Current Water Quality

Total phosphorus and dissolved oxygen are the two parameters of most concern to the quality of Lake Nosbonsing, both are related to human development and both can be managed to improve water quality if necessary. Excellent records of each are available. Water clarity is estimated using the Secchi depth by lake volunteers and sufficient data were available to document average values, but not trends. Algal blooms have been reported on Lake Nosbonsing and these result in degraded aesthetics (water clarity and surface scums) and the potential for harmful cyanobacteria (blue-green algae) blooms and their associated toxins. The NBMCA has monitored the relative abundance and seasonality of algae formation in the lake by measuring profiles of fluorescence specific to the algal pigments chlorophyll “a” (for the entire algal community) and phycocyanin (for the cyanobacteria community.

4.1 Data Sources

The Ontario Ministry of Environment, Conservation and Parks coordinates the Lake Partner Program, in which volunteer lake stewards resident on a lake sample the water for total phosphorus (TP) in the spring and over the summer and measure Secchi depth (water clarity) over the course of the summer. Lake Partner measurements are made as composite samples from the upper portion of the water column. During spring overturn the entire water column of a lake is mixed such that one measurement provides a good estimate of whole – lake TP concentration. As stratification develops over the summer, TP concentrations may change with depth, making whole lake estimates more challenging (Clark and Hutchinson 1992[7], Clark et al. 2010[8]). Lake Partner Program measurements were available from 30 sites on Lake Nosbonsing for the period 2003-2019. Many of these sites were located in close proximity and so data were consolidated to provide a continuous record for 8 distinct areas of the lake (Table 2.)

The NBMCA sampled profiles of dissolved oxygen, temperature and algal fluorescence at six sites in Lake Nosbonsing in May, July and August of 2018 which provided current coverage of the lake. Measurements were taken in a high resolution profile from surface to bottom using a Hydrolab water quality sonde. The Lake Partner Sites (“HESL”) and corresponding NBMCA (“NOS”) sites are shown in Table 2 and Figure 4.

---

[7] *Clark, B.J. and N.J. Hutchinson, 1992: Measuring the trophic status of lakes : sampling protocols. Ont. Min. Envir. Tech. Report. 36 pp.*

[8] *Clark, B.J., A.M. Paterson, A. Jeziorski and S. Kelsey, (2010). Assessing variability in total phosphorus measurements in Ontario Lakes. Lake and Reservoir. Mgt. 26: 63-72.*

Table 2. Sample Sites in Lake Nosbonsing.

HESL Station	NBMCA Station	Lake Partner Stations	Lake Partner Station Description	Latitude	Longitude
HESL 1 - Astorville Bay	NOS6	LP1	Astorville Bay, deep spot	461123	791618
		LP4	Astorville Bay,TEF1	461119	791624
		LP8	West basin-near Astorville	461123	791618
		LP24	West Basin close to Asterville	461124	791619
HESL2 - Main Basin North East	NOS4	LP2	E side of Mn Basin, TEF5	461252	791047
		LP20	East Basin-East Arm by N Star	461303	791025
HESL3 - Maple Cove	NOS5	LP3	Mid Maple Cove, TEF3	461256	791312
		LP10	Maple Cove	461302	791313
		LP26	Maple Cove	461303	791314
HESL4 - Perron Island Bay	NOS7	LP5	Perron Island Bay, TEF2	461215	791517
		LP9	West Basin-North of Perron Isd	461211	791514
		LP14	West Basin-West of Perron Isd.	461157	791546
		LP15	West Basin-East of Perron Isd.	461201	791435
		LP25	West basin - N of Perron Is.	461212	791515
HESL5 - Bonfield Arm	NOS8	LP6	Bonfield Bay, TEF6	461338	790912
		LP13	East Basin-east arm	461340	790910
		LP21	East End, Bonfield	461345	790905
		LP29	E basin, east arm	461341	790911
HESL6 - Main Basin	NOS9	LP7	Off McConnell Pt., TEF4	461213	791222
		LP11	East Basin-S. of McConnell Pt	461156	791257
		LP16	East Basin-W. of McConnell Pt	461221	791321
		LP17	East basin SE of Shields Pt.	461131	791325
		LP19	E.Basin- east of McConnell Pt.	461235	791156
		LP27	E basin - S of McConnell Pt	461157	791258
HESL7 - Main Basin Southeast		LP12	W. of Lakeshore	461229	791051
		LP28	W of Lakeshore	461230	791052
HESL8 - Northeast Bay		LP18	E. Basin NE Bay across Quae	461336	791223
		LP22	North Bay, by Tracks	461336	791223
		LP23	E. Basin NE Bay	461335	791223
		LP30	E. Basin NE Bay across Quae	461337	791224

Figure 4. Sample Sites in Lake Nosbonsing. “HESL” denotes Lake Partner, “NOS” denotes NBMCA.

4.2 Total Phosphorus

Total phosphorus measurements for the six Lake Partner Sites for the period 2003-2019 are presented in Figure 5 and Table 3. Analysis of Variance showed a significant ($p<0.001$) effect of site on TP concentration. The average TP concentrations in Astorville Bay (20.6 +/- 5.6 µg/L) and the West Basin (Perron Island Bay 14.9 +/- 4.13 µg/L) were significantly ($p<0.001$) greater than those in the rest of the lake. There were no significant differences between the mean values at Sites 2,3,5,6 and so the combined mean value of 13.3+/- 2.57 µg/L described the Main Basin of the lake.

Figure 5. Average total phosphorus in Lake Nosbonsing : 2003 – 2019.

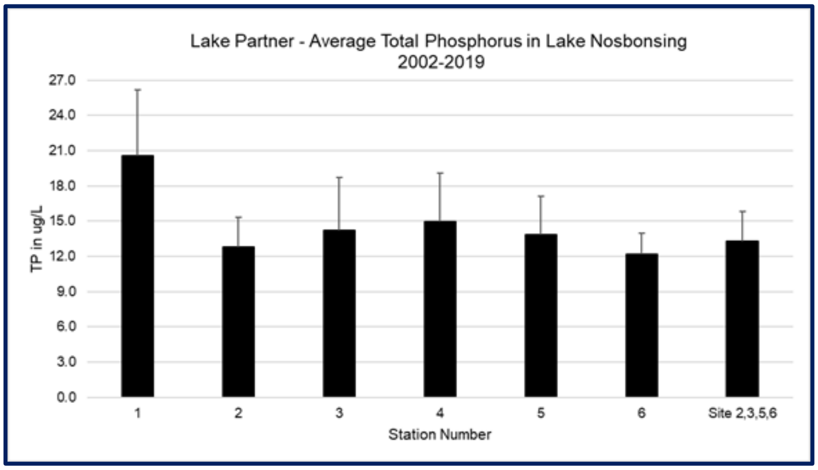
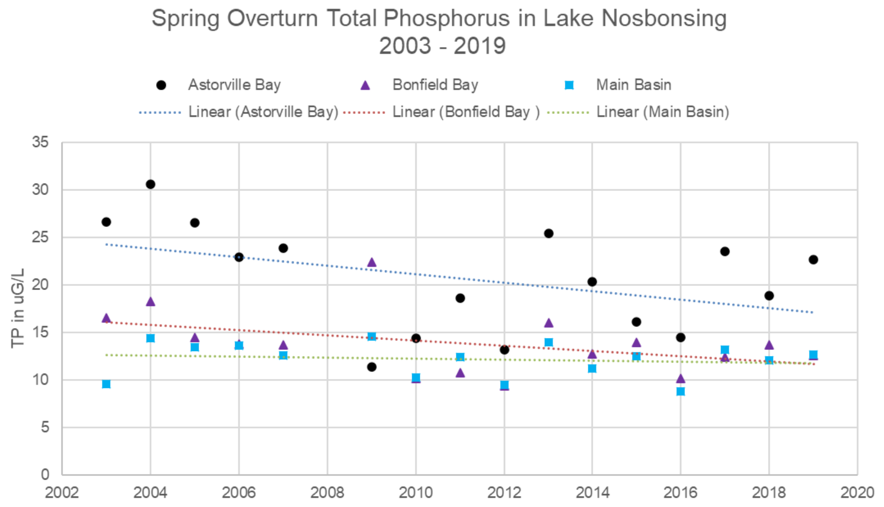


Table 3. Total Phosphorus Measurements at Six Lake Partner Sites on Lake Nosbonsing : 2003—2019.

	HESL 1	HESL 2	HESL 3	HESL 4	HESL 5	HESL 6	HESL 2,3,5,6	
	Astorville Bay	Main Basin Northeast	Maple Bay	Perron Island Bay	Bonfield Arm	Main Basin Central	Mean	STDEV
2003	26.7	15.3	28.0	10.7	16.6	9.6	17.3	7.69
2004	30.6	13.8	16.8	14.5	18.2	14.4	15.8	2.09
2005	26.6	15.3	14.7	20.1	14.5	13.4	14.5	0.77
2006	22.9	12.7	13.7	25.4	13.8	13.6	13.4	0.52
2007	23.8	11.2	12.6	16.7	13.7	12.6	12.5	1.04
2009	11.4	18.8	19.8	11.9	22.4	14.6	18.9	3.25
2010	14.4	10.3	13.5	11.8	10.2	10.3	11.1	1.62
2011	18.6	12.8	12.8	14.6	10.8	12.4	12.2	0.95
2012	13.2	9.1	8.6	8.5	9.4	9.5	9.2	0.40
2013	25.4		14.0	13.6	16.0	14.0	14.7	1.15
2014	20.3	12.0	12.5	15.5	12.8	11.2	12.1	0.70
2015	16.1		12.2		14.0	12.5	12.9	0.96
2016	14.5	9.4	9.0	11.9	10.2	8.8	9.4	0.62
2017	23.5	13.4	13.8	16.9	12.4	13.2	13.2	0.59
2018	18.9	12.7	11.7	14.9	13.8	12.1	12.5	0.91
2019	22.7	12.6	13.5	17.3	12.6	12.7	12.8	0.44
Mean	20.6	12.8	14.2	14.9	13.8	12.2	13.3	
STDEV	5.57	2.55	4.51	4.13	3.32	1.80	2.57	

Total phosphorus concentrations therefore indicate that the main basin of the lake is mesotrophic while the Astorville Basin is enriched and slightly eutrophic. Total phosphorus concentrations in the Astorville and West Basins decreased from 22-25 µg/L in 1975-1980 to ~18 µg/L in 1990, and from ~ 18 µg/L to ~ 12 µg/L in the Main (East) Basin (NBMCA 1992). Some of this decline may only be apparent, an artifact of improved analytical methods (Clark et al 2010) which were introduced to the Lake Partner Program in 2002. Nevertheless, the decreasing trends continued between 2003 and 2019 (Fig. 6) after current analysis techniques were introduced although they were not statistically significant ($p>0.05$).

Figure 6. Total Phosphorus Trends in Lake Nosbonsing : 2003 – 2019.



4.3 Water Clarity - Secchi Depth

Average annual Secchi depths ranged from 1.9m in Astorville Bay to 2.1m in the West Basin (Perron Island Bay) to 2.5m in the eastern sections of the lake (Table 4) but there was no significant difference ($p>0.05$) between sites.

Table 4. Secchi Depth in Lake Nosbonsing.

	HESL 1	HESL 2	HESL 3	HESL 4	HESL 5	HESL 6
	Astorville Bay	Main Basin Northeast	Maple Bay	Perron Island Bay	Bonfield Arm	Main Basin Central
2003		2.8	2.3	2.0		
2012	1.7	2.7	2.4	2.3	2.3	2.3
2017	1.5	2.4	2.4	2.2	2.4	2.3
2018	2.5	1.8	2.0	1.7	2.3	2.1
2019	1.8	2.8	2.3	2.1	2.9	2.4
Mean	1.9	2.5	2.3	2.1	2.5	2.3
STDEV	0.44	0.45	0.15	0.24	0.30	0.13

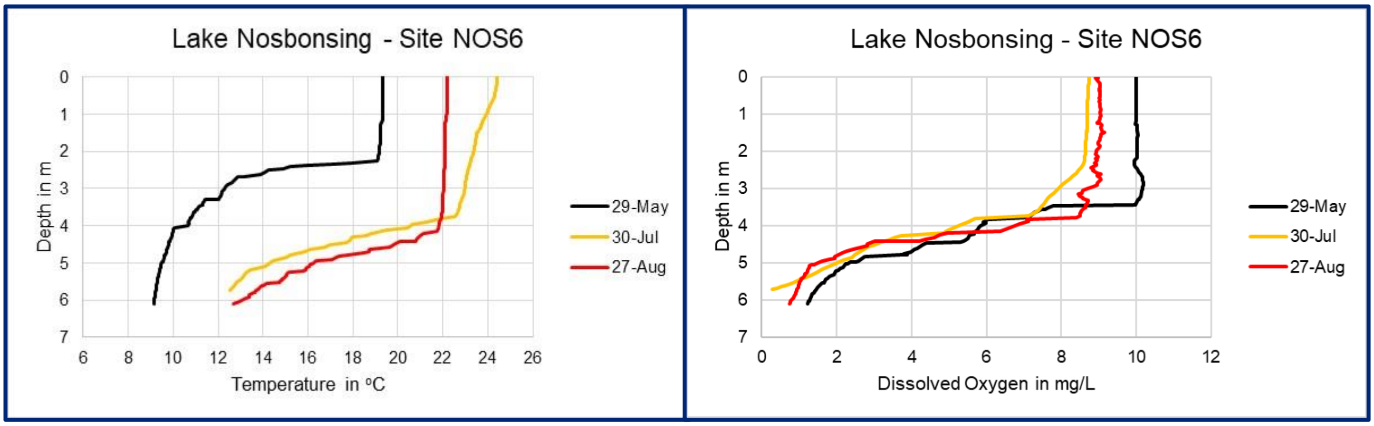
4.4 Temperature and Dissolved Oxygen

Profiles of temperature and dissolved oxygen were recorded at all sites in Lake Nosbonsing in late May, early July, late July and late August in 2018, except where prevented by equipment failure.

4.4.1 Astorville Bay – NOS6 Site

Equipment failure prevented recording the July 3 profile at this site. Thermal stratification was strong by late May. Water temperature was 19ºC in the upper 2m and then dropped to 12ºC and 10ºC through the thermocline at 3m and 4m depths respectively. The thermocline was stable at the 4m depth for the rest of the summer although the bottom waters warmed to 12ºC. Dissolved oxygen was also strongly stratified, exceeding 8 mg/L in the upper 4m throughout the summer but decreasing to <2 mg/L by the end of the summer (Figure 7). The shallower depths of Astorville Bay allowed some exchange of oxygen to the hypolimnion, either by diffusion from, or mixing with, the surface waters – as dissolved oxygen levels increased at depth between the end of July and the end of August.

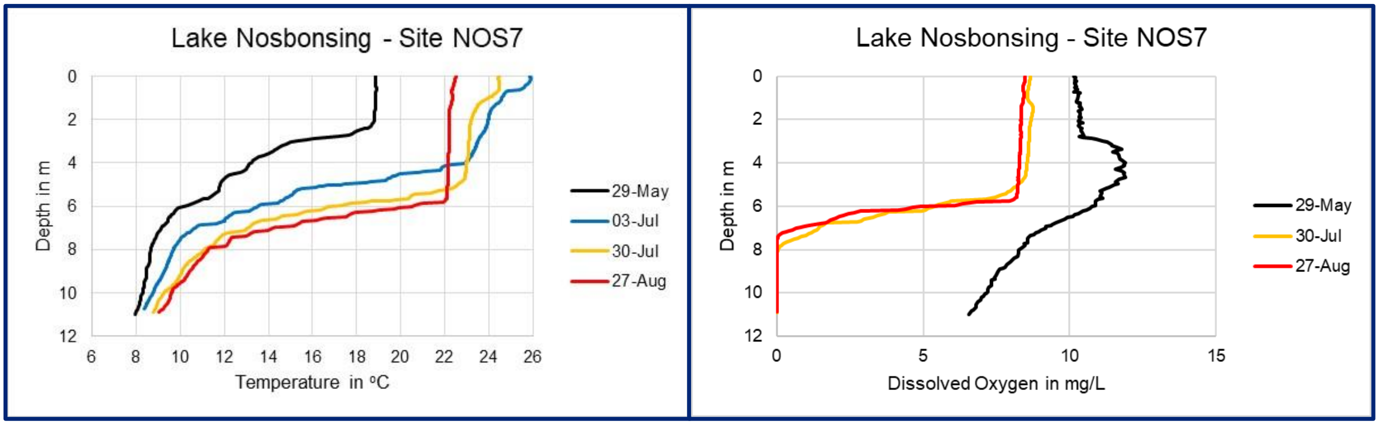
Figure 7. Temperature and Dissolved Oxygen Profiles - Astorville Bay : 2018.



4.4.2 West Basin

Thermal stratification was strong by late May. Water temperature was 19ºC in the upper 2m and then dropped to 14ºC through the thermocline to the 4m depth (Figure 8). The epilimnion warmed to 22 ºC to the thermocline depth of 6m by the end of the summer, dropped to 12 ºC at the 8m depth and declined steadily to 9 ºC at the bottom depth of 11m. Dissolved oxygen was stable in the upper 3m in May. Dissolved oxygen is more soluble in cool water and increased from ~ 10 mg/L to ~12 mg/L as the water cooled through the thermocline in May before declining to 6 mg/L at the bottom. Dissolved oxygen exceeded 8 mg/L in the 6m of the epilimnion for the rest of the summer but dropped sharply between 6m and 8m, and the water was anoxic between 8m and the bottom at 11m. Equipment failure prevented recording the July 3 dissolved oxygen profile at this site.

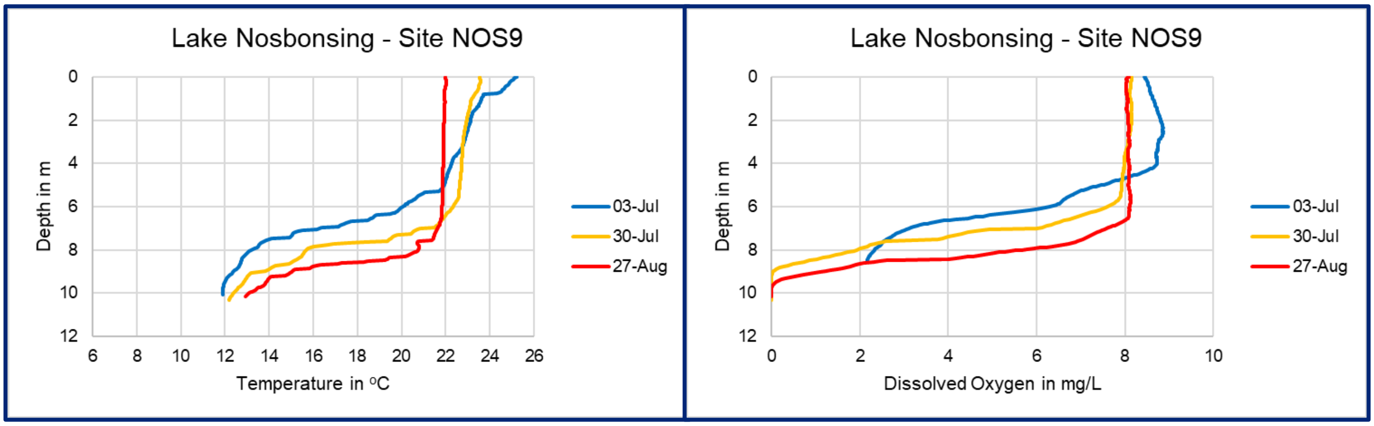
Figure 8. Temperature and Dissolved Oxygen Profiles – West Basin : 2018.



4.4.3 Main Basin – West End

Equipment failure prevented recording the May 29 profiles at this site. Thermal stratification was evident by July 3 (Figure 9) and the epilimnion warmed to 22 ºC and increased to the 8m depth by the end of August. The deeper thermocline at this site reflects greater exposure and more wind mixing in the open lake compared to the West or Astorville Basins. Hypoxic conditions were present below the thermocline by July 3 and the hypolimnion was anoxic by the end of July.

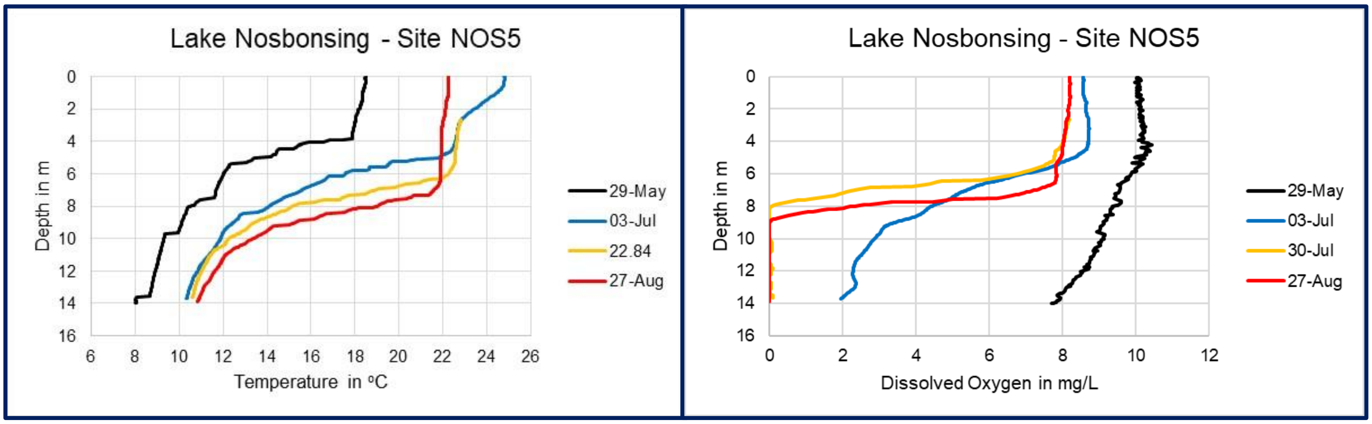
Figure 9. Temperature and Dissolved Oxygen Profiles – Main Basin – West End : 2018.



4.4.4 Main Basin – Maple Bay

Maple Bay is the deepest part of the lake with a depth of 14m (Figure 10). Stratification was present at the 4m depth in late May and the thermocline deepened to 7m by the end of the summer, when the epilimnion was 22 ºC and temperature dropped to 10 ºC at the bottom. Some oxygen loss occurred with depth in May, the hypolimnion was hypoxic by early July and the lake was anoxic from the 8m depth to the bottom by the end of July.

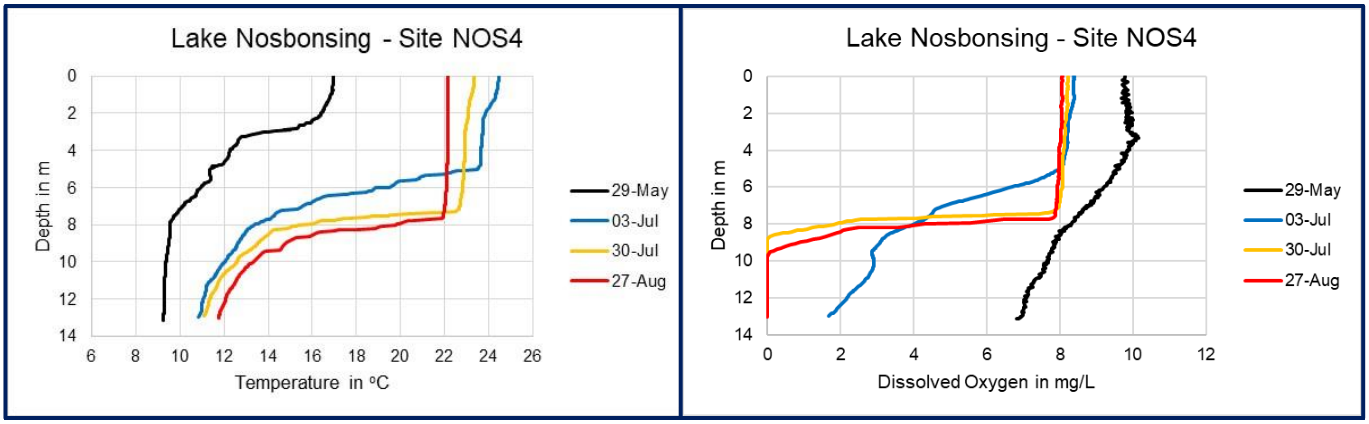
Figure 10. Temperature and Dissolved Oxygen Profiles – Main Basin – Maple Bay.



4.4.5 Main Basin – East End

Stratification was present at the 3m depth in late May and the thermocline deepened to 8m by the end of the summer, when the epilimnion was 22 ºC and temperature dropped to 11 ºC at the bottom. Some oxygen loss occurred with depth in May, the hypolimnion was hypoxic by early July and the lake was anoxic from the 9m depth to the bottom by the end of July (Figure 11).

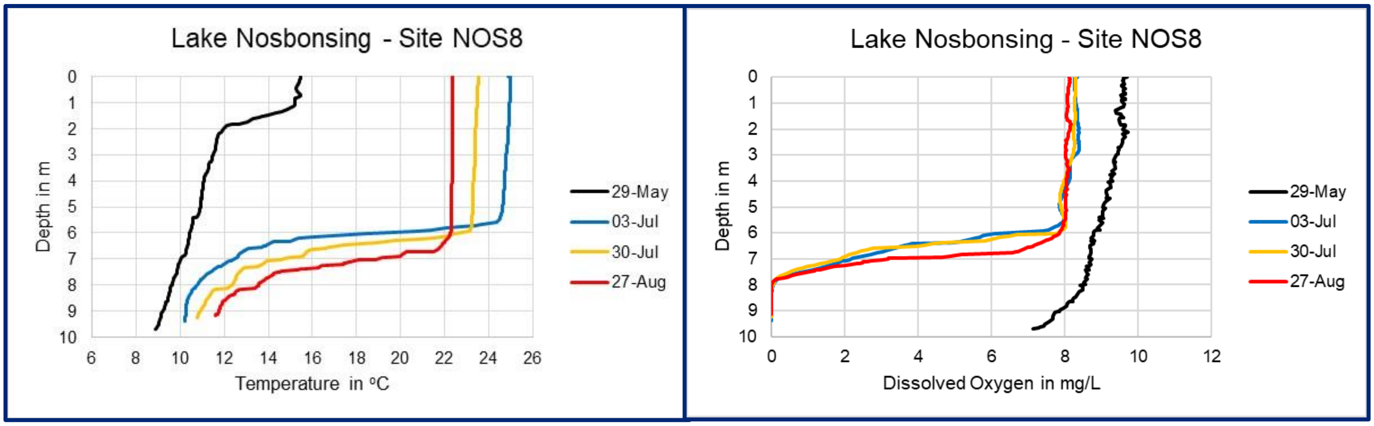
Figure 11. Temperature and Dissolved Oxygen Profiles – Main Basin – East End.



4.4.6 Bonfield Basin

Stratification was present at the 2m depth in late May and the thermocline deepened to 7m by the end of the summer, when the epilimnion was 22 ºC and temperature dropped to 12 ºC at the bottom. Bottom temperature increased by ~2ºC over the course of the summer, indicating some exchange with upper waters. Some oxygen loss occurred with depth in May and the bottom 1m of the lake was anoxic by early July (Figure 12).

Figure 12. Temperature and Dissolved Oxygen Profiles – Bonfield Basin.



4.4.7 Summary

There is a strong oxygen demand in Lake Nosbonsing which is a result of the lake productivity and resultant decomposition of algae in the hypolimnion. The moderate depth and small hypolimnetic volume mean that the algal decomposition consumes the available dissolved oxygen and the hypolimnion is anoxic by early summer. Although the lake turns over in the autumn and oxygen is restored, the lake characteristics suggest that also occurs at depth in the winter, when ice cover impedes wind mixing and there is weak temperature stratification.

Hypolimnetic anoxia allows for internal loading of phosphorus when the lake sediments lose oxygen and release phosphorus that is normally sequestered. The shallower depths and evidence of exchange between hypolimnetic and shallower waters over the summer suggests that some of this internal load is available to algae. In addition, some species of cyanobacteria (blue-green algae) are able to migrate vertically, to sink to the bottom and take up internally loaded phosphorus (see Section 4.5), and then rise back up to the euphotic zone where available sunlight allows photosynthesis.

Recommendation – While it is likely that internal loading of phosphorus is occurring in Lake Nosbonsing **t**here is no direct evidence of internally loaded phosphorus. Water samples should be collected from 1m above bottom at the end of the summer and analysed for total phosphorus to determine if internal loading occurs. If it is documented then further research would be required to determine its extent and severity and any need to mitigate it. Internal loading can be controlled by adding oxygen or air to the hypolimnion or by treating sediments with alum or lanthanum-enriched clay (“Phoslock”©) to prevent the release of phosphorus. Such treatments are costly , however, and have not been adopted for routine use in Ontario.

4.5 Algae

Fluorometer profiles made by the NBMCA were used to determine seasonal changes in relative algal abundance with depth at six sites in Lake Nosbonsing. The North Bay Health Unit provided information on algal blooms reported over the past 3 years.

4.5.1 Algal Blooms

Algal bloom monitoring and reporting is not done on a systematic basis by formal surveys. Blooms that are observed by residents are reported to the North Bay Health Unit or to the MECP, who then sample the bloom. Analysis is done by the MECP and the results are sent to the Health Unit. The provincial algal bloom reporting process is evolving in response to the recent increases in reported algal blooms (Winter et al. 2011[9]) and so not all reports are equally detailed. In some cases, the analysis only determines the potential for or presence of harmful cyanobacterial toxins while in other cases a more detailed determination of algal species is made. The following information was provided in response to a request made to the North Bay Health Unit[10].

Blooms were reported by lake residents in 2012, 2013, 2015, 2017, 2018, 2019 and 2020. None of these reports provided the location of the bloom in the lake but blooms are considered mobile as they can be spread by wind and currents and will continue blooming, as long as favourable conditions are present. Most blooms were reported in the late summer and early fall:

- the August 13, 2018 bloom tested positive for cyanotoxins and the MECP report identified that the bloom was made up of the blue-green alga *Anabaena* with trace amounts of the blue-green *Aphanizomenon,*
- a September 17, 2019 bloom of the species *Woronichinia* and *Anabaena* tested positive for cyanotoxins. Trace amounts of *Aphanizomenon* were observed,
- a bloom on July 24, 2020 tested negative for cyanotoxins. The MECP report concluded that. although some blue-green algae were present (*Aphanothece, Aphanocapsa* and *Anabaena*), the levels were “*considered too low to contribute to a bloom”.* Non-blue-green species included diatoms (*Synedra, Navicula*), golden brown algae (*Dinobryon*) and green algae (*Staurastrum*),
- a bloom on September 23, 2020 near Bonfield tested positive for the cyanotoxins Anatoxin “A” and microcystin in a bloom of Anabaena. Other blue-green algae were present (*Woronichinia, Aphanizomenon flos-aquae) as well as the* cryptophyte *Rhodomonas* and the diatoms *Navicula and Synedra* but the levels were “*considered too low to contribute to a bloom”.*
- an under - ice bloom (no date given) was reported by an angler and tested positive for cyanotoxins

The threat of harmful algal blooms is therefore present and the blooms recur regularly. Although high levels of phosphorus may predispose a lake to algal blooms the triggers for specific blooms are not known. The Ontario MECP considers that blooms are more likely to occur if TP exceeds 20 µg/L. Astorville Bay is

---

[9] *Winter, J.W., A.M. DeSellas, R. Fletcher, L. Heintsch, A. Morley, L. Nakamoto and K. Utsumi. 2011. Algal blooms in Ontario, Canada: Increases in reports since 1994. Lake and Reservoir Management. 27:2 107-114.*

[10] *Brendan Hatton, pers. comm. November 25, 2020*

therefore more likely to experience blooms but none of the records for Lake Nosbonsing identify the bloom locations, except for the September 2020 bloom near Bonfield. Recent research (Winter et al. 2011), however, shows that blooms may occur in low nutrient lakes that are remote from human influence. Internal phosphorus loading in anoxic lakes (see Section 5.2) favours species of blue-green algae such as *Anabaena* that can regulate their buoyancy, sinking to the deeper lake depths to take up phosphorus released by internal loading before migrating back to the sunlit upper waters to form a bloom (Pick 2015[11]). This mechanism is favoured by a warming climate, in which a shorter period of ice cover and warmer water leads to a longer period of stratification and increased internal loading (Pick 2015). Declines in wind speed have been observed over Muskoka lakes in recent years – this will also increase water column stability, favouring blue-green algae (Yao et al. 2013[12]).

Recommendation - The potential for internal phosphorus loading in Lake Nosbonsing and its role in the phosphorus budget (Section 5.1) and algal growth should be investigated by completing lake surveys to:

c) document the phosphorus, nitrogen and total metal concentrations in the water column and at 1 meter above bottom from August to the end of September,

d) measure the oxygen profiles in the lake between early August and mid October to determine the intensity and extent of anoxia in all lake basins.

4.5.2 Profiles of Relative Algal Abundance

Profiles of the algal pigments chlorophyll “a” (all algae) and phycocyanin (blue-green algae) showed different patterns of species dominance and succession over the course of the summer of 2018 at the different sites in the lake. The units measured are relative fluorescence and so indicate relative abundance of algal pigments at each site, but are not quantified as units of concentration such as µg/L of pigment. The fluoresence scales (X axes) have been standardized to the same range for each site to allow comparison, with the exception of the Astorville and West Basin sites where the range was increased to account for higher values.

Astorville Basin

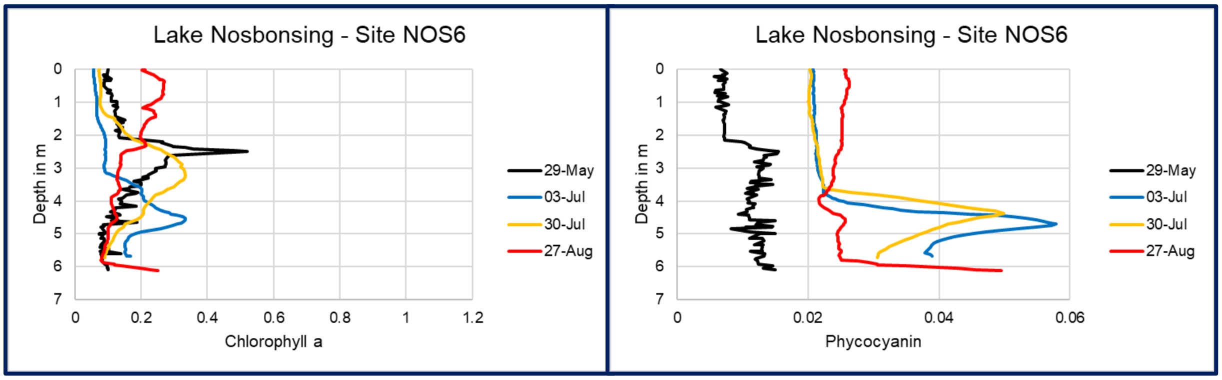
Chlorophyll “a” abundance peaked in late May at the 2.5m depth in the Astorville Basin, coincident with the typical spring bloom of diatom algae in PreCambrian Shield lakes (Figure 13). Chlorophyll was more evenly distributed throughout the water column as the summer progressed while phycocyanin was at low levels in May, then increased sharply at depth as the summer progressed, suggesting that they were taking advantage of higher TP levels near the bottom.

---

[11] *Pick, F.R. 2015. Blooming algae: a Canadian perspective on the rise of toxic cyanobacteria. Can. J. Fish. Aquat. Sci. 73: 1149-1158.*

[12] *Yao, H., Rusak, J.A., Paterson, A.M., Somers, K.M. ,Mackay,M., Ingram, R., McConnell, C., and Girard, R. 2013. The interplay of local and regional factors in generating temporal changes in the ice phenology of Dickie Lake, south-central Ontario, Canada. Inland Waters 3: 1-14.*

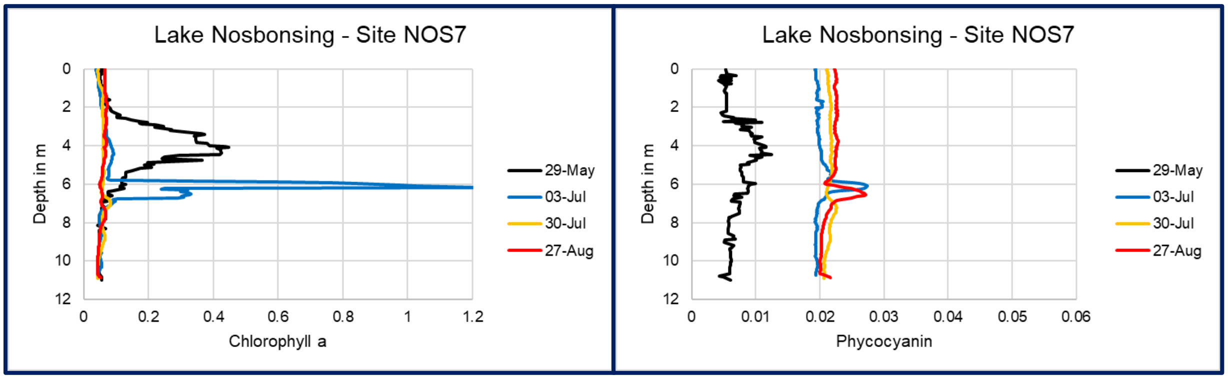
Figure 13. Algal Pigments in Astorville Basin - 2018.



West Basin

Chlorophyll “a” abundance also peaked in late May in the West Basin, but at a depth of 4m (Figure 14) and showed a very large peak at 6m on July 3. The West Basin showed strong thermal stratification on July 3 with the thermocline at the 4-6m depth, (Figure 8) and so the algal community was accumulating on the higher density, cooler water at the thermocline. Abundance declined and was evenly distributed with depth over the rest of the summer. Phycocyanin increased over the course of the summer and preferentially accumulated on the top of the thermocline at the 6m depth suggesting that they were regulating their buoyancy.

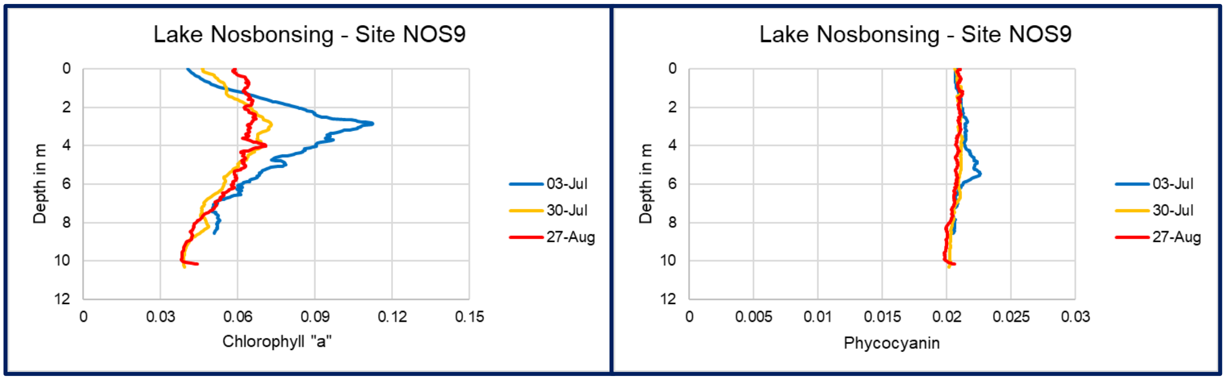
Figure 14. Algal pigments in West Basin.



Main Basin – West

No profile data were collected during May as the equipment malfunctioned. Maximum chlorophyll “a” abundance occurred in July and was concentrated at the 3m depth (Figure 15) although the thermocline was located well below that depth at 6-8m (Figure 9). Chlorophyll “a” remained generally high between the 2m and 6m depths over the summer. Phycocyanin distribution showed no major differences with depth, other than a slight increase at 6m on July 3.

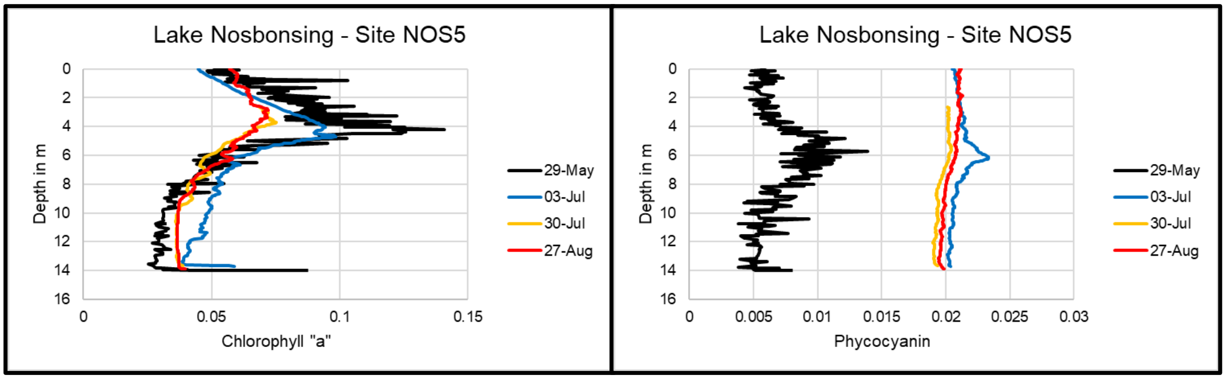
Figure 15. Algal pigments in Main Basin – West.



Maple Bay

Chlorophyll "a" abundance was highest between the 3m and 5m depths from May until the end of August (Figure 16) with a thermocline present at 4m in May, 5m on July 3 and at 6m for the rest of the summer (Figure 10). The spring bloom was most pronounced, with maximum chlorophyll abundance at the end of May. Phycocyanin abundance increased after May and distribution showed no major differences with depth, other than a slight increase at 6m on July 3.

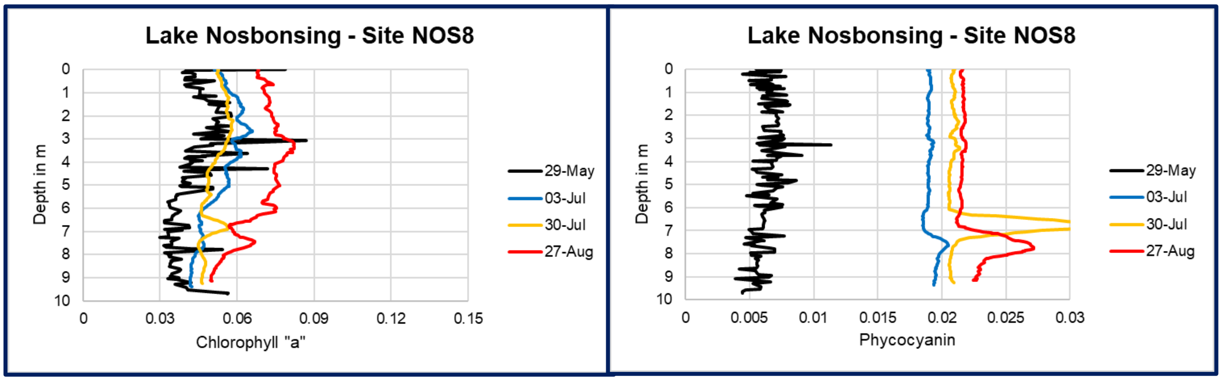
Figure 16. Algal pigments in Maple Bay.



Bonfield Basin

Chlorophyll "a" abundance increased between May 29 and July 3, declined by the end of July and reached its maximum value at the end of August (Figure 17). There was little tendency for chlorophyll accumulation at the top of the hypolimnion – the late August profile showed little change between the surface and 6m depth and a gradual decline between 6m and the bottom at 9m. Phycocyanin profiles showed increasing blue-green algal abundance as the summer progressed and accumulation on the upper thermocline at 7-8m.

Figure 17. Algal Pigments in Bonfield Basin.



Algal Summary

Overall, Lake Nosbonsing showed a pattern of a significant spring algal bloom, as shown by high chlorophyll “a” concentrations in late May and early July. As the summer progressed and thermal stratification advanced, the pattern shifted to one of chlorophyll, and especially phycocyanin (blue-green algae), accumulation at the top of the thermocline at the 6-8m depth. This pattern was most pronounced in the Astorville Basin, the West Basin and the Bonfield Basin. Blooms of blue-green algae species were confirmed in the late summer of 2018, 2019 and 2020. This, plus the pattern of late summer anoxia, suggests that blue-green algae were preferentially accumulating where internal loading had increased phosphorus concentrations in the deeper waters.

Recommendation – The recurrence of blue-green blooms in Lake Nosbonsing suggests that the algal community should be monitored over the course of one summer to confirm the algal community makeup. Samples should be taken as a euphotic zone composite (2X the Secchi Depth) and at the point of maximum phycocyanin fluorescence and community species composition determined by an algal taxonomist. These results, along with the measurement of internal loading (Section 4.5.1) will help determine the cause of the observed blooms.

5. Lakeshore Capacity Modelling

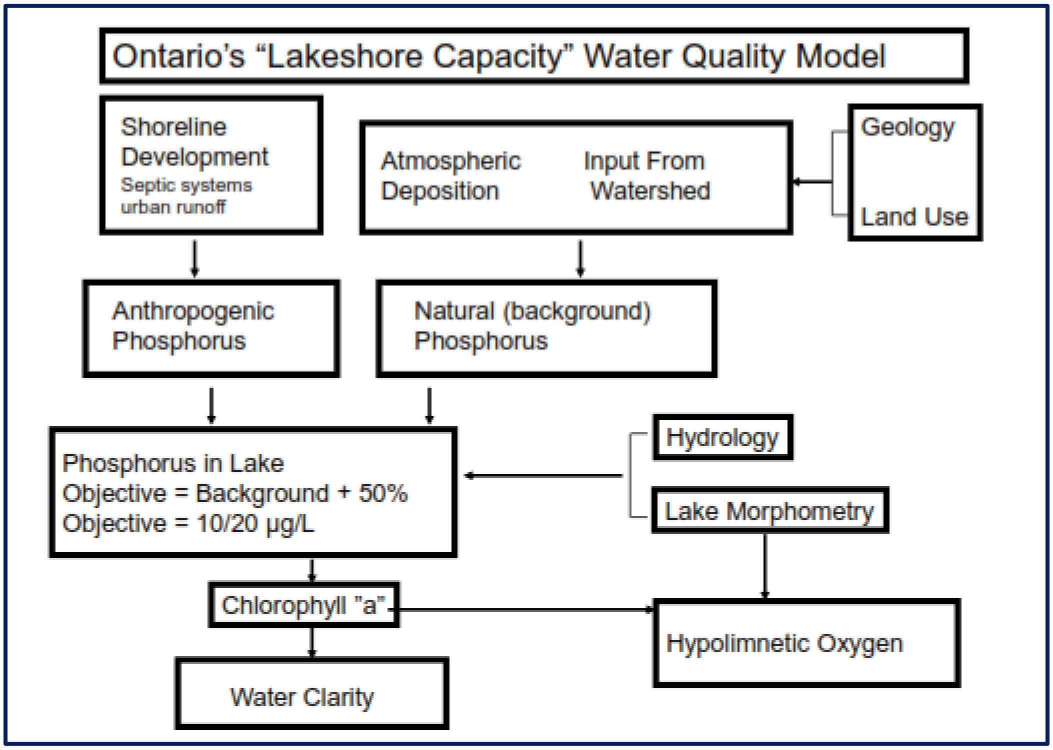
Many factors can be considered when trying to establish a ”capacity’ - an acceptable limit to the amount of human development that a lake can sustain. Much depends on the uses that humans make of a lake. Uses such as recreational boating, wildlife habitat, wilderness aesthetic, peace and quiet or fishing capacity can all, in theory have capacities associated with them. The challenge lies in determining what uses are most desired in a lake (as some uses may conflict with other, equally valid uses), how capacity could be measured, what the capacity “limit’ would be, how much each user contributes to the capacity and finally, how to enforce any capacity limit.

In 2010, the Ontario Ministry of the Environment, (now Environment, Conservation and Parks) implemented “LakeCap”, the culmination of over 30 years of investigating capacity, beginning with the Ontario Lakeshore

Capacity Study in 1986. Although the Lakeshore Capacity Study investigated Wildlife, Land Use, Microbiology, Fisheries and Trophic Status (water quality), the latter was the only component which was formally implemented (as “LakeCap”).

“Lakecap” is based on a mass balance model that integrates natural and human sources of phosphorus to a lake with physical lake characteristics and hydrology in a mass balance model that predicts the steady state concentration of total phosphorus (TP). The model then compares the TP concentration to a water quality objective for TP and estimates capacity as how much human phosphorus loading the lake can sustain and remain within the water quality objective (Figure 17).

Figure 18. Ontario "Lakecap" Model.



The Ontario MECP supports two forms of a water quality objective for TP:

- MOE (1994) sets an objective of 10 µg/L of TP for all lakes naturally below that value and 20 µg/L for lakes naturally above 10 µg/L, with the 20 µg/L serving as a threshold beyond which nuisance algal growths may occur. This objective applies to lakes located off the Precambrian Shield and to lakes on the Shield for which the “Lakecap” model does not predict TP concentrations within 20% of the measured value.
- Lakecap sets an objective of “Background + 50%” for lakes on the Precambrian Shield. The model calculates the TP concentration in a lake with only natural phosphorus loads and then calculates how much phosphorus can be added such that the concentration increases by a maximum of 50% above the background value. “Lakecap” also maintains the maximum increase to 20 µg/L as a threshold beyond which nuisance algal growths may occur.

The Lakecap approach of the provincial government was used to estimate the development capacity of Lake Nosbonsing based on water quality (nutrient (TP) or “trophic status”). Earlier studies (NBMCA 1992) used earlier variants of the same approach to estimate capacity but with different input values.

5.1 Model Inputs

The Lake Nosbonsing model used the assumptions and recommended coefficients and constants provided by the Province (MOE, 2010), development counts provided by the Municipality of East Ferris and watershed characteristics and flows estimated using OFAT, the Ontario “Watershed Flow Assessment Tool[13]” (Table 5). Model results were compared to current measured values of TP in Lake Nosbonsing (Section 4.1) to determine model accuracy.

Table 5. Information on the data used in the Lakeshore Capacity Assessment.

Type of Data	Inputs	Source
Physical	Lake area and depth	OFAT and NBMCA (1993)
	Catchment and wetland area Land Use	OFAT
Development	Lots and occupancies	Municipality of East Ferris
Water chemistry	Total phosphorus	MECP Lake Partner Data (Section 4.1)
Hydrological	Annual depth of runoff	OFAT

Although Lake Nosbonsing is a headwater lake with no upstream lakes it was broken into three basins (Figure 1, Section 2) for modelling, based on the lake characteristics and differences in TP concentrations (Section 4). The Astorville Basin flowed onto the West Basin which flowed into the Main Basin.

Phosphorus Loads

TP loading from overland runoff area was determined using the following equations based on % wetland or % cleared land Paterson et al. (2009, in MOEE (2010)). Each approach was used to determine the best fit of the model to measured data.

- TP (kg/yr) = catchment area (km^2) * 9.8 $mg/m^2/yr$
  - Where cleared land >15%

- TP (kg/yr) = catchment area (km^2) * (0.47 * % wetland area^2 + 3.82) * (1.8)
  - Where wetland >3.5%

A TP loading rate of 0.167 kg/ha/yr was used to calculate TP loads to the surface of the lake from atmospheric deposition.

---

[13] *https://www.gisapplication.lrc.gov.on.ca/OFAT/Index.html?site=OFAT&viewer=OFAT&locale=en-US*

The outflow discharge values for each basin were calculated from the mean annual daily flow as determined by OFAT and flow was accumulated from one basin to the next.

The Municipality of East Ferris provided development counts for each basin as permanent and seasonal residences, vacant lots and resort units located within 300m of the lakeshore. All lots were assumed to be serviced by standard septic systems and all phosphorus was assumed to migrate from the septic system to the lake. TP loads from septic systems were calculated assuming a loading rate of 0.66 kg/capita/yr for each septic system. Septic usage rates of 2.56 capita yrs/yr for permanent residences, 1.27 capita yrs/yr (extended seasonal) for seasonal residences and 1.18 for resort units were applied. All lots included an overland runoff load of 0.04 kg of TP/lot/yr.

A settling velocity of 7.6 m/yr was initially used to indicate that anoxic conditions are present in the bottom waters of the West Basin and Main Basin of Lake Nosbonsing. Astorville Bay is shallower and does not exhibit anoxia (Section 5.2.1) and so was initially modelled with the “oxic” settling velocity of 12.4 m/yr. It is likely that some anoxia would occur during calm periods but the basin is shallow enough that oxygen is reintroduced to the bottom waters during sustained wind events.

Model input terms and loadings calculated from them are provided in Table 6. All inputs used the recommended values from MOE (2010) for the initial model formulation but some inputs were later revised to improve model fit (Section 5.2.1).

Table 6. Lakecap Model Input Terms (MOEE 2010).

	Basin		
	Astorville	West	Main
Surface Area (ha)	63	379.5	1958
Anoxic ? (Y/N)	N	Y	Y
Watershed Area - Local	837	823	12504
Watershed Area - Cumulative	837	1660	14164
Average Annual Inflow (m^3/sec)	0.13	0.26	2.22
Depth of Runoff (m)	0.456	0.402	0.430
Areal Water Load (m/yr)	6.51	3.24	4.17
Wetland Area (%)	13.1	7.6	9.83
Cleared Land (%)	19.2	19	9.4
Residences			
Permanent	47	145	103
Extended Seasonal	11	70	95
Vacant Lots	10	20	36
Resort Units	0	26	33
Campgrounds	0	0	1
Phosphorus Load (kg/yr)			
Atmospheric	10.52	63.38	326.99
Watershed	150.31	220.87	1195.30
Shoreline	90.95	333.55	288.88
Vacant Lots	8.78	17.56	31.62
Total	251.79	617.80	1811.17
Upstream Load (kg/yr)			
Natural	0.00	55.35	105
Shoreline	0.00	31.30	113.25
Vacant Lots	0.00	3.02	6.39
Areal Phosphorus Load (mg/m^2/yr)	399.66	185.63	103.67
Areal Phosphorus Load + Vacant Lots	413.60	191.05	105.61

5.2 Model Results

5.2.1 Standard Inputs

The Lakecap model was first run using the recommended input parameters from MOEE (2010) (Table 6). The model overpredicted TP concentrations in Astorville and West Bays but under-predicted concentrations in the Main Basin of the lake (Table 7). Model error for the West and Main Basins exceeded the MOEE (2010) criterion for acceptable model fit of +/-20%.

Table 7. Lakecap Model Results Using MOEE (2010) Input Terms.

	Basin		
Total Phosphorus as Spring Overturn	Astorville	West	Main
Modelled (µg/L)	22.5	17.8	8.1
Measured (µg/L)	20.6	13.6	13.6
% Error	9.1	30.7	-40.3
Future (µg/L)	23.1	18.2	8.2
Background (µg/L)	14.8	9.7	6.3
Background + 50% (µg/L)	22.2	14.5	9.5

5.2.2 Model Revisions

The following changes were made, based on watershed characteristics, to improve model fit:

- Although Astorville Bay was not measured as anoxic (Section 4), the high oxygen demand and hypoxic conditions observed in late August 2018 mean that it likely does become anoxic in some years or in still periods. It was therefore modelled with a “hybrid” settling velocity of 10.6 m/yr, halfway between the MOEE (2010) values of 7.2 for anoxic and 12.8 for oxic hypolimnia.

- The soils in the watershed of Lake Nosbonsing are thicker than is typical in the Precambrian Shield and support agricultural activities which increase nutrient content in the overland runoff. As a result, 19.2%, 7.6% and 9.4% of the catchments of Astorville, West and the Main Basins have been cleared for agricultural or settlement uses. Those portions of the watershed were therefore assigned a phosphorus export coefficient of 40 mg/m^2/yr - a “hybrid” value for agricultural (30 mg/m^2/yr) and urban (50 mg/m^2/yr land uses (Paterson et al, 2006[14]).

These modifications improved the model accuracy for the Astorville Basin, but results were still variable, under or over predicting for different basins, and exceeded the MOEE (2010) criterion of acceptable model fit (+/-20%) in the West and Main Basins (Table 8).

---

[14] *Paterson, A.M., P.J. Dillon, N.J. Hutchinson, M.N. Futter, B.J. Clark, R.B. Mills, R.A. Reid and W.A. Scheider. 2006. A review of the components, coefficients and technical assumptions of Ontario’s Lakeshore Capacity Model. Lake and Reservoir Management 22(1): 7 – 18*

Table 8. Lakecap Model Results Using Modified Input Terms.

Total Phosphorus as Spring Overturn	Basin Astorville	 West	 Main
Modelled (µg/L)	20.4	17.1	9.6
Measured (µg/L)	20.6	13.6	13.6
% Error	-0.9	25.9	-29.2
Future (µg/L)	21.1	17.6	9.7
Background (µg/L)	11.5	8.8	7.8
Background + 50% (µg/L)	17.3	13.2	11.8
Percent Above Background	83%	100%	24%
Capacity?	No	No	Yes

It has been my experience that the model is most prone to overestimating TP in a lake through assuming that all phosphorus from all septic systems migrates to the lake. Both the Western Basin and the Main Basin support substantial development but:

- shoreline development has doubled the total load to West Basin and the West Basin TP is over-predicted which suggests that a substantial portion of the septic load is retained in the soil and not expressed in the lake. Application of the soil retention values presented in Robertson et. al. (2019) however results in under prediction
- shoreline development has increased the total load to the Main Basin by 31% but TP in the model is under predicted. It would take an additional 1450 kg of phosphorus (1917 cottages or 944 permanent homes) for the model to balance with the measured value.

If retention of septic phosphorus was the reason for the inaccurate model results then the model would over-predict TP concentrations in both basins. This was not the case.

5.2.3 Model Revision - Internal Phosphorus Loading

Both the West Basin and the Main Basin of Lake Nosbonsing have anoxic bottom waters which means that internal loading of phosphorus needs to be accounted for in the model input terms. Phosphorus added to the upper water layers ultimately settles to the bottom and becomes incorporated into the lake sediments. The "Lakecap" model accounts for this by using one of two estimates of phosphorus settling velocity:

- If a lake has oxygenated bottom waters then phosphorus settles out of the water column at a rate of 12.4 m/yr which was the average value for oligotrophic PreCambrian Shield lakes (Dillon et al 1986),
- If the bottom waters are anoxic then phosphorus settles out of the water column at a rate of 7.2 m/yr. This is a "net" settling rate which accounts for internal loading of phosphorus from anoxic sediments as a lower settling rate (or less efficient removal of TP from the water column) and not as an explicit loading term. The value was derived using data from the anoxic basin of one lake (Dillon et al. 1986).

Internal phosphorus load can also be estimated as a direct addition to the phosphorus budget of a lake instead of a modified settling velocity. One method requires estimates of the area (m^2) of lake sediments that are anoxic, the period of time (days) for which they are anoxic and the phosphorus release rate from the sediments (Nurnberg 1984, 1988[15]). Orihel et al. (2017, Fig. 6[16]) provided estimates of phosphorus release rates for anoxic sediments from a review of Canadian lakes as 2-7 and 7-12 mg/m^2/day for mesotrophic and eutrophic lakes respectively and 7.3 and 8.9 mg/m^2/day for sediments underlying hypoxic and anoxic waters respectively. Tammeorg et al (2020)[17] provided a value of 6.1 mg/m^2/day for mesotrophic lakes from a set of lakes world-wide. Lake Nosbonsing is mesotrophic with documented anoxia (Section 3, Section 4) and so a value of 7.5 mg/m^2/yr was used to provide explicit estimates of internal load. The period of anoxia was determined from the approximate date of onset of anoxia in the measured profiles for 2018 (Section 4.2) and was assumed to last from then until the end of September. The area of anoxic sediments was estimated using Google Earth© imagery using the depth of the onset of anoxia (6m in Astorville Bay and 9m for the West and Main Basins) based on the measured profiles (Section 4.2) and the map of lake bathymetry (Figure 1). Areas were estimated as 5.8, 24.4 and 257 ha for Astorville, West and Main Basins respectively. The revised input terms are presented in Table 9.

Explicit estimation of internal load improved the model predictions. Modelled estimates were 5.6% below, 2.4% above and 14.2% below measured values (Table 10), within the acceptable accuracy for the model (MOEE 2010).

5.3 Model Results – Capacity – Water Quality

The MOEE (2010) Provincial Water Quality Objective (PWQO) for TP in PreCambrian Shield lakes is "Background + 50%"; shoreline development shall not increase loading or concentration by more than 50% from the modelled background TP. Table 10 shows that the Astorville and West Basins exceed the PWQO, with present day concentrations 71% and 130% above background. The Main Basin, however has additional capacity, as concentrations are Background + 12%. Although the model is underpredicting TP in the Main Basin, the measured value of 13.6 µg/L represents Background + 30%, which also allows additional development. The Main Basin currently supports 95 seasonal residences but could sustain ~725 additional "extended seasonal" residences, or 330 additional permanent homes, within the Background + 50% objective, based on an increase from the measured value.

---

[15] *Nurnberg, G.K. 1984. The prediction of internal phosphorus load in lakes with anoxic hypolimnia. Limnol. Oceanogr. 29(10): 111-124.*
Nurnberg, G.K. 1988. Prediction of Phosphorus Release Rates from Total and Reductant-Soluble Phosphorus in Anoxic Lake Sediments. Can. J. Fish. Aquat. Sci. 45 (3): 453-462.

[16] *Orihel,D., H. Baulch, N. Casson, R. North, C. T. Parsons, D. C.M. Seckar, and J. J. Venkiteswaran, 2017. Internal phosphorus loading in Canadian fresh waters: a critical review and data analysis. Can. J. Fish. Aquat. Sci.* ***74****: 2005–2029 (2017).*

[17] *Tammeorg, O, G, Nürnberg, J Niemistö, M Haldna and J Horppil. 2020 Internal phosphorus loading due to sediment anoxia in shallow areas: implications for lake aeration treatments. Aquatic Sciences 82:54.*

Table 9. Lakecap Model Input Terms With Internal Load.

	Basin		
	Astorville	West	Main
Surface Area (ha)	63	379.5	1958
Anoxic Sediment Area (ha)	5.80	24.44	256.58
Watershed Area - Local	837	823	12504
Watershed Area - Cumulative	837	1660	14164
Average Annual Inflow (m^3/sec)	0.13	0.26	2.22
Depth of Runoff (m)	0.456	0.402	0.430
Areal Water Load (m/yr)	6.51	3.24	4.17
Wetland Area (%)	13.1	7.6	9.90
Cleared Land (%)	19.2	19	9.4
Residences			
Permanent	47	145	103
Extended Seasonal	11	11	95
Vacant Lots	10	20	36
Resort Units	0	26	33
Campgrounds	0	0	1
Phosphorus Load (kg/yr)			
Atmospheric	10.5	63.4	327
Watershed	101	200	1238
Shoreline	91.0	282	289
Vacant Lots	8.8	17.6	32
Internal Load	10.4	133	1408
Total	213	679	3262
Upstream Load (kg/yr)			
Natural	0.00	41.1	70.3
Shoreline	0.00	32.4	85.5
Vacant Lots	0.00	3.02	4.27
Areal Phosphorus Load (mg/m^2/yr)	339	198	175
Areal Phosphorus Load + Vacant Lots	353	204	176

Table 10. Lakecap Model Results With Internal Load.

	Basin		
Total Phosphorus as Spring Overturn	Astorville	West	Main
Modelled (µg/L)	19.4	13.9	11.7
Measured (µg/L)	20.6	13.6	13.6
% Error	-5.6	2.4	-14.2
Future (µg/L)	20.1	14.2	11.7
Background (µg/L)	11.4	6.0	10.5
Background + 50% (µg/L)	17.1	9.1	15.7
Percent Above Background - Current	71%	130%	12%
Percent Above Background - Future	76%	135%	12%
Capacity?	No	No	Yes

5.4 Other Capacity Determinants

Seguin Township in Ontario supports the "Lakecap" planning approach but also screens lakes using a capacity limit of 1 lot/1.6 ha of lake surface and 1 resort unit/0.8ha as a "social filter"[18]. This is intended to prevent over crowding of shoreline and lake surface area. The area of the three basins of Lake Nosbonsing was used to estimate the "social capacity".

The Official Plan for the Municipality of East Ferris requires a minimum frontage of 60m (~198') for waterfront lots. This puts a physical limit on the "lake capacity" and further restrictions are imposed by the need to avoid environmentally sensitive areas such as wetlands, areas of steep slope or where the water table does not allow septic system installation. The perimeter of the three basins was measured on Google Earth and used to estimate the "physical capacity", the available shoreline for lot development as the number of 60m lots. Sensitive areas such as wetland not excluded from the measurement and so this capacity is overestimated but is provided for sake of comparison.

5.5 Conclusions

Table 11 compares "capacity" estimates for the three basins of Lake Nosbonsing as derived using water quality (Background + 50%), surface area (1 lot/1.6ha) and perimeter (1 lot/60m) filters.

Table 11. Comparison of Capacity Filters.

Social Capacity Filters	Basin		
	Astorville	West	Main
Surface Area	63.0	379.5	1958.0
Capacity - 1 lot/1.6 ha	39	237	1224
Present Lots	68	189	251
Additional Capacity ?	N	Y	Y
Additional Lots	0	48	973
Perimeter			
Shoreline Length - km	3.8	10.7	34.6
Capacity - 1 lot/60m	64	179	576
Additional Capacity ?	N	N	Y
Additional Lots	0	0	326
Water Quality			
Additional Lots	0	0	775

The Astorville Basin is clearly overdeveloped by all three criteria:

- TP concentrations are at Background + 71%,
    - Conversion of residences from seasonal to permanent occupancy will increase the extent of overdevelopment.

---

[18] https://www.seguin.ca/en/explore-play/resources/SeguinOfficialPlanandSchedules.pdf
Section B.3.3 of the Official Plan calculates surface area by excluding the area within 30m of the shore. The calculations for Lake Nosbonsing were done as an example only and did not follow that approach. Precise measurement is recommended If the Township wishes to formalize that approach.

- The 68 lots exceed the social filter of 39 lots – there are 0.93 ha for each lot vs 1.6 ha of water surface per lot,
- The 68 lots exceed the shoreline perimeter capacity of 64 lots at 60m per lot.
- Conversion of residences from seasonal to permanent occupancy will increase the extent of overdevelopment.

The existing development freeze on Astorville Bay is therefore warranted and should be maintained.

The West Basin is near or over capacity by two of three criteria:

- TP concentrations are at Background + 130%,
    - Conversion of residences from seasonal to permanent occupancy will increase the extent of overdevelopment.
- The 189 lots are within the social filter of 237 lots allowing for 1.6 ha of water surface per lot and 0.8ha for each resort unit. An additional 48 lots would be allowed by this criterion
- The 176 lots are within the shoreline perimeter capacity of 576 lots at 60m per lot, allowing for an additional 3 lots. Many of the existing lots however, have <60m frontage and so available shoreline would exceed the 3 lots allowed by the physical filter.

Although TP in West Bay exceeded the Background + 50% criterion, the additional 3 lots allowed by the physical filter could be developed with no threat to water quality or to the social filter. Addition of the 48 lots allowed under the social filter is not warranted as a) the TP concentrations are well in excess of the TP criterion and b) there is only available shoreline for 3 lots.

The Main Basin has additional development capacity by all three criteria:

- TP concentrations are at Background + 12% and an additional 2246 seasonal lots could be accommodated within the water quality filter,
    - If all existing and vacant lots were occupied on a permanent basis TP concentrations would be increased to Background + 15% (12.06 µg/L) and an additional 2020 seasonal or 579 permanent lots could be accommodated within the water quality filter
- The 234 existing lots are well within the social filter of 1224 lots allowing for 1.6 ha of water surface per lot. An additional 973 lots would be allowed by this criterion
- The 234 lots are well within the shoreline perimeter capacity of 576 lots at 60m per lot, allowing for an additional 342 lots.

There is therefore available capacity in the Main Basin and the three filters tested do not support freezing additional lot creation. The shoreline perimeter is the most sensitive capacity determinant but the 342 lots calculated here would be reduced after considering those areas of the shoreline which were wetland or otherwise unsuitable for building.

6. Best Management Practices

Although Lake Nosbonsing is nutrient enriched and there is capacity for additional development without threatening water quality in the Main Basin, the nature of existing development (altered and urbanized shorelines) and the enriched nutrient status recommend that a) additional development be encouraged to incorporate Best Management Practices to minimize any impacts to water quality and b) that existing development be encouraged to implement Best Management Practices to improve shoreline naturalization, improve wildlife habitat and protect water quality.

Waterfront development can introduce phosphorus and other pollutants into surface water by migration from septic systems and contaminants contained in stormwater runoff from cleared areas. A variety of BMPs are, however, capable of minimizing TP loading from sewage systems and stormwater to adjacent waterbodies during both the short-term (i.e. construction) and long-term. Any desire to use BMPs must, however, be supported by promotion of voluntary stewardship initiatives or enforcement of planning instruments such as site plan controls.

Shoreline buffers are a well-studied mitigation measure associated with waterfront development. The availability of information results from the well-known and established effectiveness of shoreline buffers of dense native vegetation in mitigating the impacts of stormwater though filtering, infiltration and attenuation.

Zhang et al. (2010[19]) found that buffer width can explain 35 - 60% of variance in removal efficacy for sediment, pesticides, nitrogen and phosphorus but site characteristics such as soils, slope and vegetation are also important considerations. Buffer size recommendations, as they relate to water quality function, are variable because of different site conditions but also some inconsistency in study designs and different measures of “effective” attenuation of water quality. Most studies demonstrate that buffers from 9 - 30 m provide more effective attenuation than smaller buffers and 30 m buffers provide effective water quality protective functions (Dillaha 1989[20]). Naturalized buffers provide additional benefits as habitat for shorebirds and small mammals and provide a social filter as well.

All attempts should be made to minimize the actual area disturbed along a shoreline – low profile vegetation will provide a buffer and still maintain a lake view and waterfront access should be maintained through disturbing no more than 25% of the existing frontage (15m of a 60m lot frontage).

We recommend that any future development on Lake Nosbonsing include a 30m deep naturalized buffer along the shoreline with limited allowance of vegetation removal for access and views. Residents should be encouraged to take on shoreline naturalization programs as voluntary initiatives, working with either the Municipality or the NBMCA. Excellent resources can be found at the North Bay Mattawa Conservation Authority https://www.restoreyourshore.ca/ and the Muskoka Water Web: http://www.muskokawaterweb.ca/resources-by-topic#ab.

---

[19] *Zhang, X., X. Liu, M. Zhang, M., R. A. Dahlgren and M. Eitzel. 2010: A review of vegetated buffers and a meta-analysis of their mitigation efficacy in reducing nonpoint source pollution. Journal of Environmental Quality, Vol. 39, pp. 76-84*.

[20] *Dillaha, T.A. 1989. Water quality impacts of vegetative filter strips. ASAE Paper No. 89-2043.*

Appendix A. Algal Bloom Reports

Ministry of the Environment, Conservation and Parks

Environmental Monitoring and Reporting Branch
125 Resources Road
Toronto, ON M9P 3V6
Phone: 416-235-6300
Fax: 416-235-6235

Ministère de l'Environnement, de la Protection de la nature et des Parcs

Direction de la Surveillance Environnementale
125 Resources Road
Toronto, ON M9P 3V6
Tél: 416-235-6300
Téléc.: 416-235-6235

Ontario

September 18, 2019

MEMORANDUM

TO: Victoria Thomas
North Bay Area Office

FROM: Kaoru Utsumi
Phytoplankton Specialist, EMRB

RE: **Algal identification of sample collected on September 17, 20 from Lake Nosbonsing (NOS 01)**

Analysis of the sample was indicative of a bloom of blue-green algae (specifically: Anabaena (aka Dolichospermum), Woronichinia). Many species of blue-green algae (also called cyanobacteria) have the potential to produce toxins that are harmful to the health of humans and animals. This determination was based on the amount of algal material present in the submitted sample.

Small amounts of the following types of algae were observed in the sample, at levels considered too low to contribute to a bloom:

- blue-green algae (specifically Aphanizomenon)

Observations included particles that were not identified as algae: debris.

The sample was submitted to Laboratory Services Branch for algal toxin analysis. Inquiries about these tests should be directed to lasbcustomerservice@ontario.ca. Product code MCYST3469 will return ELISA results and MCYST3450 will return mass spectrometry results. ELISA is a screening test for total microcystins, a group of algal toxins. Mass spectrometry measures individual variants of common algal toxins, including microcystin-LR. The Ontario Drinking Water Quality Standard for microcystin-LR is a maximum acceptable concentration of 1.5 micrograms per litre.

The information in this memo was intended for the individual and/or entity to which it is

Brendan Hatton

From: noreply@nbpsdhu.ca
Sent: Monday, August 13, 2018 2:21 PM
To: Brendan Hatton
Subject: Employee Portal - News Release: Blue-Green Algae in Lake Nosbonsing

News Release: Blue-Green Algae in Lake Nosbonsing

BONFIELD, ON – The Health Unit would like to advise the public that blue-green algae has been found in Lake Nosbonsing. The geographic location of the algae is 46.2239808, -79.1646094.

Because of the blue-green algae, immediately follow these safety measures:

- Do not use the water. This includes: drinking, cooking, bathing, brushing teeth, and water sports. Note: Using a private water system or boiling the water will NOT destroy the toxins.
- Do not swim where there is blue-green algae.
- Some toxins can build up in fish and shellfish. Do not eat the liver, kidneys and other organs. Be careful not to cut the organs when filleting. Limit the amount of fish flesh you eat.
- The blue-green algae may float or sink to the bottom of the lake and you may not see it.
- Even when blue-green algae has disappeared, toxins can remain in the water for a long time.
- The Health Unit and the District Office of the Ministry of the Environment, Conservation and Parks cannot confirm when the water is safe to use.

You can find out more about blue-green algae at myhealthunit.ca or by calling the Health Unit at 705-474-1400, ext. 5400 or 1-800-563-2808.

Quick Facts

- Cyanobacteria, also called blue-green algae or 'pond scum', are not really algae, but tiny bacteria.
- Although usually hard to see, during hot weather they can grow rapidly to form a large mass, called a bloom. Blooms continually change and are difficult to predict. Wind, temperature or sunlight could change where the bloom is located in the water.
- Dense blue-green algae blooms may make the water look bluish-green, or like green pea soup or turquoise paint. Very dense blooms may form solid-looking clumps.
- Fresh blooms often smell like newly mown grass, while older blooms may smell like rotting garbage.
- Even when a bloom has disappeared, toxins can persist in water bodies for a long time. Toxins can irritate the skin and, if swallowed, cause diarrhea and vomiting. At high enough levels, the toxins may cause liver and nervous system damage.
- If skin contact does occur, wash with soap and water or rinse thoroughly with clean water to remove algae.

Read this news update on our website

View more News and Alerts notifications.

Unsubscribe

Ministry of the Environment, Conservation and Parks

Laboratory Services Branch
125 Resources Road
Toronto, ON M9P 3V6
Phone: 416-235-5743
Fax: 416-235-5744

Ministère de l'Environnement, de la Protection de la nature et des Parcs

Direction des services de laboratoire
125 Resources Road
Toronto, ON M9P 3V6
Tél: 416-235-5743

Ontario

July 24, 2020

MEMORANDUM

TO: Victoria Thomas
North Bay Area Office

FROM: Kaoru Utsumi
Phytoplankton Specialist

RE: **Algal identification of sample collected on July 22, 2020 from Lake Nosbonsing (NO-1) (C265556)**

Analysis of the sample indicated an algal bloom was not present. This determination was based on the amount of algal material present in the submitted sample.

Small amounts of the following types of algae were observed in the sample, at levels considered too low to contribute to a bloom:

- blue-green algae (specifically Woronichinia, Aphanothece, Aphanocapsa, Anabaena (aka Dolichospermum))
- diatoms (specifically Synedra, Navicula)
- golden-brown algae (specifically Dinobryon)
- green algae (specifically Staurastrum)

Observations included particles that were not identified as algae: debris, unidentified organic material, Protozoa.

The sample was submitted with the submission # C265556 for algal toxin analysis. Inquiries about algal toxin analysis should be directed to lasbcustomerservice@ontario.ca. Product code MCYST3469 will return ELISA results and MCYST3450 will return mass spectrometry results. ELISA is a screening test for total microcystins, a group of algal toxins. Mass spectrometry measures individual variants of common algal toxins, including microcystin-LR. The Ontario Drinking Water Quality Standard for microcystin-LR is a maximum acceptable concentration of 1.5 micrograms per litre.

Field ID:	NO-1
Sample ID:	C266682-0001
MOE*LIMS ID:	2020WS39-00032
Station ID:	
Collect Date:	23 SEP 2020
Sample Location Description:	LAKE NOSBONSING, BONFIELD
Sample Comments Description:	

Listid	Parmname	Value	Units	Qual	Rmk1	Rmk2	MDL	Analysis Date
3469L1	Microcystins (total)	0.88	ug/L		EL1		.1	01-OCT-2020
3568L1	Anatoxin-A	.2	ug/L	<MDL			.2	01-OCT-2020
3573L1	CYANO BLOOM TAXA		none	NDRS				25-SEP-2020
	NON-CYANO BLOOM TAXA		none	NDRS				25-SEP-2020
	MAT TAXA		none	NDRS				25-SEP-2020
	ALGAE SCAN TIER		none	NDRS				25-SEP-2020

Ministry of the Environment, Conservation and Parks

Laboratory Services Branch
125 Resources Road
Toronto, ON M9P 3V6
Phone: 416-235-5743
Fax: 416-235-5744

Ministère de l'Environnement, de la Protection de la nature et des Parcs

Direction des services de laboratoire
125 Resources Road
Toronto, ON M9P 3V6
Tél: 416-235-5743

Ontario

September 25, 2020

MEMORANDUM

TO: Victoria Thomas
North Bay Area Office

FROM: Kaoru Utsumi
Phytoplankton Specialist

RE: **Algal identification of sample collected on September 23, 2020 from Lake Nosbonsing (NO-1) (C266682)**

Analysis of the sample was indicative of a bloom of blue-green algae (specifically: Anabaena (aka Dolichospermum)). Many species of blue-green algae (also called cyanobacteria) have the potential to produce toxins that are harmful to the health of humans and animals. This determination was based on the amount of algal material present in the submitted sample.

Small amounts of the following types of algae were observed in the sample, at levels considered too low to contribute to a bloom:

- blue-green algae (specifically Woronichinia, Aphanizomenon flos-aquae)
- cryptophytes (specifically Rhodomonas)
- diatoms (specifically Navicula, Asterionella)

Observations included particles that were not identified as algae: debris, unidentified organic material, Protozoa.

The sample was submitted with the submission # C266682 for algal toxin analysis. Inquiries about algal toxin analysis should be directed to lasbcustomerservice@ontario.ca. Product code MCYST3469 will return ELISA results and MCYST3450 will return mass spectrometry results. ELISA is a screening test for total microcystins, a group of algal toxins. Mass spectrometry measures individual variants of common algal toxins, including microcystin-LR. The Ontario Drinking Water Quality Standard for microcystin-LR is a maximum acceptable concentration of