JLR No.: 32004
Revision: REV03

November 3, 2023

Township of Bonnechere Valley

Draft Planning Report (REV03)

Lake Clear Lake Capacity: RV Land Use Study

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

Value through service and commitment

Table of Contents

List of Appendices

1.0 Introduction

The Township of Bonnechere Valley (Township) is a rural municipality, centrally located in Renfrew County (County) and roughly 130 kilometres (km) west of the City of Ottawa. The Township is approximately 589 square kilometres (km^2) in area and is home to approximately 3,900 people (2021 Census).

Township residents enjoy a high quality of life, rich cultural history and a diversity of natural features, including forests, caves, rivers and freshwater lakes. In addition to its natural beauty which affords numerous outdoor recreation, tourism and cottage development opportunities, the Township boasts an affordable small-town feel while being close to larger commercial centres, such as Ottawa, Pembroke, Petawawa, Renfrew and Arnprior.

Lake Clear is one of the Township's many natural assets. Located in the southwestern part of the Township (roughly 15 km southwest of the community of Eganville), it is a relatively small lake and has an average depth of 10.4 metres (m). Lake Clear is surrounded by forested hills and is relatively undeveloped, with a mix of permanent and seasonal residential properties abutting its shoreline. The lake is known for its clear, clean water and is a popular destination for outdoor recreational activities such as swimming, boating, hiking and fishing.

At present, Lake Clear is an 'at-capacity lake' as it supports a natural lake trout population (a globally rare species) and, by definition, has reached its limit capacity for assimilating phosphorus without negatively impacting the quality of the water (specifically dissolved oxygen concentrations and related lake trout habitat requirements). As a result, new lot creation within 300 m of the shoreline is generally prohibited; and the Township's Zoning By-law similarly permits a limited range of land uses within 300 m of the shoreline, but permits new development on existing vacant lots of record, subject to certain conditions.

Within this context, an increasing number of consumers across Canada have turned to the recreation vehicle (RV) lifestyle as an alternative way to spend their leisure time. Along with this trend, the use of RVs on waterfront properties abutting Lake Clear has raised concerns about their potential impacts on lake water quality associated with septic systems and phosphorous loading, particularly given Lake Clear's status as an at-capacity lake. Concerns have also been raised about the compatibility of RVs with the surrounding environment and their effects on the municipal property tax base. As such, the Township retained:

1. Hutchinson Environmental Sciences Ltd. (HESL) to prepare an updated Lakeshore Capacity Assessment (LSCA) for Lake Clear (HESL Report); and

2. J.L. Richards & Associates Ltd. (JLR) to prepare the enclosed Planning Report (JLR Report) which reviews the existing land use planning framework for RVs within 300 m of the Lake Clear shoreline and outlines associated recommendations pursuant to the HESL Report, case study research, and best management practices (BMPs) (Study).

The intent of these combined efforts is to better balance the use of RVs to enjoy Lake Clear with the heath and integrity of the lake itself.

The more specific scope of the Study is as follows:

1. To review relevant background information, including:

    a. land use and development patterns within 300 m of the Lake Clear shoreline available from the Township, digital satellite imagery and GIS mapping information from the County; and

    b. the current land use planning framework regarding the use of RVs on properties abutting Lake Clear i.e., 2020 Provincial Policy Statement, County Official Plan, Township Zoning By-law, and administrative reports.

2. To research a select number of municipalities (i.e., the Townships of North Frontenac, Strong and Whitewater Region) that have similar issues regarding the use of RVs on properties abutting lakes within their respective jurisdictions and review their associated land use planning frameworks to determine potential application(s) to the Study.

3. To supplement the above tasks with a review of the HESL Report to recommend 'good land use planning' measures regarding the use of RVs within 300 m of the Lake Clear shoreline.

4. To partner with Township staff in undertaking the above tasks and support Council's legislative decision-making process in considering the recommendations outlined herein and in the HESL Report.

2.0 RV Trends and Issues

The Canadian RV Association and the RV Dealers Association of Canada reported that in 2018, there were just over 2.1 million households in Canada (approximately 15%) that owned an RV[1]. This was slightly up from, but in line with, previous studies (i.e., 13% to 14% from 2012 and 2005). Furthermore, in 2022, over 50,000 RV shipments were recorded in Canada, a 16% increase from 2021[2]. The use of RVs also has favourable economic benefits, as documented in a 2020 study by The Portage Group for the Canadian RV Association[3]:

1. Vacations in RVs cost households 16% less on average than driving and staying in Airbnb rentals; 37% less than driving and staying in hotels; and 57% less than flying and staying in hotels.

2. The RV sector directly and indirectly supported an estimated 67,200 jobs and delivered $4.8 billion in added economic value to the Canadian economy from an initial expenditure of $6.2 billion in 2019.

At the same time however, the use of RVs on waterfront properties has raised concerns about their impacts on:

1. Lake water quality: RVs that still have running gear attached and are still mobile may be brought to a licensed sewage disposal area. But without a septic system permit, the sewage produced by using an RV is unregulated and undocumented. As such, there is a

[1] Source: 2021 RV trends from the Canadian Recreational Vehicle Association (ontarioparks.com)
[2] Source: 6 Statistics About RVing In Canada That Might Surprise You - MountainviewToday.ca
[3] Source: Economic Impact of the Canadian Recreation Vehicle Industry (rvda.ca)

risk that whatever on-site sewage system is used may not properly attenuate phosphorous loading into the lake which is a parameter of concern for water quality.

2. Compatibility: Concerns have been raised about the compatibility of RVs with the surrounding environment which typically focus on aesthetics and noise from portable power generators.

3. Health and safety: A property with an RV may not have a civic address for first responders in an emergency and/or may not have an approved road access to the property.

4. Financial: The Municipal Property Assessment Corporation (MPAC) employs the following criteria for when an RV is considered an assessable structure:

    a. if the RV is more than 2.6 m wide as it would require an oversize permit for road travel; or

    b. if the RV has an enclosed structure attached to it (e.g., sunroom, porch, etc.).

    If one of the above criteria is not satisfied, then the RV is not considered an assessable structure. This means that an otherwise vacant property containing an occupied RV would be assessed as vacant residential land and assessed using a vacant land tax rate. Comparatively, a single detached dwelling (permanent or seasonal) is taxed based on its assessed value which includes the value of the land, buildings and structures. This increases the assessed value for the property and therefore increases the property taxes which ultimately contributes to the municipal costs of providing services to ratepayers[4].

3.0 Study Area

As shown on Figure 1, the Study area lies in the southwestern part of the Township, roughly 15 km southwest of the community of Eganville and within the Lake Clear Watershed. Its more specific extent covers 300 m of the Lake Clear shoreline, as shown on Figure 2.

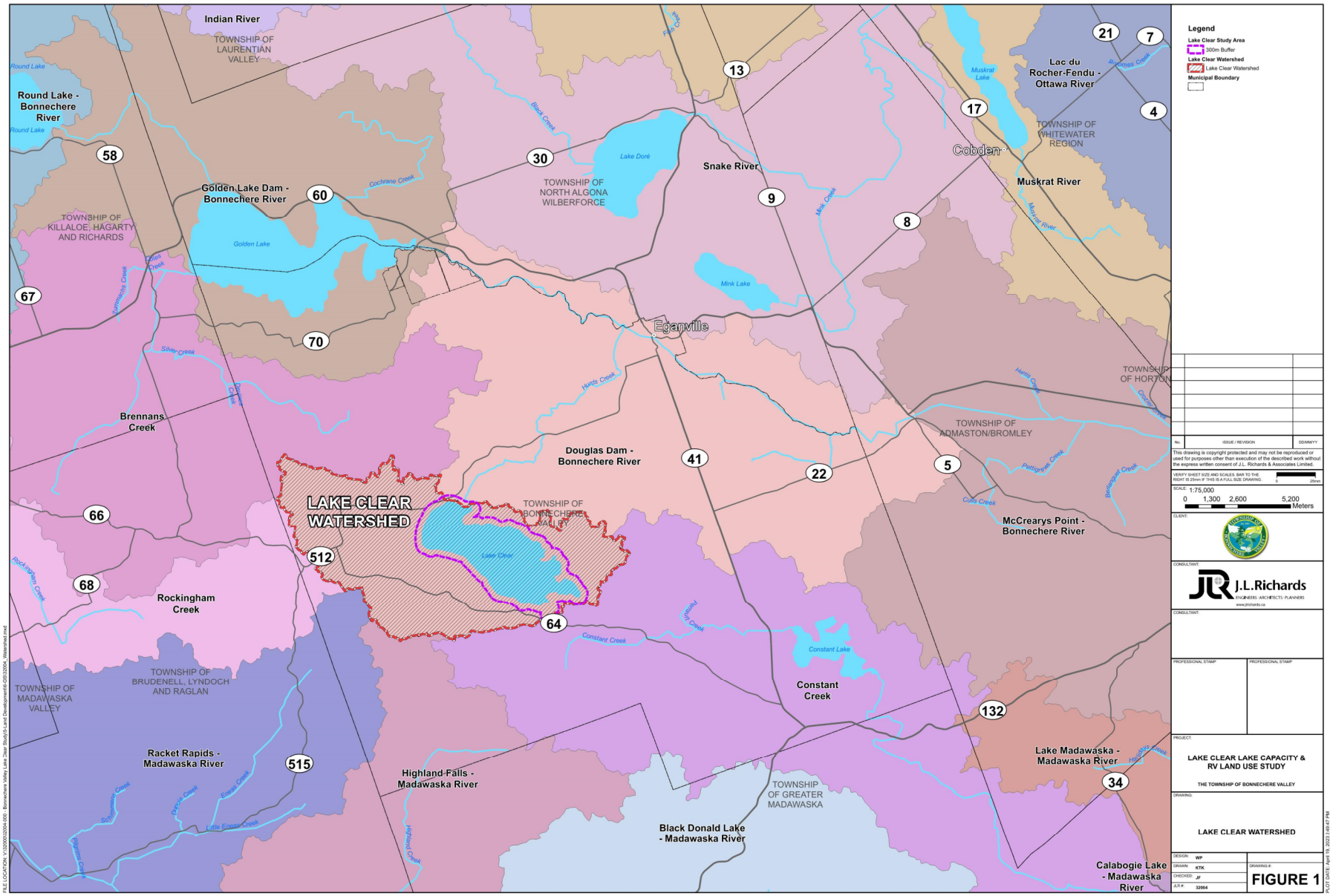
4.0 Study Area Characteristics

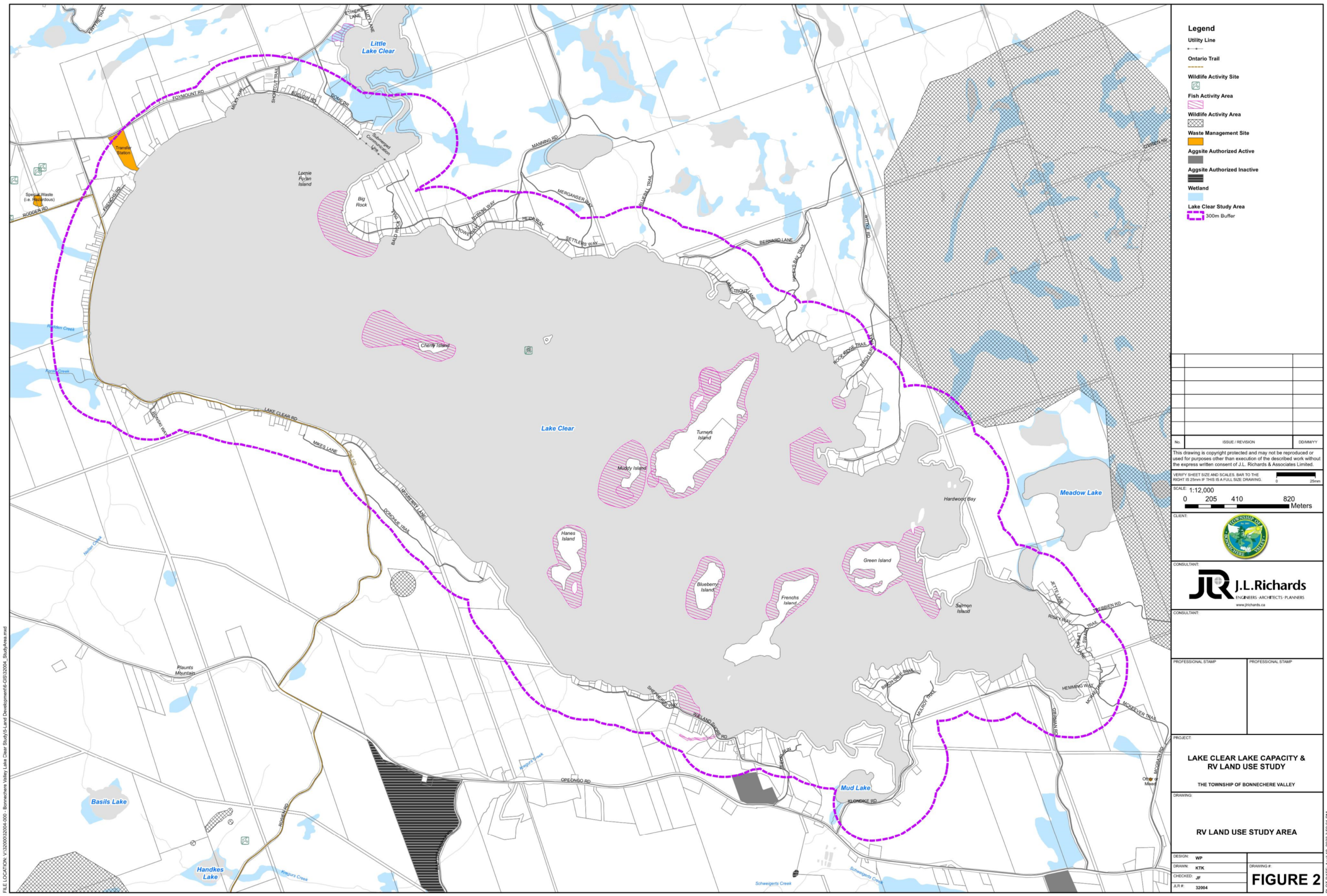
4.1 Lake Clear

Lake Clear is about 1.5 km long and 0.5 km wide and has a surface area of roughly 3.8 km^2. Known for its clear and clean water, Lake Clear is fed by several streams and springs. Its water level, which has a maximum depth of roughly 40 m and an average depth of 10.4 m, is maintained by a small dam at the eastern end of the lake. Lake Clear is shallow around the shoreline and gets deeper towards its center. The shoreline is irregular and rocky, with several bays and coves.

Lake Clear is home to a variety of fish species, including smallmouth bass, northern pike, yellow perch, and lake trout. As such, Lake Clear is identified as a ‘lake trout lake’, in that it contains suitable lake trout habitat (i.e., clear-deep-cold water with adequate levels of dissolved oxygen).

[4] Source: ‘Recreational Vehicle Options Report to the Council of the Township of Bonnechere Valley’, Renfrew County Planning Services, December 13, 2021.


LAKE CLEAR WATERSHED
Indian River
TOWNSHIP OF LAURENTIAN VALLEY
Round Lake - Bonnechere River
Golden Lake Dam - Bonnechere River
TOWNSHIP OF KILLALOE, HAGARTY AND RICHARDS
TOWNSHIP OF NORTH ALGONA WILBERFORCE
Snake River
Lac du Rocher-Fendu - Ottawa River
TOWNSHIP OF WHITEWATER REGION
Cobden
Muskrat River
Eganville
TOWNSHIP OF HORTON
TOWNSHIP OF ADMASTON/BROMLEY
Brennans Creek
Douglas Dam - Bonnechere River
TOWNSHIP OF BONNECHERE VALLEY
McCrearys Point - Bonnechere River
Rockingham Creek
TOWNSHIP OF BRUDENELL, LYNDOCH AND RAGLAN
TOWNSHIP OF MADAWASKA VALLEY
Racket Rapids - Madawaska River
Highland Falls - Madawaska River
Constant Creek
Lake Madawaska - Madawaska River
TOWNSHIP OF GREATER MADAWASKA
Black Donald Lake - Madawaska River
Calabogie Lake - Madawaska River
Legend
Lake Clear Study Area
300m Buffer
Lake Clear Watershed
Municipal Boundary
LAKE CLEAR LAKE CAPACITY & RV LAND USE STUDY
THE TOWNSHIP OF BONNECHERE VALLEY
LAKE CLEAR WATERSHED
FIGURE 1


Legend
Utility Line
Ontario Trail
Wildlife Activity Site
Fish Activity Area
Wildlife Activity Area
Waste Management Site
Aggsite Authorized Active
Aggsite Authorized Inactive
Wetland
Lake Clear Study Area
300m Buffer
Lake Clear
Little Lake Clear
Meadow Lake
Mud Lake
Basils Lake
Handkes Lake
Turners Island
Muddy Island
Cherry Island
Hanes Island
Blueberry Island
Frenchs Island
Green Island
Salmon Island
Hardwood Bay
Transfer Station
LAKE CLEAR RD
OPEONGO RD
SCALE: 1:12,000
0 205 410 820 Meters
PROJECT:
LAKE CLEAR LAKE CAPACITY &
RV LAND USE STUDY
THE TOWNSHIP OF BONNECHERE VALLEY
DRAWING:
RV LAND USE STUDY AREA
DESIGN: WP
DRAWN: KTK
CHECKED: JF
JLR #: 32004
DRAWING #:
FIGURE 2
PLOT DATE: April 19, 2023 2:59:01 PM

4.2 Shoreland Area

Lake Clear is surrounded by forested hills (comprised of a mix of deciduous and coniferous trees) and small cliffs, with some areas of exposed Canadian Shield granite outcroppings. In addition to being a popular destination for recreational activities such as swimming, boating, hiking and fishing, the shoreland area also contains a mix of land uses. As shown on Figure 3, based on available MPAC data, existing land uses within 300 m of the Lake Clear shoreline include residential (i.e., permanent and seasonal dwellings), farms, commercial operations (i.e., Opeongo Mountain Resort, Whispering Pines Resort), a public 'industrial' use (i.e., Township waste transfer station), Crown land and vacant land. Furthermore, based on a review of information provided by the Lake Clear Property Owners Association (LCPOA) (August, 2018), which has been contrasted and compared to near-present digital satellite imagery from Renfrew County (2020), Figure 3 also suggests there are 51 RVs (situated on 27 privately owned parcels) within 300 m of the Lake Clear shoreline (i.e., north shoreline: 16 RVs; south shoreline: 17 RVs; east shoreline: 12 RVs; west shoreline: 6 RVs). It is noted that the LCPOA counted 55 RVs in 2018, 46 of which appeared to be used for residency purposes[5].

5.0 Policy and Regulatory Context

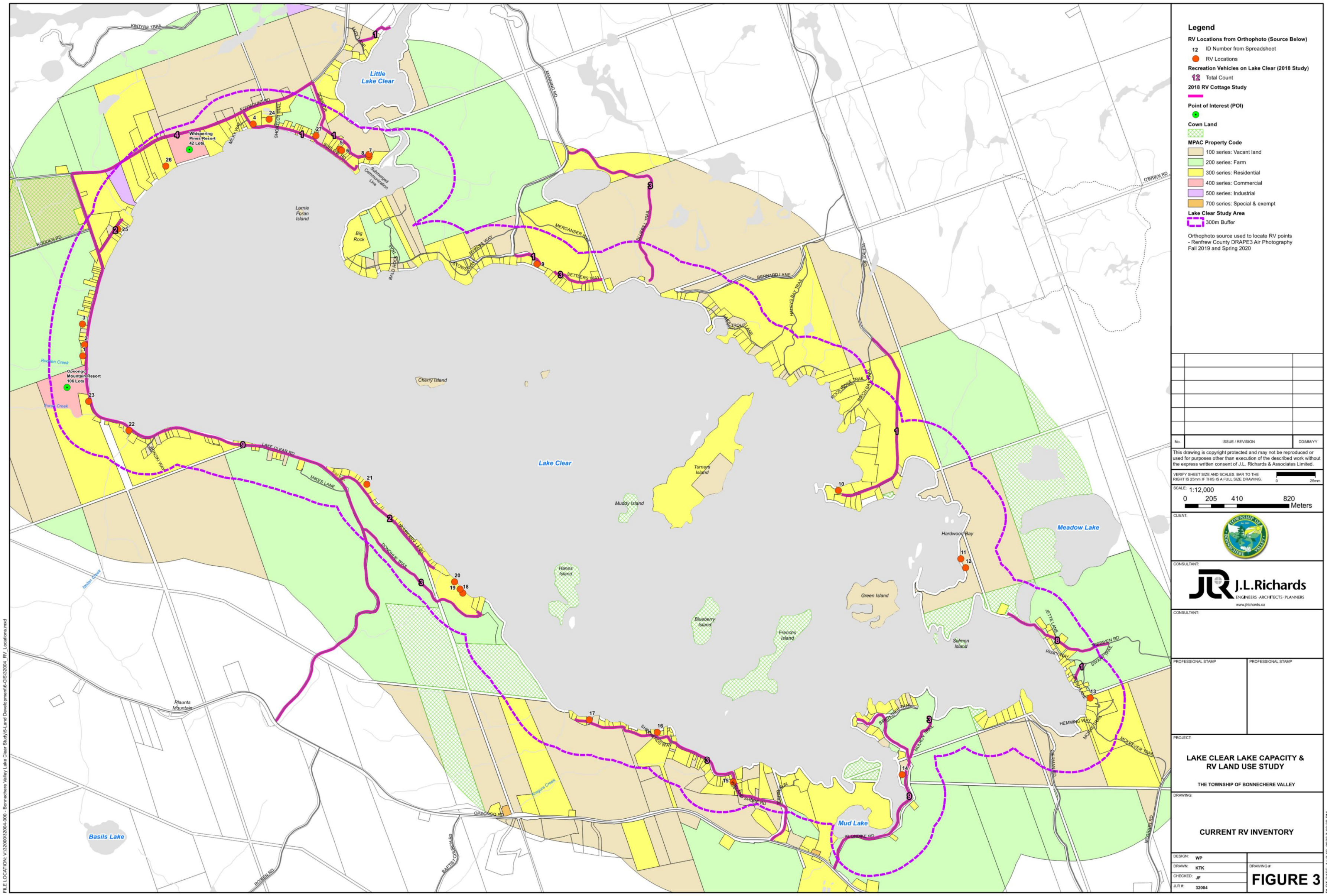
5.1 Ontario Lakeshore Capacity Model

Ontario's Lakeshore Capacity Model was developed to determine suitable development capacity on lakes through an assessment of phosphorus and the associated modelling procedure for dissolved oxygen concentrations. For inland recreational lakes on the Precambrian Shield such as Lake Clear, phosphorus and dissolved oxygen concentrations are the parameters of concern for water quality. Ontario's revised Provincial Water Quality Objective (PWQO) allows for a 50% increase in phosphorus concentration from development over levels that would occur in the absence of any development on the lake (i.e., 'Background' plus 50%) to a maximum concentration of 20 micrograms per litre (µg/L). The dissolved oxygen guideline for protection of lake trout habitat is 7 milligrams per litre (mg/L) (minimum), measured between August 15 and September 15.

Phosphorus comes from natural and human sources. In the absence of significant agricultural or urban drainage, or point sources such as sewage treatment plants, the primary human sources of phosphorus are sewage systems from permanent and seasonal dwellings. Shoreline clearing, fertilizer use, erosion and overland runoff can also be sources of phosphorus inputs. When a lake's capacity to assimilate phosphorus is reached or exceeded, its water quality can degrade, resulting in depletion of dissolved oxygen and loss of cold water fish habitat.

In direct association with its status as a lake trout lake, Lake Clear is also an 'at-capacity lake'. For Lake Clear, average dissolved oxygen concentrations in the bottom layer of the lake have been measured below the 7 mg/L guideline. This means that at present, Lake Clear is considered to have reached its limit capacity for assimilating phosphorus without negatively impacting the quality of the water generally, and the quality of lake trout habitat more specifically.

[5] Source: LCPOA. 2020. LCPOA proposal for controlling use of Recreational Vehicles on Lake Clear.


Legend
RV Locations from Orthophoto (Source Below)
12 ID Number from Spreadsheet
RV Locations
Recreation Vehicles on Lake Clear (2018 Study)
12 Total Count
2018 RV Cottage Study
Point of Interest (POI)
Cown Land
MPAC Property Code
100 series: Vacant land
200 series: Farm
300 series: Residential
400 series: Commercial
500 series: Industrial
700 series: Special & exempt
Lake Clear Study Area
300m Buffer
Orthophoto source used to locate RV points
- Renfrew County DRAPE3 Air Photography
Fall 2019 and Spring 2020
Lake Clear
Little Lake Clear
Meadow Lake
Mud Lake
Basils Lake
Whispering Pines Resort 42 Lots
Opeongo Mountain Resort 106 Lots
Turners Island
Muddy Island
Hanes Island
Blueberry Island
Frenchs Island
Green Island
Salmon Island
Cherry Island
Hardwood Bay
Plaunts Mountain
SCALE: 1:12,000
0 205 410 820 Meters
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LAKE CLEAR LAKE CAPACITY & RV LAND USE STUDY
THE TOWNSHIP OF BONNECHERE VALLEY
CURRENT RV INVENTORY
FIGURE 3

5.2 2020 Provincial Policy Statement

The 2020 Provincial Policy Statement (PPS) is issued under Section 3 of the Planning Act (Act) and provides policy direction on matters of provincial interest related to land use planning and development. The 2020 PPS provides for appropriate development while protecting resources of provincial interest, public health and safety, and the quality of the natural and built environment. The Act requires that all decisions made under it by an approval authority 'shall be consistent with' the 2020 PPS.

A summary of 2020 PPS policies pertinent to the Study is provided below:

1. Development that is compatible with the rural landscape and can be sustained by rural service levels should be promoted. This includes recreational dwellings and other resource-based recreational uses (Section 1.1.5).

2. In areas where municipal sewage services and municipal water services or private communal sewage services and private communal water services are not available, planned or feasible, individual on-site sewage services and individual on-site water services may be used so long as site conditions are suitable for the long-term provision of such services with no negative impacts (Section 1.6.6).

3. The diversity, connectivity and function of natural features in an area should be maintained, restored or, where possible, improved (Section 2.1.2).

4. Planning authorities shall protect, improve or restore the quality and quantity of water by considering environmental lake capacity (Section 2.2.1).

5. Development shall be restricted in or near sensitive surface water features and sensitive ground water features such that these features and their related hydrologic functions will be protected, improved or restored (Section 2.2.2).

6. Development shall generally be directed to areas outside of hazardous lands which are impacted by flooding hazards and/or erosion hazards (Section 3.1.1).

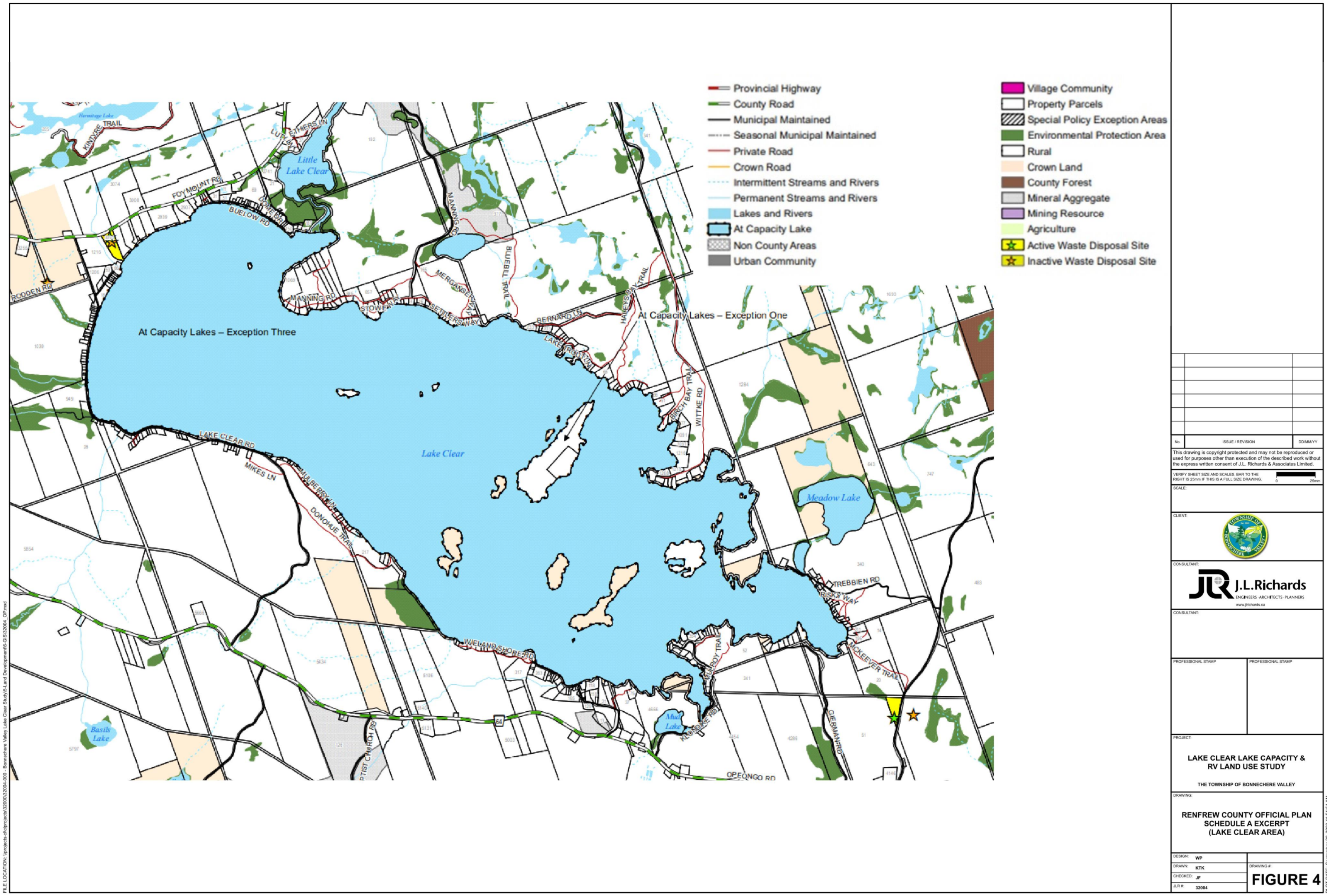
As the 2020 PPS is a high-level policy document, it does not contain specific policies relative to the Study. Still, it is JLR's professional opinion that the Study is consistent with the intent of the 2020 PPS.

5.3 County Official Plan

The Township uses the County Official Plan as its municipal Official Plan for managing growth and development. A summary of County Official Plan policies pertinent to the Study is provided below:

1. The land use designations affecting the Study area are shown on Figure 4, and highlighted below:

    a. **Crown Lands:** As per Section 2.2, the Province administers the use of Crown Lands in accordance with applicable management policies and plans. Should Crown Lands become private lands, the policies in the Rural designation shall apply.


Provincial Highway
County Road
Municipal Maintained
Seasonal Municipal Maintained
Private Road
Crown Road
Intermittent Streams and Rivers
Permanent Streams and Rivers
Lakes and Rivers
At Capacity Lake
Non County Areas
Urban Community
Village Community
Property Parcels
Special Policy Exception Areas
Environmental Protection Area
Rural
Crown Land
County Forest
Mineral Aggregate
Mining Resource
Agriculture
Active Waste Disposal Site
Inactive Waste Disposal Site
At Capacity Lakes – Exception Three
At Capacity Lakes – Exception One
Lake Clear
Little Lake Clear
Meadow Lake
Basils Lake
Mud Lake
LAKE CLEAR RD
MIKES LN
DONOHUE TRAIL
WIELAND SHORES RD
OPEONGO RD
TREBBIEN RD
MCKEEVER TRAIL
GERMANIA RD
BLUEBILL TRAIL
WITTKE RD
BERNARD LN
MANNING RD
STOWE
FOYMOUNT RD
BUELOW RD
RODDEN RD
KINTYRE TRAIL
LAKE CLEAR LAKE CAPACITY & RV LAND USE STUDY
THE TOWNSHIP OF BONNECHERE VALLEY
RENFREW COUNTY OFFICIAL PLAN SCHEDULE A EXCERPT (LAKE CLEAR AREA)
J.L.Richards
FIGURE 4

b. **Rural:** As per Sections 2.2 and 5.0, the Rural designation guides rural type development on private and municipal lands. Permitted uses generally include agricultural, forestry, limited low density residential (including single detached seasonal dwellings), commercial, industrial, recreational (including resource-based recreational uses), institutional, and conservation uses, subject to location and development criteria. This infers a multi-layered land use policy framework which for Study context purposes, shall consider factors such as private servicing provisions; potential development impacts on natural heritage features (including surface water quality / quantity and shoreline integrity); compatibility of farm and non-farm land uses, relative to maintaining the character of rural areas; and the capability of the land to accommodate development, relative to the presence of natural and human-made hazards.

c. **Environmental Protection:** As per Section 8.0, the Environmental Protection designation controls development within identified natural heritage areas. Permitted uses are limited to conservation of soil and wildlife, passive outdoor recreation uses, dams and other water control devices, agricultural uses, forestry, and boat anchorages / moorings. Considerations to permit uses from an abutting land use designation shall be subject to satisfying location and development criteria as well as a Zoning By-law Amendment.

d. **Waste Disposal (Active):** As per Section 12.0, the Township waste transfer station is designated Waste Disposal (Active). A land use compatibility assessment of all proposed developments should be undertaken within 500 m of the licensed perimeter of the waste transfer station.

e. **At Capacity Lake:** Section 9.0 outlines policies for ‘at-capacity lakes’ such as Lake Clear. Highlights applicable to the Study are provided below:

    i. Unless otherwise specified in the County Official Plan, the following general provisions shall apply to lands within 300 m of an At Capacity Lake:

        1. lot creation shall not be permitted unless:

            a. it is required to separate existing habitable dwellings, each of which contains an existing sewage system and is on a lot that can support a Class 4 sewage system, provided that the land use would not change and there would be no net increase in phosphorus loading to the lake; or

            b. new tile fields are setback at least 300 m from the shoreline of lakes and it can be demonstrated that there will be no impacts on lake water quality from either the septic system or other land uses (i.e., dwelling, accessory buildings, site alteration); development must be supported by a report prepared by a qualified professional that demonstrates the lake and the related hydrologic functions will be protected, improved or restored; mitigation measures and/or alternative development approaches may be required; site plan control or development agreements may be used by

the Township to implement any recommended mitigation measures[6]; or

c. a site-specific soils investigation prepared by a qualified professional demonstrates that phosphorus can be retained in deep, native, acidic soils on-site; a report, prepared by a qualified professional, is required to demonstrate that there will be no negative impact on the lake water quality from the proposed development; site plan control or development agreements may be used by the Township to implement any recommended mitigation measures; and

d. where the above criteria can be met, the minimum lot area for new lots shall be 1 hectare (ha); note this may be reduced only where it is required to separate existing habitable dwellings, as noted above;

2. no new or enlarged tent or trailer parks or tourist establishments (uses not defined) shall be permitted;

3. no further erection of multiple dwellings (use not defined) for rent or lease shall be permitted;

4. development on existing lots with lakeshore frontage shall only be permitted under the following conditions:

    a. no more than one single detached dwelling unit (use not defined) shall be permitted, and furthermore:

        i. all buildings and structures and associated private waste disposal systems shall have a minimum setback of 30 m from the high water mark; or where a 30 m setback cannot be met, the setback shall be as remote from the high water mark as the lot will permit to the satisfaction of the Township and other applicable approval authorities;

        ii. all new permits issued by the applicable approval authorities for private waste disposal systems which involve construction of tile beds will be conditional upon the use of a fill material known to have a good phosphorus retention capability;

        iii. the portion of the lot between the shoreline and the single detached dwelling or private waste disposal system will be retained where possible in its natural state to serve as a buffer which will assist in minimizing the land-surface transport of nutrient laden silt to the lake; and the retention of the natural

[6] The More Homes Built Faster Act, 2022 (Bill 23) exempts developments of up to ten units or less from site plan control.

soil mantle and natural vegetation within 30 m of the shoreline will also be encouraged;

iv. dredging and/or filling activities involving the littoral zone shall be discouraged to avoid the re-suspension of lake sediments and the destruction of fish habitat; and any such dredging or filling shall require the prior approval of the Township and other applicable approval authorities; and

ii. In addition to (or despite) the above, the following specific provisions shall apply to lands within 300 m of Lake Clear:

1. development shall be restricted to permanent and seasonal single detached dwellings, home occupations, small scale convenience stores, institutional community use, non-intensive farming and forest management uses;

2. undeveloped lands may be placed in a holding category, wherein the principle of development has been established, and the following provisions shall apply:

a. development shall be encouraged on a comprehensive basis, where appropriate, to include plans and provisions for phasing and road access for future development, including adjacent land holdings;

b. the creation of new lots or the establishment of new roads, either under the consent process or by plan of subdivision, shall not be permitted;

c. a soils and hydrogeological report may be required for approval by the Township, in consultation with other applicable provincial review agencies;

d. waterfront access for proposed and potential future development shall be made available, either as separate water frontage for each lot, or in the case of a plan of subdivision, as a common access which is zoned in separate classification; and

e. a plan of subdivision shall be required to create new lots where the Township determines that the information provided is not adequate to assess the environmental impact of development.

2. The secondary (or additional) dwelling unit (ADU) policies in the County Official Plan were recently reviewed as part of Amendment No. 35 to the County Official Plan (OPA No. 35), pursuant to prior changes to the Act through the More Homes For Everyone Act, 2022 (Bill 109) and Bill 23. Part B, clause (c) in OPA No. 35 states that:

a. ADUs are considered a self-contained residential use with kitchen and bathroom facilities that are within or accessory to a permitted single detached, semi-detached, or row house dwelling (uses not defined but regards primary dwellings on a separately conveyable lot). ADUs are also permitted as separate, detached dwellings.

b. RVs shall not be considered ADUs, and ADUs shall not be permitted on 'at-capacity lakes' such as Lake Clear. Note these policies were original to the County Official Plan and carried forward in OPA No. 35.

3. The County Official Plan enables the Township to develop measures for temporary uses and structures (such as RVs) on lots adjacent to inland lakes, provided such measures do not adversely affect lake water quality and public health.

Based on JLR's review of the County Official Plan, relative to lands in the Study area:

1. The general provisions for At Capacity Lakes indicate that the creation of new lots can be considered, but only under specific conditions. This excludes Lake Clear as consents or plans of subdivision are not permitted (note a plan of subdivision shall be required only in cases where the principle of future development of undeveloped lands has been established, and where the Township determines that the information provided is not adequate to assess the environmental impact of the proposed development).

2. For At Capacity Lakes, including Lake Clear, no more than one single detached dwelling unit (permanent or seasonal) is permitted on an existing lot of record, and which is subject to satisfying development criteria. Furthermore, ADUs are not permitted, and RVs are not considered ADUs.

3. As the residential uses referenced above are not defined in the County Official Plan, it is assumed that RVs are not considered primary single detached dwelling units (permanent or seasonal), given they are not considered ADUs.

4. While RVs are neither considered primary single detached dwellings nor ADUs in the County Official Plan, the Township is enabled to develop mitigative measures for RVs as temporary uses and structures on lots adjacent to inland lakes. It is assumed that this enabling policy also extends to lots adjacent to 'at-capacity' inland lakes such as Lake Clear, given the County Official Plan does not explicitly prohibit RVs as temporary uses and structures within this context.

5.4 Township Zoning By-law No. 2022-042

Zoning By-law No. 2022-042 (Zoning By-law) is the primary means of implementing the County Official Plan in the Township. A summary of Zoning By-law provisions pertinent to the Study is provided below:

1. Section 1.9.16 states that, with respect to any lands to which the Zoning By-law applies, all uses are prohibited unless specifically permitted in established Zones.

2. The Zones affecting the Study area are shown on Figure 5. Permitted residential and residential-related uses are limited to the Zones noted below in Table 1. Their respective definitions, as provided in Section 2.0 of the Zoning By-law, are also provided:

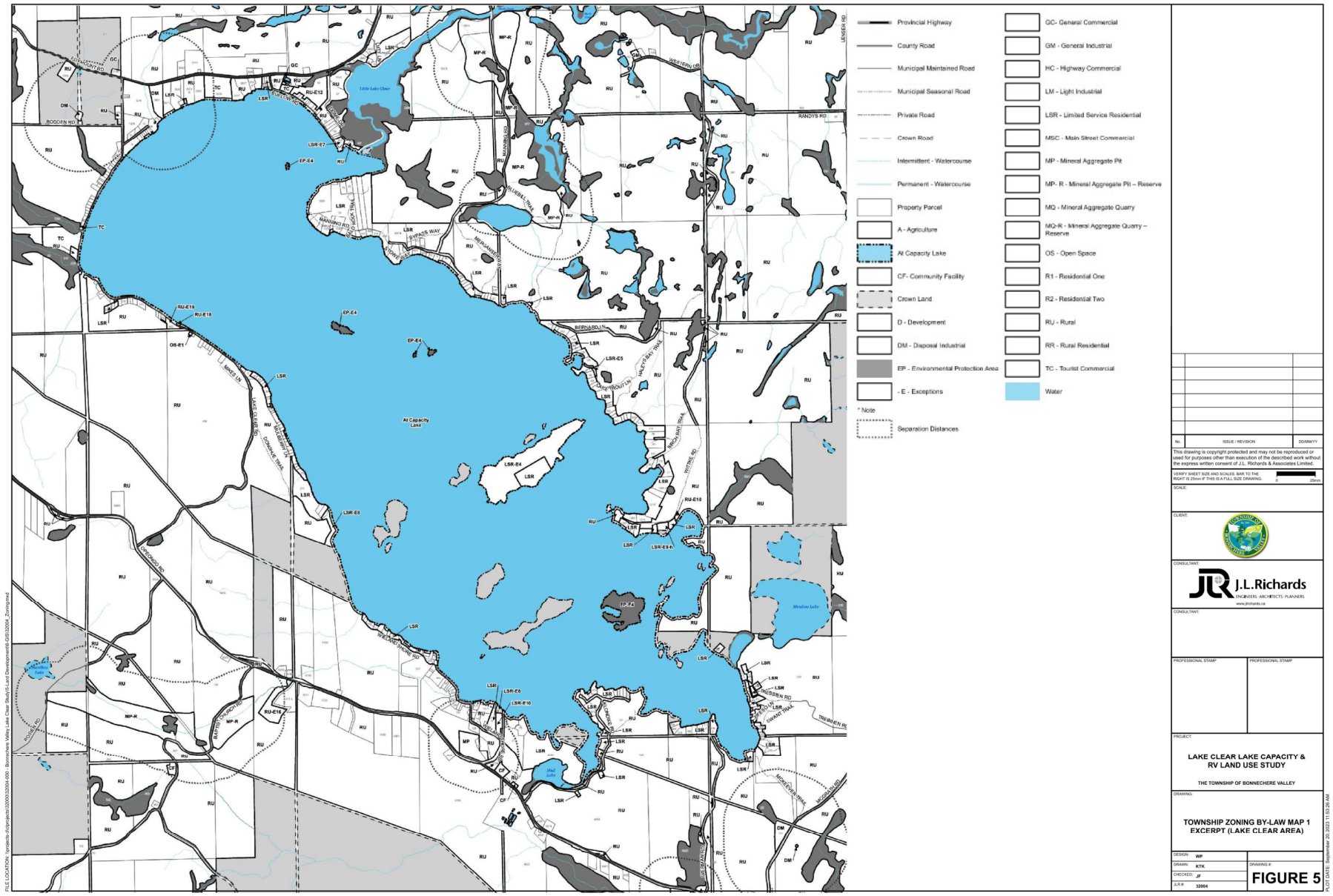

Provincial Highway
County Road
Municipal Maintained Road
Municipal Seasonal Road
Private Road
Crown Road
Intermittent - Watercourse
Permanent - Watercourse
Property Parcel
A - Agriculture
At Capacity Lake
CF- Community Facility
Crown Land
D - Development
DM - Disposal Industrial
EP - Environmental Protection Area
- E - Exceptions
* Note
Separation Distances
GC- General Commercial
GM - General Industrial
HC - Highway Commercial
LM - Light Industrial
LSR - Limited Service Residential
MSC - Main Street Commercial
MP - Mineral Aggregate Pit
MP- R - Mineral Aggregate Pit – Reserve
MQ - Mineral Aggregate Quarry
MQ-R - Mineral Aggregate Quarry – Reserve
OS - Open Space
R1 - Residential One
R2 - Residential Two
RU - Rural
RR - Rural Residential
TC - Tourist Commercial
Water
LAKE CLEAR LAKE CAPACITY & RV LAND USE STUDY
THE TOWNSHIP OF BONNECHERE VALLEY
TOWNSHIP ZONING BY-LAW MAP 1 EXCERPT (LAKE CLEAR AREA)
FIGURE 5

Table 1
Township Zoning By-law: Permitted Residential Uses (Study Area)

Zone	Permitted Residential Uses	Residential / Residential-Related Use Definition
LSR: Limited Service Residential	Limited Service Dwelling	A Single Detached Dwelling that (a) has no frontage on a municipally maintained street but has an alternative means of lot access; and (b) the owner is responsible for services, and for ensuring accessible road access.
TC: Tourist Commercial	Camping Establishment	A tourist establishment consisting of at least five camping lots and comprising land used or maintained as grounds for the camping or parking of RVs and tents.
	RV Campground / Trailer Park	A parcel of land under single ownership which is intended to provide accommodation on a temporary or seasonal basis, for RVs and/or tents plus accompanying towing or carrying vehicles. It may also include supportive / accessory uses.
RU: Rural	Single Detached Dwelling	A single dwelling unit which is freestanding, separate and detached from other main buildings or main structures and includes a prefabricated single dwelling unit but does not include a mobile home.
	Hunting and Fishing Camp	A building or structure (i.e., light frame construction without any interior wall / ceiling finishings) providing basic shelter and accommodation on an occasional basis for a person or group of persons engaged in hunting, fishing or other outdoor recreational activities.

3. Section 2.0 provides other definitions for general terms and land uses referenced in the Zoning By-law. Highlights are as follows:

    a. **Primary Dwelling** means a single detached dwellings, townhouse dwellings or semi-detached dwellings, and excludes any other dwelling unit type referenced in the Zoning By-law (e.g., seasonal dwellings).

    b. **Park Model Trailer** means a trailer constructed to CSA Z-241 standard that is built on a single chassis mounted on wheels, designed for relocation from time to time, designed as living quarters for seasonal camping with the possibility for connection to services, and has a gross floor area, including lofts, not greater than 50 square metres (m^2)[7] when in set-up mode and having a width greater than 2.6 m in transit mode. A park model trailer is deemed to be a building or structure for the purposes of the Zoning By-law.

    c. **Recreation Vehicle** means any vehicle constructed to be attached and propelled by a motor vehicle and that is capable of being used by persons for living, sleeping or eating, even if the vehicle is jacked-up or its running gear is removed. It includes

[7] A park model trailer must be under 50 m^2 to be considered an RV; those over 50 m^2 are considered 'manufactured dwellings' or 'ready-to-move dwellings' and – though not referenced in the Zoning By-law – are typically regarded as single detached dwellings.

any vehicle designed, intended and used as accommodation exclusively for travel, recreation and vacation, and which is either capable of being drawn by a passenger vehicle or is self-propelled. RVs include travel trailers, park model trailers, tent trailers, vans, motor homes and tiny homes, and excludes mobile homes.

d. **Secondary Dwelling** (or ADU) means a second self-contained residential dwelling ancillary and subordinate to a primary dwelling, in which food preparation, eating, living, sleeping and sanitary facilities are provided for the exclusive use of the occupants thereof, and which may also be located within structures accessory to a dwelling such as a garage or other detached structure.

4. Section 3.9.2 states that ADUs are not permitted on lots within 300 m of 'at-capacity lakes' such as Lake Clear. As such, no more than one building used as a dwelling, containing one or more dwelling units, shall be erected on any lot (i.e., one single detached dwelling unit on an existing lot of record in the Study area, as per the County Official Plan).

5. Section 3.17 is entitled, 'Mobile Homes and Recreational Vehicles' but only includes provisions for Mobile Homes.

6. Section 3.23 states that no truck, bus, coach, vehicle, tiny home and/or RV / trailer shall be used as a permanent dwelling unless the occupancy complies with Section 3.17 of the Zoning By-law (as noted above, Section 3.17 only includes provisions for Mobile Homes).

7. Section 3.24.1 states that in a Residential, Rural, or Agriculture Zone (i.e., properties zoned LSR Zone and RU Zone in the Study area), a maximum of one RV / trailer and one boat may be stored on a property with a primary dwelling, provided that:

    a. No parking space required by the Zoning By-law is used.

    b. The RV / trailer is not occupied for habitable purposes.

    c. The RV / trailer and/or boat is not located within a front yard or exterior side yard for longer than 72 hours in any one calendar month.

    d. The RV / trailer and/or boat is setback at least 1.2 m from any interior side yard or rear yard.

    e. Notwithstanding the above, for properties in a Rural or Agricultural Zone (i.e., properties zoned RU Zone in the Study area) which are greater than 1 ha, a maximum of two RVs / trailers and three boats may be stored thereon.

8. Section 3.27.4 establishes the following minimum water setbacks applicable to the Study:

    a. 30 m from the high water mark.

    b. Notwithstanding the above, for an existing lot of record which has less than 64 m of lot depth or is situated between two existing dwellings separated by not more than 100 m, the minimum water setback is 20 m.

Based on JLR's review of the Zoning By-law, relative to lands in the Study area:

1. RVs, which include travel trailers, park model trailers (under 50 m^2), tent trailers, vans, motor homes and tiny homes, shall not be used as permanent dwellings unless compliant with Section 3.17 of the Zoning By-law. As noted above:

    a. A park model trailer must be under 50 m^2 to be considered an RV; those over 50 m^2 are considered 'manufactured' or 'ready-to-move' dwellings. Though these dwelling types are not referenced in the Zoning By-law, they are typically regarded as single detached dwellings.

    b. Section 3.17 does not include permanent occupancy provisions for RVs, which means RVs can only be used for temporary accommodation.

2. ADUs are not permitted on lots within 300 m of 'at-capacity lakes' such as Lake Clear; and as noted earlier, the County Official Plan excludes RVs as ADUs.

3. County Official Plan policy enabling the Township to develop measures for RVs as temporary uses and structures on lots adjacent to inland lakes (and 'at-capacity' inland lakes such as Lake Clear by extension) focuses at present on the storage of RVs (which includes restricting their occupancy while in storage) in the Residential, Rural, or Agriculture Zones. This applies to properties zoned LSR Zone and RU Zone in the Study area.

4. Within the Study area, RVs are permitted for temporary seasonal occupancy under the Camping Establishment and RV Campground / Trailer Park use classes in the TC Zone only. Therefore, occupying an RV for habitable purposes in the other Zones within the Study area does not comply with the Zoning By-law.

6.0 Updated Lake Clear Capacity Assessment

HESL was retained by the Township to prepare an updated LSCA for Lake Clear, given its status as an 'at-capacity lake'. HESL used Ontario's Lakeshore Capacity Model – which as noted earlier assesses phosphorus and dissolved oxygen concentrations[8] – at six test sites to determine if Lake Clear is at capacity to allow the temporary or seasonal occupancy of RVs on properties zoned LSR Zone and RU Zone in the Study area. The HESL Report is attached in Appendix 1.

6.1 Findings

A summary of the main findings in the HESL Report is provided below:

1. Lake water quality is good and there are no increasing trends in nutrient concentrations. However, cyanobacteria (i.e., blue-green algae) was observed during site investigations and climate change is increasing the amount of cyanobacteria in oligotrophic lakes such as Lake Clear. While both factors are known to promote cyanobacterial blooms, the future effects of climate change and anthropogenic nutrient loading on algal blooms in Lake

[8] Ontario's revised PWQO allows for a 50% increase in phosphorus concentration from development over levels that would occur in the absence of any development on the lake (i.e., 'Background' plus 50%) to a maximum concentration of 20 µg/L. The dissolved oxygen guideline for protection of lake trout habitat is 7 mg/L (minimum), measured between August 15 and September 15.

Clear cannot be quantitatively assessed based on available data. But based on what is generally known about climate change effects on lake stratification and the life cycle of cyanobacteria, it is expected that blooms will become more frequent in Lake Clear, even if nutrient loading remains unchanged. With respect to the potential risk for an increased cumulative effect from increased nutrients and climate change, available data suggests the combined effect is not greater than the sum of the individual effects.

2. The predicted 'existing' total phosphorus concentration of Lake Clear during the ice-free season is 8.64 µg/L. Assuming the vacant lots around Lake Clear are converted to extended seasonal use[9] (as recommended by Ontario's Ministry of the Environment, Conservation and Parks), the predicted 'future' total phosphorus concentration is 8.99 µg/L. This concentration is ~26% higher than the predicted 'Background' (i.e., pre-development) concentration of 7.11 µg/L, meaning that the lake has additional development capacity based on the Lakeshore Capacity Modelling. According to the Lakeshore Capacity Model, either 146 permanent residences or 291 extended seasonal residences or 522 seasonal residences [or up to two RVs per each existing residential lot (permanent, extended seasonal and seasonal)] could be added around Lake Clear without exceeding the water quality objective for phosphorus.

3. At 6.20 mg/L, dissolved oxygen concentration levels are below the recommended 7 mg/L guideline for lake trout habitat. While this suggests that Lake Clear is at-capacity based on this criterion, the modelling also indicates that dissolved oxygen concentration levels were slightly below the recommended 7 mg/L guideline prior to development. The addition of two RVs to each existing residential lot is predicted to decrease dissolved oxygen concentration levels by approximately 7% (or ~0.4 mg/L).

4. The current use of RVs on Lake Clear is unregulated and therefore it is not known if they are properly serviced via appropriately sized tile beds or holding tanks that are pumped out regularly. The impact of RVs on lake water quality depends not only on the number of shoreline RVs but also on the effectiveness of RV wastewater management in minimizing nutrient loading to the lake.

6.2 Recommendations

A summary of the recommendations in the HESL Report is provided below:

1. The Township could consider allowing the use of up to two RVs on each of the existing 610 lots of record on Lake Clear which permits residential development (i.e., properties zoned LSR Zone and RU Zone in the Study area), if appropriate BMPs are developed and enforced to ensure that impacts to Lake Clear are minimized.

2. Sewage treatment systems to service the RVs should meet Ontario Building Code requirements. Systems designed to maximize the amount of phosphorus attenuation should be encouraged such as the Waterloo Biofilter with EC-P unit, EcoFlo Biofilter or the use of a tank and bed system that incorporates soils that are high in phosphorus retention, aluminum and iron, and low in calcium carbonate.

[9] The Lakeshore Capacity Model incorporates phosphorus loading from residences based on either permanent (2.56 capita-years/year), extended seasonal (1.27 capita-years/year), or seasonal (0.69 capita-years/year) occupancy. In this context, a 'capita-year/year' represents one person living in a residence on an annual basis (e.g., the phosphorus loading from a residence with 2.56 capita-years/year would be the load expected to come from, on average, 2.56 people living in the residence over the course of one year).

3. A 30 m naturally vegetated shoreline buffer should be required on all existing lots of record, especially on lots with RVs that have the potential to generate additional stormwater and wastewater. Continued retention or establishment of natural vegetation over time should be encouraged through stewardship actions and enforced, as necessary.

4. Stormwater management features that maximize infiltration and limit stormwater runoff should be encouraged on all existing lots of record (and especially on those lots with RVs that have the potential to generate additional stormwater) to minimize development-related impacts on Lake Clear.

5. Water quality and the effectiveness of BMPs should be monitored. Water quality should continue to be monitored through the Lake Partner Program, and dissolved oxygen measurements should be collected annually at the end-of-summer (August 15 to September 15) so that water quality conditions can be tracked over time. The implementation and management of BMPs should be assessed through visual inspections.

7.0 Case Study Research

JLR researched municipal provisions enabled under the Act (i.e., Official Plans, Zoning By-laws) and the Municipal Act (i.e., Licensing By-laws) in Strong, North Frontenac, and Whitewater Region – given their similar rural contexts to the Township – to see how the use of RVs on properties abutting lakes have been addressed. The intent was to determine their potential application(s) to the Study, relative to the findings and recommendations in the HESL Report. Highlights are noted below and in Table 2:

1. Official Plan provisions (relative to the County Official Plan in the Township):

    a. Differentiate between residency in single detached dwellings (permanent or seasonal) on waterfront residential lots (including ‘at-capacity lakes’) and the temporary occupancy of RVs thereon. The North Frontenac Official Plan is explicit in allowing one RV to be stored or used on a temporary basis, regardless of whether the lot is vacant or occupied by a single detached dwelling.

    b. Outline BMPs regarding the temporary occupancy of RVs on waterfront residential lots (e.g., shoreline buffers, on-site servicing, accessory structure standards), regardless of whether the lots are vacant or developed.

    c. Enable the municipalities to prepare more detailed provisions and regulations regarding both the storage and temporary occupancy of RVs on waterfront residential lots, mainly through municipal zoning and licensing.

Table 2
Case Study Research: Municipalities of Strong, North Frontenac and Whitewater Region (Official Plan, Zoning By-law, Licensing By-law)

Policy / Regulatory Provisions	Municipality		
	Strong	**North Frontenac**	**Whitewater Region**
Official Plan	1. RVs may be permitted on lands designated Shoreline Area (generally all lands within 300 m of a lake) on a temporary basis, subject to municipal licensing. 2. Lake Bernard is a 'lake trout lake' and an 'at-capacity lake': development is therefore limited to existing vacant lots and changes in land use that will not increase phosphorous loading. 3. Lot creation provisions reflect the intent of the general provisions for At-Capacity Lakes in the Township, though less explicit regarding site assessment requirements. 4. Development, which includes any main buildings and the filter bed and mantle for a private septic tank shall be set back a minimum of 20 m from the high water mark for existing lots; and 30 m for lots created after January 1, 1993. Vegetation disturbance within these setbacks shall be limited to minor alterations for access trails, docks, water pumping equipment and/or restoration work.	1. One RV may be stored or used on a temporary basis on a lot, regardless of whether the lot is vacant or occupied by a seasonal or permanent dwelling, subject to municipal licensing (note licensing provisions shall not apply to RVs where they are stored only and not used or for RVs in an RV Park or Campground). Additional RVs may be allowed on larger lots for hunters and fishers, subject to the Zoning By-law. 2. RVs shall only be permitted where they are serviced with a potable water supply, and with an on-site sewage disposal system (which shall be in addition to any on-board holding tanks), as approved under the Building Code. This shall not apply to RVs which are stored on a lot and to RVs which are used on a lot and occupied by a seasonal or permanent dwelling for two weeks or less over one season. 3. Decks may be permitted, subject to the Building Code and Zoning By-law. Extensions or additions to an RV shall not be permitted unless such structures have been pre-engineered for the RV by the manufacturer and are capable of being removed. No such structures shall be permitted which have the effect of rendering the RV as a permanent structure or dwelling on a lot. 4. Accessory buildings and structures shall be permitted, subject to the Zoning By-law. This includes a private garage to store an RV over the winter. 5. The setbacks for an RV shall be comparable to setbacks for residential uses. Regard shall be had for naturalizing / retaining shorelines in their natural state. 6. Council may enact a Property Standards By-law to regulate the maintenance of properties, buildings and structures used for RVs.	1. Whitewater Region is part of Renfrew County and uses the County Official Plan as its municipal Official Plan for managing growth and development, similar to the Township. 2. Whitewater Region does not have any 'at-capacity lakes' within its jurisdiction. As stated earlier, the County Official Plan enables the municipality to develop measures for temporary uses and structures (such as RVs) on lots adjacent to inland lakes, provided such measures do not adversely affect lake water quality and public health.

Table 2
Case Study Research: Municipalities of Strong, North Frontenac and Whitewater Region (Official Plan, Zoning By-law, Licensing By-law)

Policy / Regulatory Provisions	Municipality		
	Strong	**North Frontenac**	**Whitewater Region**
Zoning By-law	1. Noteworthy definitions: • Hunt Camp: a partially furnished building having a maximum 75 m^2 area and which may include facilities for the preparation of food and overnight accommodation on a temporary basis during the hunting or fishing seasons, but shall not include any other dwelling unit type in the Zoning By-law; • RV: a self-propelled vehicle used as temporary seasonal accommodation and equipped with sanitary and cooking facilities; • Travel or Tent Trailers: a trailer for temporary accommodation, with or without cooking facilities and which has running gear and towing equipment that is permanently attached, and is not permanently affixed to the ground. 2. Hunt Camps: • a permitted accessory building to recreational and resource management uses on minimum 10 ha lots in the Open Space (OS) Zone and RU Zone, provided the lot has access onto an unimproved municipal road allowance, a private road or a maintained municipal road; and the building area does not exceed 60 m^2. 3. RVs and Travel or Tent Trailers: • can be located on any lot in the RU Zone, LSR Zone or SR Zone and may be occupied, subject to municipal licensing (note this excludes park model trailers); • attached accessory structures shall not exceed the ground floor area of the RV; • a minimum 30 m setback from the high water mark of Lake Bernard (i.e., an 'at-capacity lake'); 4. Shoreline Buffers in the LSR and SR Zones: 75% vegetated buffer required within the front yard (note up to 10% can be landscaped access to the shoreline).	1. Noteworthy definitions: • Dwelling Unit: means a building occupied as the home or residence of one or more persons, where food preparation and sanitary facilities are provided but shall not include a hotel, motel, accommodation unit or unit in an institution; • Park Model Trailer: similar definition to the Township excepting a maximum 19 m^2 area (note a maximum 50 m^2 area is in the Township definition); • RV: a similar definition to the Township excepting RVs only includes travel trailers, motor homes or campers (note in the Township definition, RVs exclude mobile homes but include travel trailers, park model trailers, tent trailers, vans, motor homes and tiny homes). 2. On lands within 300 m of the high-water mark of an at capacity lake, ADUs are not permitted and only 1 dwelling unit per lot is allowed (permanent or seasonal and excluding RVs). 3. All structures shall maintain a minimum 30 m setback from the high water mark of all waterbodies. 4. The area from the high water mark extending inland to a depth of a minimum of 15 m for the entire width of the lot shall retain natural vegetation, except for shoreline maintenance and to provide shoreline / dock access. 5. Provisions for the placement of RVs on lots shall be subject to municipal licensing.	1. Similar RV definition to the Township except: • there are specific references to the running gear and towing equipment being permanently attached and the RV not being permanently affixed to the ground (note this is excluded in the Township definition); • while there is reference to 'similar transportable accommodation', the provisions below exclude park model trailers (note this is included in the Township definition). 2. One RV can be located on any vacant lot in the Rural (RU) Zone and Waterfront (WV) Zone and may be occupied provided it can be located on a lot with frontage on a private road, and is subject to municipal licensing. 3. Attached accessory structures shall not exceed the ground floor area of the RV. 4. Unattached accessory structures or buildings shall not exceed 11.25 m^2.

Table 2
Case Study Research: Municipalities of Strong, North Frontenac and Whitewater Region (Official Plan, Zoning By-law, Licensing By-law)

Policy / Regulatory Provisions	Municipality		
	Strong	**North Frontenac**	**Whitewater Region**
Licensing By-law	1. Noteworthy definitions: • Trailer: further to the Travel or Tent Trailer definition (above), examples include a tent trailer, a camper trailer, a recreational trailer, a fifth wheel, a bus converted into a motor home and park model trailer; • The By-law excludes trailers in storage and trailers assessed under Ontario's Assessment Act. 2. No person shall: • use a trailer for more than 30 days, except in a designated Camping Establishment, without an annual license (expires December 31); • have a trailer without a license even if it was legally in place prior to the effective date of this By-law; • add to a trailer (e.g., porches, roofs, decks); • occupy a trailer from December to April; • locate more than 1 trailer on a residential lot. 3. RV use setbacks are the same as for the main dwelling in the Zoning By-law. 4. Trailers shall be connected to a sewage disposal system that complies with the Building Code and is enforced by the Conservation Authority unless the unit contains an on-board holding tank (in which case it shall be emptied at a provincially licensed facility). 5. A license is not transferrable to a new lot owner. 6. No license shall be issued if the trailer contravenes any federal, provincial or municipal regulation; any trailer in contravention of this By-law shall be removed at the expense of the lot owner, and the lot owner shall be liable to a fine pursuant to the Provincial Offences Act. 7. Any person designated by Council to enforce this By-law may, at any reasonable time and upon producing proper identification, enter and inspect any property licensed under or in contravention of the provisions of this By-law.	1. Similarities with Strong: • definitions and exclusions (except RVs used up to 28 days per visit are excluded); • license renewal periods (expires December 31); • enforcement provisions (except contraveners have up to 14 days to remove the RV). 2. Permitted accessory structures (subject to zoning and Building Code compliance): • unattached decks not exceeding 10 m^2; • gazebos not exceeding 10 m^2 and up to 8 m high; • docks and pump houses; • must be capable of being removed. 3. RV use setbacks and standards (for waterfront lots): • 30 m from a high water mark; • 10 m from easements, rights-of-way and rear yards; • 5 m from a side yard; • 3 m from all other RVs, buildings or structures; • the owner shall obtain a civic address (vacant lot); • temporary RV use (see above) subject to approval by the Chief Building Official and provided there is a main dwelling on the lot. 4. (A) RV storage – units (for waterfront lots): • 1 RV on a lot less than 2 acres (no license); • 2 RVs on a lot greater than 2 acres (no license); • 1 additional RV on a lot greater than 2 acres from October 15 to May 15 (with a license). (B) RV storage – setbacks (for waterfront lots): • 30 m from a high water mark; • 5 m rear yard and 3 m side yard. 5. RVs shall be serviced with an approved (a) potable water supply, and (b) a Class 1 (outhouse)-Class 2 (grey water pit) system or a Class 4 (septic) system. 6. Exemptions (with prior notice to Chief Building Official): • 1 RV per acre (up to 25 RVs) for up to 7 days, 3 times a year for special events (e.g., hunting, fishing); • Council approval is required for larger events.	1. Similarities with Strong: • definitions and exclusions; • prohibitions [except the license trigger is at 10 days of occupancy (not 30 days); the annual license expires October 31 (not December 31); and the restricted occupancy provision is more specific i.e., November 30 to April 30 (not December to April); • no more than 1 RV on a residential lot (except By-law 'variance applications' to Committee of Adjustment can be filed if a second RV is proposed; and development agreements may be imposed); • RV use setbacks are the same as for the main dwelling in the Zoning By-law; • similar sewage disposal system requirements; • a license is not transferrable to a new lot owner; • similar inspection and enforcement provisions. 2. Similarities with North Frontenac: • the owner shall obtain a civic address (vacant lots); • similar sewage disposal system requirements; • similar inspection and enforcement provisions. 3. A license may be issued for an RV within identified Flood Fringe and Floodway areas so long as the owner enters into a development agreement relating to: • restricting occupancy before June 1; • restricting additions to the RV; • removing the RV before or on November 30. 4. Additional RV occupancy compliance provisions: • the lot shall have an entrance permit; • garbage and recycling disposal shall comply with municipal standards; • the lot / use shall comply with the municipal Property Standards By-law and the Clean Yards By-law; • electrical service shall connect to on-site services; or via renewable energy sources; or via fuel burning generator which shall not operate between 1900-0800 hours and/or within 30 m of any dwelling.

2. Zoning By-law regulations (relative to the Township Zoning By-law):

    a. Differ regarding whether park model trailers are considered RVs for the purposes of applying temporary RV occupancy provisions.

    b. The Strong Zoning By-law allows RVs on <u>any</u> lot in the Rural (RU) Zone, Limited Service Shoreline Residential (LSR) Zone or Shoreline Residential (SR) Zone and further enables RV occupancy pursuant to municipal licensing; similar provisions are in the Whitewater Zoning By-law but RV occupancy is limited to vacant lots only and subject to municipal licensing.

    c. While building on enabling Official Plan policy, the zoning provisions are more general in nature (e.g., permitted zones, accessory structure standards, setbacks from the high water mark), and rely on municipal licensing.

3. Licensing By-law regulations (note the Township does not have a Licensing By-law):

    a. All By-laws exclude RVs in storage and those assessed under Ontario's Assessment Act; and include similar themes regarding sewage disposal system requirements and inspection and enforcement provisions.

    b. The Strong and Whitewater Region By-laws:

        i. include similar themes regarding prohibitions for RV use (e.g., length of stays, occupancy during the year, restricting additions to RVs, non-transferability of RV licenses); and

        ii. both cross-reference the Zoning By-law in applying setbacks for RVs.

        While both By-laws also include similar limits on the number of RVs allowed on a lot (i.e., one), the Whitewater Region By-law allows up to two RVs on a lot, subject to the owner obtaining approval from the Committee of Adjustment.

    c. The Whitewater Region and North Frontenac By-laws:

        i. require the lot owner to obtain a civic address for the RV if its proposed location is on a vacant lot; and

        ii. include special allowances for RVs i.e., RVs may be allowed within identified Flood Fringe and Floodway areas (Whitewater Region); and one RV per acre (up to 25 RVs) for up to 7 days, 3 times a year may be allowed for special events such as hunting and fishing (North Frontenac).

    d. The North Frontenac By-law includes specific 'zoning-related' setbacks for RV use and storage.

8.0 Study Conclusions and Recommendations

The following are the main conclusions from JLR's review of Township planning documents, the HESL Report and the case study research, relative to the Study:

1. While RVs are neither considered primary single detached dwellings nor ADUs in the County Official Plan, the Township is enabled to develop mitigative measures for RVs as temporary uses and structures on lots adjacent to inland lakes. It is assumed that this enabling policy also extends to lots adjacent to 'at-capacity' inland lakes such as Lake Clear, given the County Official Plan does not explicitly prohibit RVs as temporary uses and structures within this context.

2. Despite the enabling policy noted above, the Township Zoning By-law focuses at present on the storage of RVs (which includes restricting their occupancy while in storage) in the Residential, Rural, or Agriculture Zones. This applies to properties zoned LSR Zone and RU Zone in the Study area. Furthermore, RVs are currently permitted for temporary seasonal occupancy under the Camping Establishment and RV Campground / Trailer Park use classes in the TC Zone only. Therefore, occupying an RV for habitable purposes in the other Zones within the Study area does not comply with the Zoning By-law.

3. The HESL Report recommends that the Township could consider allowing the use of up to two RVs on each of the existing 610 lots of record abutting Lake Clear which permits residential development (i.e., properties zoned LSR Zone and RU Zone), if appropriate BMPs and periodic monitoring protocols are developed and enforced to ensure that impacts to Lake Clear are minimized.

4. The case study research of the municipalities of Strong, North Frontenac and Whitewater Region indicates that Official Plan policy in their respective jurisdictions differentiate between residency in single detached dwellings (permanent or seasonal) on waterfront residential lots (including 'at-capacity lakes') and the temporary occupancy of RVs thereon. Official Plan policy enabling these municipalities to prepare more detailed provisions and regulations regarding both the storage and temporary occupancy of RVs on waterfront residential lots is advanced generally through municipal zoning and translated more specifically through municipal licensing.

5. As stated earlier, the intent of the Study is to better balance the use of RVs to enjoy Lake Clear with the heath and integrity of the lake itself. Within this context, it is recognized that the HESL Report recommends the Township could consider allowing the use of over 1,200 RVs on the existing lots of record abutting Lake Clear which permits residential development according to the Lakeshore Capacity Model and the water quality objective for phosphorus. However, the Study must not only consider the ecological integrity of Lake Clear (including the dissolved oxygen concentrations that support lake trout habitat), but also its neighbourhood character and the ability of property owners and visitors to continue to enjoy its amenities. Therefore, when considering the prospect of future development and/or land use change through the Study, matters regarding scale, form, function and use, relative to the existing local context, are equally critical factors.

Based on the above, JLR recommends the following [note proposed amendments to Township planning documents are shown in ~~**strikethrough**~~ font (for deletions) and ***italicized*** font (for insertions)]:

1. That the Township consider amending the County Official Plan as follows:

    a. The following clause under Section 9.4.3 (At Capacity Lakes – Special Policy Exceptions – Exception Three (geographic Township of Sebastopol – Lake Clear) be amended to read as follows:

    "Land use development shall be restricted to permanent and seasonal ~~**single-family**~~ ***single detached*** dwellings, home occupations, small scale convenience stores, institutional community use, non-intensive farming and forest management uses. ***This shall include Recreation Vehicles which may be stored or used on a temporary seasonal basis on existing lots of record, regardless of whether the said lots are vacant or occupied by permanent or seasonal single detached dwellings, and which shall be subject to the other applicable ancillary provisions of the County Official Plan, the Township Zoning By-law, the Township Licensing By-law and the following:***

    (a) Recreation Vehicles shall only be permitted where they are serviced with a potable water supply, and with an on-site sewage disposal system (which shall be in addition to any on-board holding tanks), as approved under the Ontario Building Code. This shall not apply to:

    1. Recreational Vehicles which are stored;

    2. Recreational Vehicles on vacant lots and which the said Recreational Vehicles are occupied for up to but not more than seven consecutive days from May 01 to November 29 of any given year, in which case the on-board holding tank shall be emptied at a provincially licensed facility; and

    3. Recreational Vehicles on lots occupied by permanent or seasonal single detached dwellings and which the said Recreational Vehicles are occupied for hunters, fishers or special gatherings from May 01 to November 29 of any given year, in which case the on-board holding tank shall be emptied at a provincially licensed facility."

2. That the Township consider amending the Township Zoning By-law as follows:

    a. The following definition under Section 2 (Definitions) be amended to read as follows:

    "***RECREATIONAL*** ~~***RECREATION***~~ VEHICLE means any vehicle constructed to be attached and propelled by a motor vehicle and that is capable of being used by persons for living, sleeping or eating, even if the vehicle is jacked-up or its running gear is removed. It includes any vehicle designed, intended and used as ***temporary seasonal*** accommodation exclusively for travel, recreation and vacation, and which is either capable of being drawn by a passenger vehicle or is self-propelled. RVs include travel trailers, park model trailers, tent trailers, ~~***vans,***~~ motor homes and tiny homes, and excludes mobile homes."

b. The following be inserted before clause 3.17.1 under Section 3.17 (Mobile Homes and Recreational Vehicles):

"3.17.1 Mobile Homes"

c. The numbering for clauses 3.17.1 to 3.17.3 inclusive under Section 3.17 (Mobile Homes and Recreational Vehicles) be amended as per 2(b) above.

d. The following be added to Section 3.17 (Mobile Homes and Recreational Vehicles):

"3.17.2 Recreational Vehicles

a) The temporary seasonal occupancy of one Recreational Vehicle shall be permitted for up to seven consecutive days from May 01 to November 29 of any given year on an existing vacant lot of record abutting Lake Clear which is zoned Limited Service Residential (LSR) Zone or Rural (RU) Zone, subject to the following:

i. the setback provisions for the Recreational Vehicle shall be the same as for a Single Detached Dwelling;

ii. additions and accessory structures to the Recreational Vehicle (i.e., decks, porches, sunrooms, docks, sheds and similar) shall not be permitted without compliance to Section 3.17.2 (a-iv);

iii. the Recreation Vehicle and all associated private waste disposal systems shall have a minimum 30 metre setback from the high water mark, and the vegetation within this setback shall be retained in its natural state, except for maintenance and/or restoration work;

iv. in addition to Section 3.17.2 (a-i) and notwithstanding Section 3.17.2 (a-ii and a-iii):

1. additions to the Recreational Vehicle (i.e., decks, porches, sunrooms, and similar) shall be permitted, subject to the Township Licensing By-law and the following:

a. the said addition(s) shall not, based on their cumulative area, exceed the ground floor area of the Recreational Vehicle;

b. the said addition(s) shall be pre-engineered for the Recreational Vehicle by the manufacturer;

c. the said addition(s) shall be capable of being removed; and

d. the said addition(s) shall comply with the Ontario Building Code;

2. ***accessory structures to the Recreational Vehicle (i.e., docks, sheds and similar) shall be permitted, subject to the Township Licensing By-law and the following:***

    a. ***the accessory structure(s) provisions shall be the same as for a Single Detached Dwelling;***

3. ***all buildings and structures and associated private waste disposal systems shall have a minimum 30 metre setback from the high water mark, and the vegetation within this setback shall be retained in its natural state, except for:***

    a. ***maintenance and/or restoration work; and***

    b. ***up to 10% of the minimum required 30 metre setback from the high water may be used for shoreline access, provided the said access area is landscaped; and***

4. ***the temporary seasonal occupancy of the Recreational Vehicle for more than three consecutive days up to seven consecutive days inclusive shall be subject to the Township Licensing By-law and the following:***

    a. ***the said occupancy shall be permitted once per season (i.e., Spring, Summer and Fall) from May 01 to November 29 of any given year.***

b) The temporary seasonal occupancy of one Recreational Vehicle shall be permitted for more than seven consecutive days from May 01 to November 29 of any given year on an existing vacant lot of record abutting Lake Clear which is zoned Limited Service Residential (LSR) Zone or Rural (RU) Zone, subject to the Township Licensing By-law and the following:

i. the setback provisions and accessory structure provisions (i.e., for docks, sheds and similar) for the Recreational Vehicle shall be the same as for a Single Detached Dwelling;

ii. additions to the Recreational Vehicle (i.e., decks, porches, sunrooms, and similar):

1. ***shall not, based on their cumulative area, exceed the ground floor area of the Recreational Vehicle;***

2. ***shall be pre-engineered for the Recreational Vehicle by the manufacturer;***

3. ***shall be capable of being removed; and***

4. ***shall comply with the Ontario Building Code;***

iii. all buildings and structures and associated private waste disposal systems shall have a minimum 30 metre setback from the high water mark, and the vegetation within this setback shall be retained in its natural state, except for:

1. maintenance and/or restoration work; and

2. up to 10% of the minimum required 30 metre setback from the high water may be used for shoreline access, provided the said access area is landscaped.

c) The temporary seasonal occupancy of one Recreational Vehicle per 0.4 ha of lot area to a maximum of two Recreational Vehicles shall be permitted for more than seven consecutive days from May 01 to November 29 of any given year on an existing vacant lot of record abutting Lake Clear which is zoned Limited Service Residential (LSR) Zone or Rural (RU) Zone, subject to the Township Licensing By-law and the following:

i. Section 3.17.2 (b);

ii. a minimum separation distance of 6 metres shall be maintained between the Recreational Vehicle and all other buildings or structures located on the lot; and

iii. approval of a minor variance shall be obtained from the Committee of Adjustment.

d) The temporary seasonal occupancy of one Recreational Vehicle per 0.4 ha of lot area to a maximum of two Recreational Vehicles shall be permitted for more than three consecutive days up to seven consecutive days inclusive once per season (i.e., Spring, Summer and Fall) from May 01 to November 29 of any given year for hunters, fishers or special gatherings on an existing lot of record abutting Lake Clear which is zoned Limited Service Residential (LSR) Zone or Rural (RU) Zone and occupied by a permanent or seasonal Single Detached Dwelling, subject to the Township Licensing By-law and the following:

i. the setback provisions for the Recreational Vehicle shall be the same as for the Single Detached Dwelling;

ii. a minimum separation distance of 6 metres shall be maintained between the Recreational Vehicle and all other buildings or structures located on the lot; and

iii. additions and accessory structures to the Recreational Vehicle (i.e., decks, porches, sunrooms, docks, sheds and similar) shall not be permitted."

3. That the Township consider preparing a Licensing By-law regarding the licensing of RVs on existing lots of record abutting Lake Clear which are zoned Limited Service Residential (LSR) Zone or Rural (RU) Zone. The main highlights are as follows:

    a. Application:

        i. This By-law applies to the occupancy of Recreational Vehicles on existing lots of record abutting Lake Clear which are zoned Limited Service Residential (LSR) Zone or Rural (RU) Zone in the Township Zoning By-law. Matters regarding legal non-conformity or non-compliance are not applicable to this By-law and no person shall use a Recreational Vehicle on a subject lot unless the said Recreational Vehicle complies with this By-law.

        ii. Notwithstanding (i), this By-law does not apply to:

            1. Assessed Recreational Vehicles under Ontario's Assessment Act; or

            2. The occupancy of a Recreational Vehicle on a subject lot for up to but not more than three consecutive days from May 01 to November 29 of any given year, provided there are no additions and/or accessory structures to the said Recreation Vehicle (i.e., decks, porches, sunrooms, docks, sheds and similar); or

            3. A Stored Recreational Vehicle.

    b. Definitions:

        i. Recreational Vehicle means any vehicle constructed to be attached and propelled by a motor vehicle and that is capable of being used by persons for living, sleeping or eating, even if the vehicle is jacked-up or its running gear is removed. It includes any vehicle designed, intended and used as temporary seasonal accommodation exclusively for travel, recreation and vacation, and which is either capable of being drawn by a passenger vehicle or is self-propelled. RVs include travel trailers, park model trailers, tent trailers, motor homes and tiny homes, and excludes mobile homes.

        ii. Stored Recreational Vehicle means a Recreational Vehicle located on a lot which is not connected to hydro, water or sewage hook-up and the stabilizers shall not be used or in accordance with manufacturer's recommendations.

        iii. Township means the Corporation of the Township of Bonnechere Valley.

        iv. Use, Occupy or Occupancy means to inhabit and maintain on a temporary basis.

        v. Zoning By-law means the Township Zoning By-law, as amended.

c. Scope:

i. No person shall use nor shall an owner of a subject lot permit a person to use a Recreation Vehicle on the said subject lot without purchasing an annual License from the Township, which shall apply under the following circumstances:

1. where occupancy is for up to seven consecutive days in any given year and there are existing or proposed additions and/or accessory structures to the said Recreation Vehicle;

2. where occupancy is for more than seven consecutive days in any given year; and

3. where there are two Recreational Vehicles available for occupancy for more than seven consecutive days in any given year.

ii. No person shall construct any additions to, or accessory structures for, a Recreational Vehicle on a subject lot without first obtaining a Building Permit from the Township.

d. Licensing – Vacant Lot of Record:

i. A License issued pursuant to this By-law authorizes the occupancy of either:

1. one Recreational Vehicle on a subject vacant lot; or

2. one Recreational Vehicle per 0.4 ha of lot area to a maximum of two Recreational Vehicles on a subject vacant lot.

The issuance of a License does not grant the Licensee the authority to occupy the Recreational Vehicle on a permanent basis. The issuance of a License is not intended and shall not be construed as permission or consent by the Township for the holder of the License to contravene or to fail to observe or comply with any law of Canada, Ontario or any By-law of the Township.

ii. The Township may impose conditions on a License, and may refuse to issue a License if any of the conditions cannot be met by the owner of the subject vacant lot.

iii. A Recreational Vehicle shall be serviced with:

1. a potable water supply;

2. an approved Class 4 (septic) system approved under the Ontario Building Code; and

3. electrical service connecting to:

a. on-site services; or

b. renewable energy sources; or

c. a fuel burning generator which shall not operate between 1900-0800 hours and/or within 30 metres of any adjacent Single Detached Dwelling.

iv. The owner of the subject vacant lot shall be responsible for obtaining:

1. a civic address for same from the Township; and

2. an entrance permit, where applicable, pursuant to Township policies and by-laws.

e. Licensing Exemptions – Vacant Lot of Record:

i. In circumstances where there is one Recreational Vehicle on a subject vacant lot, its occupancy shall be permitted for more than three consecutive days up to seven consecutive days inclusive once per season (i.e., Spring, Summer and Fall) of any given year, subject to:

1. the owner of the subject lot informing the Chief Building Official in writing at least fourteen days prior to occupancy of the details [i.e., civic address, occupancy dates, and the number of occupants] to demonstrate compliance with the Zoning By-law and for Township emergency preparedness purposes; and

2. the Recreational Vehicle having a fully and properly functioning on-board holding tank, which shall be emptied at a provincially licensed facility.

f. Licensing Exemptions – Developed Lot of Record:

i. The occupancy of one Recreational Vehicle per 0.4 ha of lot area to a maximum of two Recreational Vehicles shall be permitted for more than three consecutive days up to seven consecutive days inclusive once per season (i.e., Spring, Summer and Fall) of any given year for hunters, fishers or special gatherings on a subject lot which is occupied by a permanent or seasonal Single Detached Dwelling, subject to:

1. the owner of the subject lot informing the Chief Building Official in writing at least fourteen days prior to occupancy of the details [i.e., civic address, occupancy dates, the number of occupants, and the number and location of the Recreational Vehicle(s)] to demonstrate compliance with the Zoning By-law and for Township emergency preparedness purposes; and

2. the Recreational Vehicle having a fully and properly functioning on-board holding tank, which shall be emptied at a provincially licensed facility.

g. Occupancy Period:

    i. No person shall occupy any Recreational Vehicle to which this By-law applies from November 30 to April 30 of any given year.

h. Licensing Fees:

    i. All Applications submitted for consideration shall be subject to an Application Fee (non-refundable deposit) as set out in the Township Fees and Charges By-law. If the License is refused, then the fee is non-refundable. This fee covers the review of the Application, initial location inspection and placement inspection.

    ii. The Licensing Fees for every Recreational Vehicle to which this By-law applies shall be as set out in the Township Fees and Charges By-law.

    iii. The License shall come into effect on January 01 and shall expire on December 31 of each year. The Licensing Fees shall be invoiced by January 15 of each year and shall be payable by February 28.

    iv. No License shall be issued unless the prescribed fee has been paid. The annual license fee will be pro-rated for a new Recreational Vehicle License issued from the first day of the month if the Application is received during the year.

    v. A refund may be obtained by submitting a request in writing to the Chief Building Official indicating a Recreational Vehicle will no longer be occupied on a subject lot, and specifying the date on which it is going to be removed. The amount of the refund will be calculated from the first day of the month following the date on which the owner advised the Recreational Vehicle will be removed and it is confirmed by the Chief Building Official that the Recreational Vehicle is no longer located on the subject lot.

    vi. The Chief Building Official will issue a License for a Recreational Vehicle provided that a complete Application is submitted to the Township, all pre-conditions as specified in this By-law are satisfied, the Licensing Fee is paid in full and the occupancy of the subject lot for a Recreational Vehicle conforms with all other applicable law, including the Zoning By-law.

    vii. Applications for a new License or to annually renew a License will be refused where any terms or conditions of a previous License were breached and/or if the provisions of this By-law cannot be met.

i. Inspections:

    i. Any person designated by Township Council to enforce this By-law may, at any reasonable time and upon producing proper identification, enter and inspect any subject lot that is Licensed under or in violation of this By-law.

j. Violations and Penalties:

   i. Any person who violates this By-law is guilty of an offence and is liable to pay an Administrative Monetary Penalty.

   ii. Where any condition of a License is breached by any person, regardless of whether the Township has commenced a judicial prosecution, the Township may revoke the License upon written notice of revocation being served on the owner of the subject lot or such notice being posted conspicuously on the subject lot for which the License was issued.

   iii. Where a License is revoked by the Township, the Licensee shall be jointly and severally responsible for removing the Recreational Vehicle from the subject lot within fourteen days of receipt of the notice of revocation.

   iv. Where the Licensee fails to remove the Recreational Vehicle in accordance with this By-law, the Township may enter upon the subject lot and remove the Recreational Vehicle without further notice to the Licensee.

   v. The Licensee shall be jointly and severally liable for all costs incurred by the Township to remove any Recreational Vehicle from a subject lot where the Recreational Vehicle is in violation of this By-law. All costs incurred by the Township shall be recovered from the Licensee by action or placement of the said incurred costs on the tax roll for the subject lot where the Recreational Vehicle was located and collected in the same manner as municipal property taxes.

k. Application:

   i. Should any section, subsection or part thereof of this By-law be declared by any Court of Law to be illegal or ultra vires, such section or subsection or part thereof shall be severable and all parts hereof are declared to be separate and independent.

   ii. This By-law shall come into force and take effect immediately upon the date of passing.

J.L. RICHARDS & ASSOCIATES LIMITED

Prepared by:	Reviewed by:
DRAFT	**DRAFT**
Wes Paetkau, MCIP, RPP Senior Planner	Jason Ferrigan, RPP, MCIP, MSc.Pl. Chief Planner, Principal Associate

WDP:jf

Appendix 1

Lake Clear Capacity Assessment:
Hutchinson Environmental Sciences Ltd.

Hutchinson

Environmental Sciences Ltd.

Lake Clear Capacity Assessment

Prepared for: Township of Bonnechere Valley
Job #: 220081

October 17, 2023

Final Report

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

Signatures

Report Prepared by:

Joel Harrison, Ph.D.
Aquatic Scientist

Report Reviewed by:

Brent Parsons, M.Sc.
Principal and Senior Aquatic Scientist

Executive Summary

Lake Clear is considered to be an “at-capacity lake” in the County of Renfrew’s Official Plan as it supports a natural Lake Trout (*Salvelinus namaycush*) population and Mean Volume-Weighted Hypolimnetic Dissolved Oxygen concentrations have been measured below the Provincial criterion of 7 mg/L for the protection of Lake Trout habitat. Hutchinson Environmental Sciences Ltd. (HESL) was retained to complete a Lakeshore Capacity Assessment of Lake Clear as the Township of Bonnechere Valley is considering developing a By-law to allow Recreational Vehicles (RVs) to be located on waterfront properties. A Lakeshore Capacity Assessment is required to determine if Lake Clear is at capacity for development through a) completion of a Lakeshore Capacity Model to determine development capacity with respect to the Provincial Water Quality Objective for phosphorus, and b) updated evaluation of MVWHDO concentrations with respect to the 7 mg/L criterion. A background review and field investigations were completed to characterize water quality conditions in Lake Clear. Additional discussion on lake water quality parameter concentrations and trends, and waterfront Best Management Practices was also included to help inform conclusions and recommendations.

Lake Clear is under capacity according to Lakeshore Capacity Modelling results and the total phosphorus (TP) Provincial Water Quality Objective. It is over capacity with respect to Mean Volume-Weighted Hypolimnetic Dissolved Oxygen as concentrations are <7 mg/L but modelling indicates that oxygen concentrations were slightly below 7 mg/L prior to development. Water quality is good and there are no increasing trends in nutrients. Small amounts of cyanobacteria (i.e. blue-green algae) were however observed during site investigations.

Shoreline development, including RV use, can impact a lake through stormwater and wastewater inputs as well as associated recreational uses such as boating. Impacts can be largely mitigated through implementation of BMPs such as properly designed and maintained sewage treatment systems, the retention or establishment of naturally vegetated shoreline buffers and stormwater management features that maximize infiltration and minimize runoff. Currently the use of RVs of Lake Clear is unregulated and therefore it is not known if they are properly serviced via appropriately sized tile beds or holding tanks that are pumped out regularly. We underscore that the impact of RVs on the lake’s water quality depends not only on the number of shoreline RVs but also the effectiveness of RV wastewater management in minimizing nutrient loading to the lake.

The following recommendations were developed to help the Township develop science-based planning policy for RV use on Lake Clear:

- Permit the use of 1 or 2 RVs/lot on Lake Clear if appropriate BMPs are developed and enforced to ensure that impacts to Lake Clear are minimized. The modelled impact of two additional RVs/lot results in TP concentrations that are less than the PWQO for TP. The lake is at capacity based on MVWHDO but based on modelling results, it appears that MVWHDO concentrations have always been below the 7 mg/L criterion, and BMPs can be utilized to minimize impacts.

- Sewage treatment systems to service the RVs should meet Ontario Building Code requirements. Systems designed to maximize the amount of phosphorus attenuation should be encouraged such as the Waterloo Biofilter with EC-P unit, EcoFlo Biofilter or the use of a tank and bed system

that incorporates soils that are high in phosphorus retention, aluminum and iron, and low in calcium carbonate.

- A 30 m naturally vegetated shoreline buffer should be required on all lots, especially lots with RVs that have the potential to generate additional stormwater and wastewater. Continued retention or establishment of natural vegetation over time should be encouraged through stewardship actions and enforced as necessary.

- Stormwater management features that maximize infiltration and limit stormwater runoff should be encouraged on all lots, especially those with RVs that have the potential to generate additional stormwater, to minimize development-related impacts on Lake Clear.

- Water quality and the effectiveness of BMPs should be monitored. Water quality should continue to be monitored through the Lake Partner Program, and dissolved oxygen measurements should be collected annually at the end-of-summer (August 15 – September 15) so that Mean Volume-Weighted Hypolimnetic Dissolved Oxygen concentrations can be calculated and tracked over time. The implementation and management of BMPs should be assessed through visual inspections.

Table of Contents

List of Figures

List of Tables

Appendices

Acronyms

A0	lake area
BMP	best management practice
CWQG	Canadian water quality guideline
DO	dissolved oxygen
HESL	Hutchinson Environmental Sciences Ltd.
LCM	Lakeshore Capacity Model
LPP	Lake Partner Program
MD	maximum distance (fetch)
MECP	Ministry of the Environment, Conservation and Parks
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of the Environment
MOECC	Ministry of the Environment and Climate Change
MPAC	Municipal Property Assessment Corporation
MVWHDO	mean volume-weighted hypolimnetic dissolved oxygen
OWIT	Ontario Watershed Information Tool
PWQO	Provincial Water Quality Objective
Rs	LCM coefficient for phosphorus retention by soil
RV	recreational vehicle
TP	total phosphorus
TP_{FUTURE}	total phosphorus concentration assuming vacant lots developed as extended seasonal (LCM prediction)
TP_{LAKE}	total phosphorus concentration during the ice-free season (LCM prediction)
TP_{SO}	total phosphorus concentration at spring overturn (LCM prediction)
VSA	volume-to-sediment-area ratio
z	depth

1. Introduction

Lake Clear (45.44°N, 77.20°W) is a relatively small (17 km^2), deep (~40 m), oligotrophic lake located in the Township of Bonnechere Valley (County of Renfrew), approximately 120 km west of Ottawa. Popular recreational uses of the lake include swimming, canoeing, kayaking, and fishing, and based on a resident survey, water quality is considered the main issue faced by the lake and the top element affecting personal enjoyment of the lake, with algae/aquatic vegetation the main concern (Love Your Lake 2022). Lake Clear's drainage basin is small (76 km^2) and predominantly (~80%) forested, with agriculture and undifferentiated rural land use comprising 10% of the catchment (Ministry of Natural Resources and Forestry [MNRF] 2023). Although shoreline development density is modest, Lake Clear is considered to be an "at-capacity lake" in the County of Renfrew's Official Plan (County of Renfrew 2020); it has been designated as a "Natural Lake Trout Lake" in *Inland Ontario Lakes Designated for Lake Trout Management* (MNRF 2015) and Mean Volume Weighted Hypolimnetic Dissolved Oxygen (MVWHDO) concentrations have been measured below the Provincial criterion of 7 mg/L to protect Lake Trout (*Salvelinus namaycush*) habitat (Ministry of Environment and Climate Change [MOECC] 2016).

Hutchinson Environmental Sciences Ltd. (HESL) has been retained to complete a Lakeshore Capacity Assessment of Lake Clear as the Township of Bonnechere Valley is considering developing a By-law to allow Recreational Vehicles (RVs) to be located on waterfront properties. A Lakeshore Capacity Assessment is required to determine if Lake Clear is in fact at capacity for development through a) completion of a Lakeshore Capacity Model to determine development capacity with respect to the Provincial Water Quality Objective (PWQO) for phosphorus, and b) updated evaluation of MVWHDO concentrations with respect to the 7 mg/L criterion. Best Management Practices associated with shoreline development and RVs are also discussed to inform the development of the By-law and minimize impacts associated with development and RV use on Lake Clear, and, if there is capacity, how development impacts associated with RVs can be minimized.

Ontario's Lakeshore Capacity Model (Ministry of Environment [MOE] 2010) was developed to determine suitable development capacity on lakes through an assessment of phosphorus and the associated modelling procedure of Molot et al (1992) for dissolved oxygen (DO) concentrations. For recreational lakes on the Precambrian Shield, phosphorus and DO concentrations are the parameters of concern for water quality. The revised PWQO for inland lakes on the Precambrian Shield (MOE 2010) allows for a 50% increase in phosphorus concentration from development over levels that would occur in the absence of any development on the lake (i.e., "Background" + 50%) to a maximum concentration of 20 µg/L. The DO guideline for protection of Lake Trout habitat is 7 mg/L as End-of-Summer MVWHDO (i.e. measured between August 15 and September 15).

The Province of Ontario recommends the use of the Lakeshore Capacity Model (LCM) to determine the PWQO for phosphorus and the amount of shoreline development that can occur to maintain phosphorus levels within the phosphorus threshold (MOE 2010). The LCM is a steady-state mass balance model that estimates hydrologic and phosphorus loading from natural (watershed runoff and atmospheric deposition) and human (septic systems and land disturbance) sources and links them together considering lake dynamics to predict total phosphorus (TP) concentrations in lakes. Dissolved oxygen is modelled on the basis of lake morphometry and TP concentrations using the techniques described in Molot et al. (1992) and

Clark et al. (2002) and is commonly used to link phosphorus concentrations with MVWHDO as part of existing and future development scenarios.

A background review and field investigations were completed to characterize water quality conditions in Lake Clear and allow for the determination of development capacity through Lakeshore Capacity Modelling and DO modelling. Additional discussion on lake water quality parameter concentrations and trends, and waterfront Best Management Practices was also included to help inform conclusions and recommendations.

2. Background Review

HESL assembled and reviewed the following existing data for Lake Clear:

- MECP's Lake Partner Program data: TP (2002–2020), calcium (2008–2020), and chloride (2015–2020) concentrations and Secchi depths (1996–2020);
- MECP water quality data (2003, 2010, 2011, 2018): TP, ammonia, nitrite, nitrate, total Kjeldahl nitrogen, dissolved organic carbon, alkalinity, conductivity, calcium, hardness, total suspended solids, total dissolved solids; and
- MECP temperature and dissolved oxygen profiles (2003, 2010, 2011, 2018).

Summaries and visualizations of the existing data are presented in Section 4.

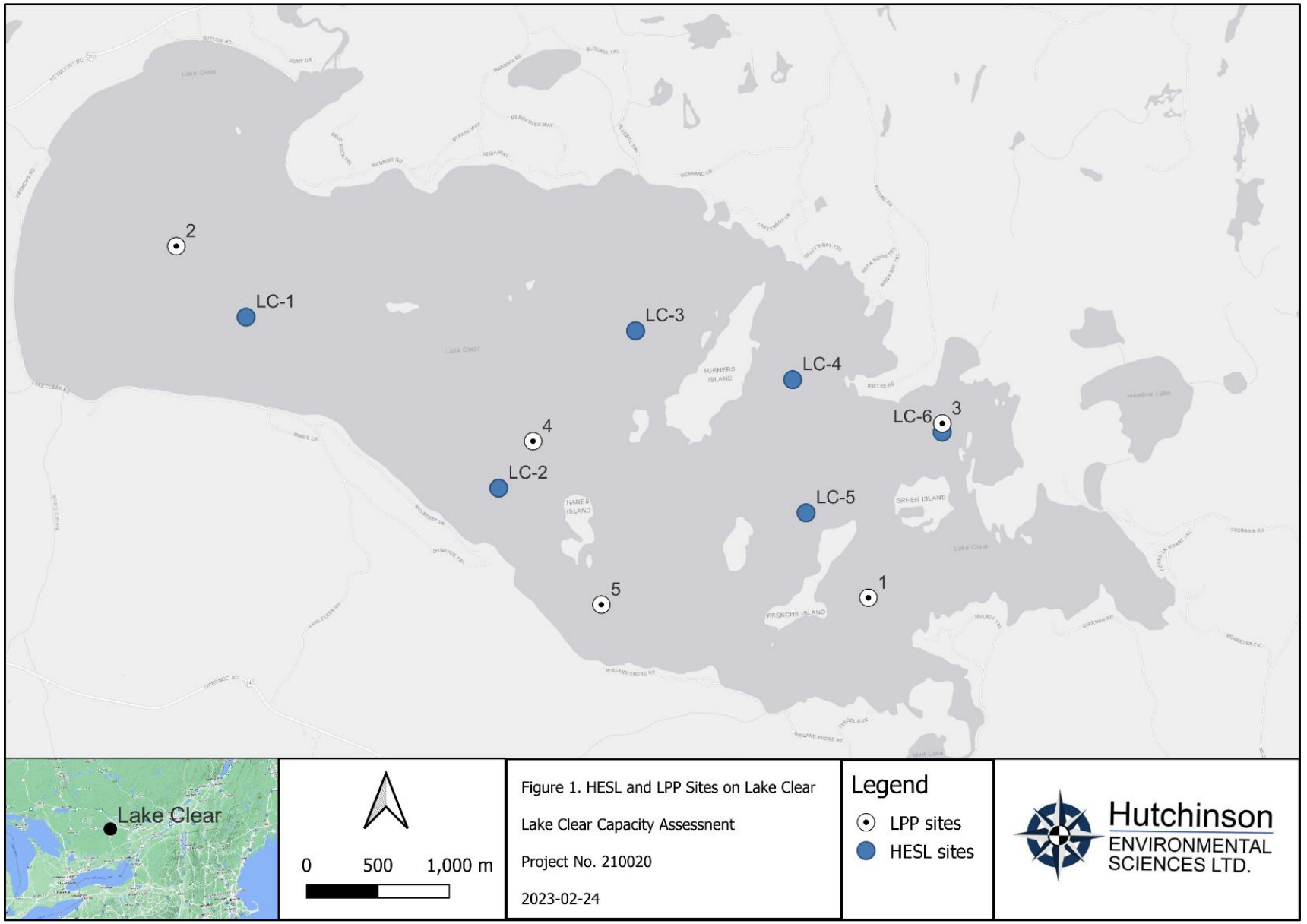
3. Field Investigation

HESL performed a field survey of Lake Clear on 7 September 2022. MOE (2010) recommends that dissolved oxygen measurements are collected between August 15 and September 15 for use in MVWHDO calculations. Six sites were selected that correspond to the deepest areas in the western, central, and eastern areas of the lake (Figure 1; Table 1).

Table 1. Coordinates and Depths of HESL Sites.

Site	Depth (m)	Latitude	Longitude
LC-1	20.7	45.4469	-77.2223
LC-2	25.4	45.4350	-77.2009
LC-3	20.1	45.4442	-77.1876
LC-4	25.2	45.4404	-77.1739
LC-5	35.2	45.4320	-77.1736
LC-6	38.1	45.4364	-77.1609

The Secchi depth was determined using a black-and-white 20-cm disc at each site. Water samples were then collected from the epilimnion by weighted bottle (integrated from the surface to Secchi Depth) and from ~1-m above the lakebed ("1-mob") using a Kemmerer sampling device. Water column profiles of temperature, DO, specific conductance, and pH were measured at a 1-m interval using a YSI sonde. The sonde was calibrated by Pine Environmental Services and the DO sensor was corrected for barometric pressure in the field prior to use. Water samples were shipped to ALS Laboratories for determination of chlorophyll-a, total nitrogen, nitrate, ammonium, dissolved organic carbon, calcium, and chloride (epilimnetic samples only), TP and total suspended solids (both epilimnetic and 1-mob samples), and total iron (1-mob samples only).


2
LC-1
LC-3
LC-4
3
LC-6
4
LC-2
LC-5
5
1
Lake Clear
0
500
1,000 m
Figure 1. HESL and LPP Sites on Lake Clear
Lake Clear Capacity Assesnent
Project No. 210020
2023-02-24
Legend
LPP sites
HESL sites
Hutchinson
ENVIRONMENTAL
SCIENCES LTD.

4. Analysis

4.1 Water Quality

4.1.1 Water Clarity

Lake Clear has high transparency: the average Secchi depth ranged between 6.7 m and 7.2 m across 4 sites based on long-term monitoring via the LPP (Table 2). The longest period of record is for the "N. end, deep spot" (45.4517°, -77.2281); here there was an increasing trend (~5 cm/year) in the annual average Secchi depth over the period 1996–2020 (R^2 = 0.23; p = 0.03; data not shown), indicating increasing water transparency. MECP has reported Secchi depths in the range of 4.5–5.0 m and of 5.5 m, for 2003 and 2011, respectively (MOE 2016). Secchi depths measured during the HESL survey on 7 September 2022 were between 7.7 m and 8.2 m (avg. = 8.0 m), higher than the long-term averages, but still within the range historically observed via LPP monitoring. Consistent with the high clarity, the concentration of total suspended solids has been relatively low in Lake Clear, averaging 1.4 mg/L according to MECP monitoring (range: 0.8–3.0 mg/L; Table 3) and confirmed to be <3 mg/L based on the recent HESL survey (Table 4).

Table 2. Summary of Secchi Depth (1996–2020), TP (2002–2020), Calcium (2008–2020), and Chloride (2015–2020) from Lake Partner Program Monitoring.

***Site #**	**Secchi Depth (m)**				**TP (µg/L)**				**Calcium (mg/L)**				**Chloride (mg/L)**			
	min.	**avg.**	max.	*n*	min.	**avg.**	max.	*n*	min.	**avg.**	max.	*n*	min.	**avg.**	max.	*n*
1	3.1	**6.9**	10.4	79	5.3	**9.0**	12.7	19	33.5	**37.7**	41.1	12	11.8	**13.4**	14.2	6
2	4.6	**6.7**	8.6	89	5.4	**8.6**	11.4	16	30.8	**35.6**	38.9	9	13.1	**13.7**	14.0	4
3	0.6**	**6.9**	9.1	54	5.0	**7.4**	12.4	15	34.5	**36.4**	40.1	9	13.3	**13.6**	13.8	4
4	4.6	**7.2**	10.1	89	5.4	**9.0**	13.0	15	34.1	**37.0**	40.1	12	13.0	**13.5**	14.1	5
5	5.8	**7.0**	8.2	96	6.7	**8.5**	11.0	10	33.3	**36.2**	38.5	10	12.0	**13.7**	14.7	6

**Site numbers correspond to the following descriptions: (1) "E. end, centre", (2) "N. end, deep spot", (3) "E end, Hardwood Bay", (4) "Hanes Island West", and (5) "South End". **The Secchi Depth of 0.6 m is an outlier (very low) and almost certainly due to an observer error or data entry error.*

4.1.2 Nutrients

Nutrients are relatively low in the upper mixed layer of Lake Clear. Average TP concentrations were 7.4–9.0 µg/L (overall range: 5.0–13.0 µg/L; Table 2) for the period 2002–2020 based on LPP monitoring); the average concentrations are below the interim PWQO of 10 µg/L for "a high level of protection against aesthetic deterioration" (MOEE 1994). There was no significant temporal trend in the annual average TP concentration for any of the LPP sites (all R^2 < 0.2; all p > 0.1; data not shown). Data provided by the MECP have a comparable median TP concentration of 6.0 µg/L, though with much higher average (15.9 µg/L) and maximum (79.0 µg/L) concentrations than recorded in the LPP dataset (Table 2).

Surface nitrogen concentrations are also relatively low, with almost no nitrite, little ammonium, and nitrate well below the Canadian Water Quality Guideline of 3 mg-N/L (Table 3). Similarly, chloride has never been measured above the CWQG of 120 mg/L, averaging only approximately 13–14 mg/L.

Most water-quality parameters did not differ appreciably between the euphotic zone and directly above the lakebed (compare Table 3 with Table 5); however, nitrate and TP were both much higher “off bottom” (averages of 46.8 µg/L and 0.188 mg-N/L, respectively) than in the upper mixed layer (averages of 15.9 µg/L and 0.021 mg-N/L, respectively).

The TP and total iron concentrations of 1-mob samples from the 7 September 2022 survey were significantly and positively correlated among sites (Pearson’s $r = 0.81$; $p < 0.05$), and the minimum DO concentration at each site was negatively correlated with the 1-mob concentrations of iron ($r = -0.92$; $p < 0.01$) and phosphorus ($r = -0.73$; $p = 0.10$); these correlations suggest that phosphorus is liberated from ferric oxyhydroxides in the sediments under anoxic conditions (i.e., that internal phosphorus loading is occurring due to oxygen depletion above the lakebed).

Table 3. Summary of Euphotic Zone Chemistry based on MECP Monitoring (2003–2018).

	n	Min.	10th%ile	25th%ile	Avg.	Median	75th%ile	90th%ile	Max.
Ammonia, Total (mg-N/L)	8	0.006	0.014	0.020	0.063	0.030	0.041	0.128	0.307
Calcium	7	30.8	32.5	33.7	34.7	34.5	36.2	37.6	38.2
Chloride	2	12.8	12.9	13.0	13.1	13.1	13.3	13.3	13.4
Conductivity (µS/cm)	8	245	245	248	262	256	271	289	292
Dissolved Inorganic Carbon	8	23.9	24.5	24.8	26.3	26.7	27.8	27.9	28.0
Dissolved Organic Carbon	8	3.2	3.2	3.4	5.7	3.6	4.6	9.7	18.4
Hardness	7	105	108	112	115	115	120	122	124
Magnesium	7	6.4	6.7	7.0	7.0	7.1	7.2	7.4	7.5
Nitrate + Nitrite (mg-N/L)	8	0.005	0.006	0.009	0.021	0.019	0.024	0.041	0.049
Nitrite (mg-N/L)	8	0.001	0.001	0.001	0.002	0.001	0.003	0.005	0.006
pH	8	8.01	8.08	8.19	8.29	8.32	8.39	8.46	8.57
Potassium	2	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Sodium	2	7.5	7.5	7.6	7.7	7.7	7.9	7.9	8.0
Sulphate	2	4.8	4.9	4.9	5.1	5.1	5.2	5.3	5.3
Total Alkalinity	8	99	103	106	110	109	115	119	120
Total Dissolved Solids	5	159	160	162	165	163	170	172	173
Total Kjeldahl Nitrogen	8	0.03	0.16	0.26	0.50	0.29	0.48	1.02	1.76
TP (µg/L)	8	4.0	4.0	4.8	15.9	6.0	9.3	34.9	79.0
Total Suspended Solids	5	0.8	0.8	0.9	1.4	1.0	1.2	2.3	3.0

Note: Units are mg/L except for pH (unitless) and where otherwise specified. Data are for site "Lake Clear – Main Basin".

Table 4. Water quality of Lake Clear on 7 Sep 2022 based on HESL Survey.

	Units	Median	LC-1	LC-2	LC-3	LC-4	LC-5	LC-6
Site Depth	m	25.3	20.7	25.4	20.1	25.2	35.2	38.1
Secchi Depth	m	7.9	8.2	7.7	8.1	7.9	7.9	7.9
Ammonia, Total	mg-N/L	<0.0050	<0.0050	0.0316	<0.0050	<0.0050	<0.0050	0.0081
Calcium	mg/L	30.8	30.6	30.9	30.6	30.6	31.2	31.0
Chloride	mg/L	15.3	15.3	15.3	15.3	15.3	16.1	15.3
Chlorophyll-a	µg/L	0.95	0.84	1.17	0.62	0.62	1.33	1.06
Dissolved Organic Carbon	mg/L	4.14	4.45	4.15	4.05	4.29	3.99	4.12
Dissolved Reactive P	µg/L	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Iron	µg/L	(29)	(14)	(55)	(11)	(15)	(42)	(64)
Nitrate	mg-N/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total Kjeldahl Nitrogen	mg-N/L	0.258	0.260	0.277	0.238	0.255	0.251	0.267
TP	µg/L	5.6 (17.8)	7.5 (8.0)	4.6 (73.3)	5.1 (8.0)	6.4 (4.2)	4.8 (27.5)	6.1 (35.7)
Total Suspended Solids	mg/L	<3.0 (<3.5)	<3.0 (<3.0)	3.9 (3.5)	<3.0 (<3.0)	<3.0 (<3.0)	<3.0 (4.1)	<3.0 (4.5)

Note: Numbers in parentheses are from 1-m-off-bottom samples; other values are from integrated samples (surface to Secchi depth).

Table 5. Summary of Off-Bottom Chemistry based on MECP Monitoring (2003–2018).

	n	Min.	10th%ile	25th%ile	Avg.	Median	75th%ile	90th%ile	Max.
Ammonia, Total (mg-N/L)	5	0.007	0.025	0.052	0.047	0.052	0.056	0.063	0.067
Calcium	5	33.4	35.5	38.7	38.2	38.9	39.1	40.1	40.7
Chloride	1	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
Conductivity (µS/cm)	5	262	262	263	268	267	273	273	273
Dissolved Inorganic Carbon	5	26.5	26.9	27.6	28.0	27.7	28.3	29.3	29.9
Dissolved Organic Carbon	5	3.0	3.1	3.2	3.3	3.3	3.3	3.6	3.8
Hardness	5	111	117	125	124	126	127	129	130
Magnesium	5	6.6	6.8	7.0	7.0	7.0	7.1	7.2	7.2
Nitrate + Nitrite (mg-N/L)	5	0.133	0.142	0.156	0.188	0.172	0.195	0.248	0.283
Nitrite (mg-N/L)	5	0.001	0.001	0.002	0.004	0.003	0.003	0.007	0.010
pH	5	7.89	7.93	7.99	8.13	8.18	8.28	8.31	8.33
Potassium	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Sodium	1	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Sulphate	1	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Total Alkalinity	5	112	114	116	116	117	118	119	119
Total Dissolved Solids	3	174	175	176	176	177	177	177	177
Total Kjeldahl Nitrogen	5	0.20	0.24	0.30	0.29	0.32	0.32	0.33	0.33
TP (µg/L)	5	24.0	30.8	41.0	46.8	50.0	53.0	60.8	66.0
Total Suspended Solids	3	1.1	1.2	1.3	1.8	1.5	2.1	2.5	2.7

Note: Units are mg/L except for pH (unitless) and where otherwise specified. Samples were collected from 1-m off bottom from site "Lake Clear – Main Basin".

4.1.3 Phytoplankton

Chlorophyll-a concentrations on 7 September 2022 were approximately 1 µg/L (Table 4), indicative of low phytoplankton biomass. FluoroProbe fluorescence measurements made on this date indicate a phytoplankton community of mixed composition but dominated by algae with very little cyanobacteria (i.e. blue-green algae) (Figure 2). Although cyanobacteria made only a minor contribution to the phytoplankton biomass, HESL did observe macroscopic colonies in the water column at multiple sites during the field survey; the colonies were examined using a compound microscope and identified as a species of the genus *Gloeotrichia* (Photographs 1 and 2); this potentially toxic, colonial cyanobacterium is known to bloom in low-nutrient lakes (Carey et al. 2012).

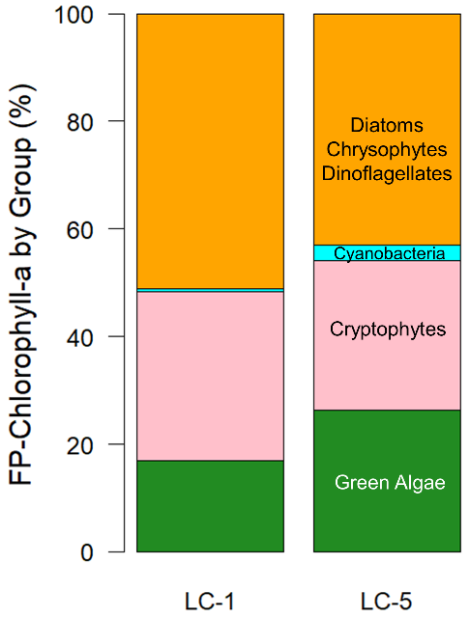


Figure 2. Phytoplankton community composition of Lake Clear on 7 September 2022, as inferred from pigment fluorescence measured by a FluoroProbe.

Photographs 1 & 2. View of the lake's surface at site LC-5 on 7 September 2022 (left) and one of the *Gloeotrichia* colonies collected from the lake, as viewed using compound microscopy (right).

4.1.4 Stratification and Dissolved Oxygen

Late-summer water column profiles of temperature and DO were obtained from MECP (Figure 3) and also measured by HESL during the 7 September 2022 survey (Figure 4). The water column of Lake Clear was always stably stratified in September, with an upper mixed layer (epilimnion), of approximately 10 m depth, separated from the hypolimnion by a strong thermal gradient (i.e., a distinct thermocline). Based on the commonly used 1°C-per-m criterion for defining the thermocline, the top of the hypolimnion was at a depth of 14–15 m. MECP recorded hypolimnetic anoxia (DO < 1 mg/L) on all survey dates, with DO concentrations of 0.29, 0.05, 0.50, and 0.24 mg/L measured immediately above the lakebed (i.e., at 35–37 m) at their deep-water sampling location on 5 September 2003, 16 September 2010, 12 September 2011, and 26 September 2018, respectively. HESL recorded hypoxic (but not anoxic) conditions immediately above the lakebed at the deepest site on 7 September 2022 (1.17 mg/L at 38 m at LC-6), somewhat higher than the concentrations reported by MECP. Off-bottom DO concentrations recorded by HESL at the other sites on 7 September 2022 ranged from 2.55 mg/L to 5.41 mg/L.

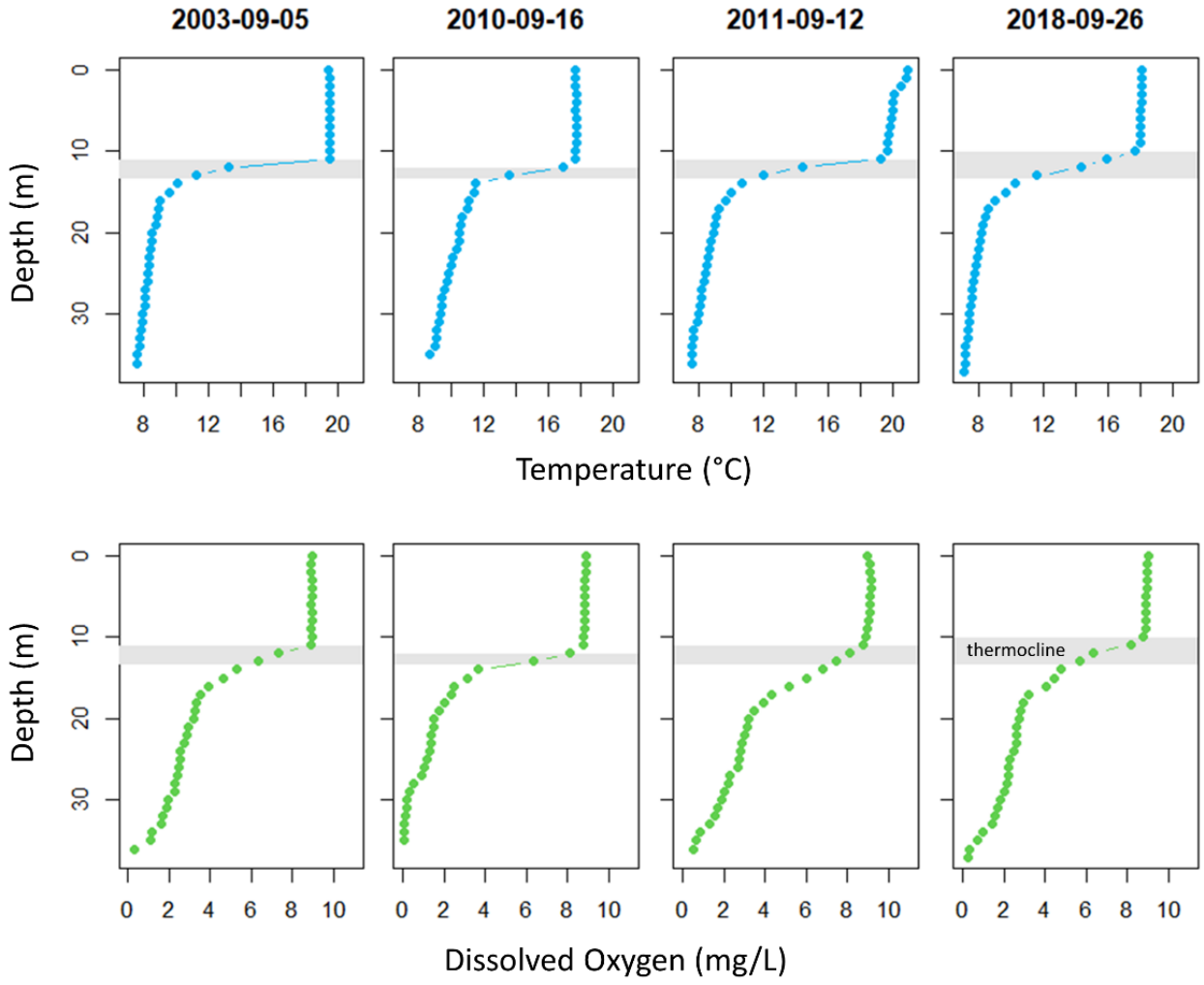


Figure 3. MECP Temperature and Dissolved Oxygen Profiles.

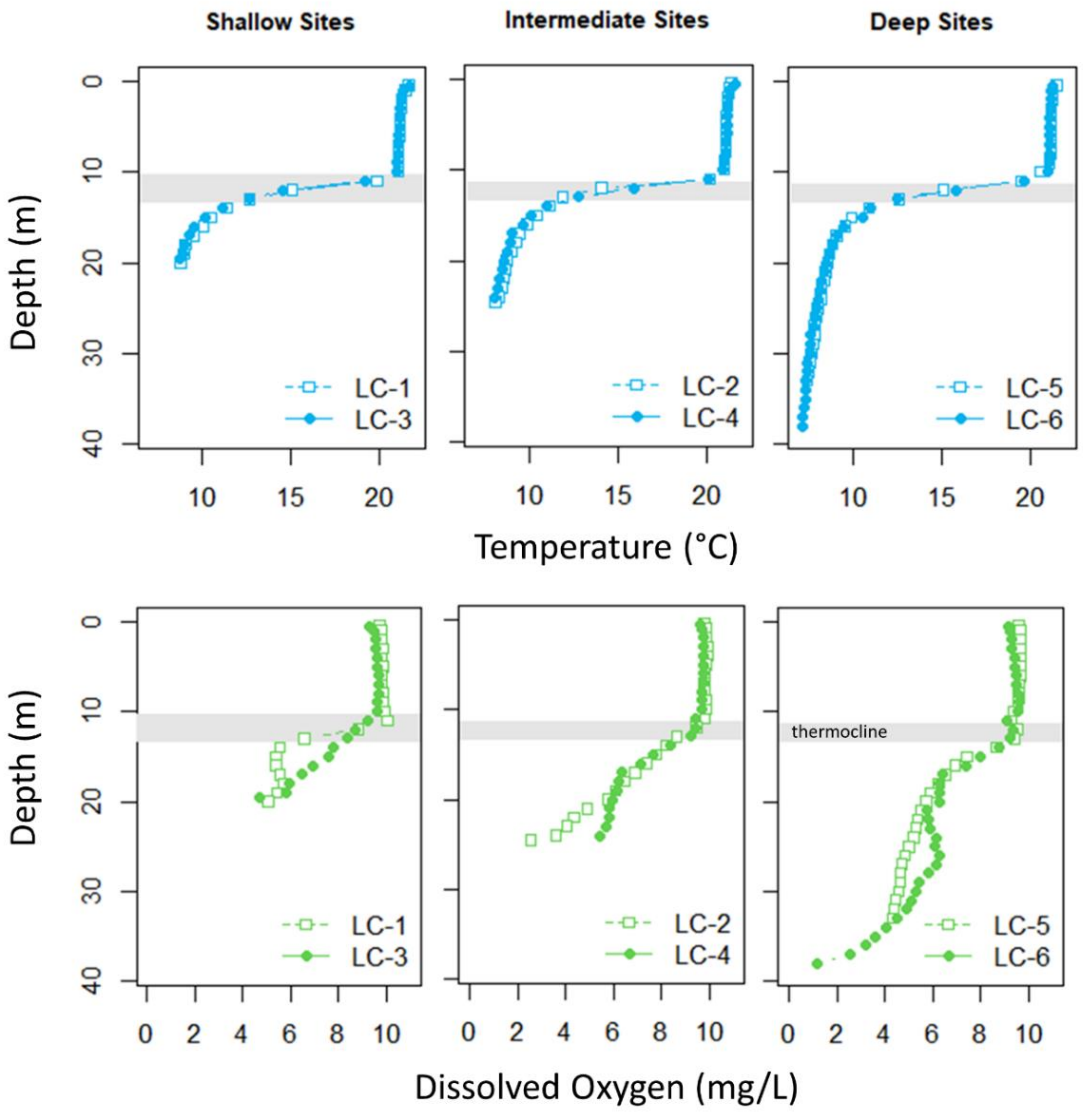


Figure 4. Temperature and Dissolved Oxygen Profiles Measured by HESL on 7 September 2022.

Based on our survey, it is clear that hypolimnetic DO can exhibit considerable spatial (horizontal) variation within Lake Clear, even among locations of comparable depth (i.e., compare the sets of DO profiles in each panel of Figure 4). For this reason, we calculated MVWHDO based on profiles from all six sampling stations by averaging 2 profiles within each of 3 depth ranges (shallow, medium, deep). MVWHDO was calculated separately for each depth range, then weighted by the respective area (based on bathymetry) in order to calculate the MVWHDO for the entire lake (Table 6). The MVWHDO for Lake Clear on 7 September 2022 was determined to be 6.20 mg/L. The MVWHDO would be estimated as 6.58 mg/L (i.e., overestimated by 6%) if calculations were made based only on data from the deepest location of the lake (Table 6). This is because the rate of hypolimnetic oxygen depletion is a function of both the oxygen demand of the sediments and the volume of the hypolimnion; thus, (volumetric) oxygen demand is greater in shallow areas where the hypolimnion is thinner (assuming comparable areal sediment oxygen demand among depths). The MVWHDO of Lake Clear was higher in 2022 than it has been in previous years (Table 7) but all concentrations are less than the Provincial criterion of 7 mg/L that is protective of Lake Trout habitat.

Table 6. Calculation of the MVWHDO of Lake Clear on 7 September 2022.

Sites	Hypolimnion (m)	Min. DO (mg/L)	Depth Range (m)	Area in Depth Range (m^2)	Area (fraction)	MVWHDO (mg/L)	Area × MVWHDO
LC-1, LC-3	14–21	4.70	14–21	4,678,423	0.8288	6.10	5.06
LC-2, LC-4	15–25	2.55	21–25	364,388	0.0646	6.79	0.44
LC-5, LC-6	15–39	1.17	≥25	602,077	0.1067	6.58	0.70
					Lake MVWHDO (mg/L):		**6.20**

Table 7. All Available MVWHDO Estimates for Lake Clear.

Data Collector	Date	Depth Range (m)	Min. DO (mg/L)	MVWHDO (mg/L)
MECP	2003-09-05	14–37	0.29	3.57
	2010-09-16	14–36	0.05	2.15
	2011-09-12	14–37	0.50	4.33
	2018-09-26	14–38	0.24	3.33
HESL	2022-09-07	14–39	1.17	6.20
			Average:	**3.92**

4.2 Lakeshore Capacity Modelling

4.2.1 Model Calibration

The LCM was used to predict natural and anthropogenic phosphorus loads and concentrations for Lake Clear. Lake/catchment-specific input data for the LCM were determined from government sources and the HESL lake survey (Table 9). Municipal Property Assessment Corporation (MPAC) data were provided by the County of Renfrew to determine development inputs. The LCM incorporates P loading from homes/cottages based on either permanent (2.56 capita-years/year), extended seasonal (1.27 capita-years/year), or seasonal (0.69 capita-years/year) occupancy[1], whereas MPAC classifies residences as either permanent or seasonal. Because the actual duration of occupancy of non-permanent residences is not known, the lots categorized as seasonal by MPAC were modelled as extended seasonal as per a conservative approach to lakeshore development and generally consistent with MECP guidance for non-permanent properties with year-round road access[2]. In addition, satellite imagery (Google Earth) and an online campsite map[3] were consulted to determine the number and type of dwellings associated with the Whispering Pines Resort and the Opeongo Mountain Resort, respectively.

4.2.1.1 Phosphorus Retention by Soil

The coefficient for phosphorus retention by soil (Rs) is of particular importance to the LCM. Rs represents the fraction of the septic-system phosphorus load that reaches the lake; thus, the increase in TP concentration above the background concentration predicted by the LCM is linearly dependent on the magnitude of Rs. MECP guidance is to assume Rs is zero unless site-specific soil assessment supports a higher value of Rs (MOE 2010). However, research has shown that septic system phosphorus is immobilized in soils. Mechanistic evidence (Stumm and Morgan 1970; Jenkins et al. 1971; Isenbeck-Schroter et al. 1993) and direct observations made in septic systems (Willman et al. 1981; Zanini et al., 1998; Robertson et al. 1998; Robertson 2003) show strong adsorption of phosphate on charged soil surfaces and mineralization of phosphate with iron and aluminum in soil. Robertson et al. (2019) summarized phosphorus concentrations in groundwater plumes from 24 septic systems throughout Ontario that were monitored over a 30-year period. Phosphorus removal averaged 97% at the non-calcareous sites and 69% at the calcareous sites. Trophic status modelling supports the mechanistic and geochemical evidence: Dillon et al. (1994) reported that only 28% 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 tills that were found in the catchment (Mollard et al. 1980; Gartner Lee Ltd. 2005).

The soils surrounding Lake Clear (and its islands) are predominantly of the Tweed type, with Westmeath and Eganville soils also covering parts of the shoreline (Figure 5; Gillespie et al. 1964). The parent material of these soils is calcareous (Table 8; Gillespie et al. 1964) and the Tweed series that dominates the

[1] *In this context, a capita-year/year represents 1 person living in a residence on an annual basis; e.g., the P loading from a residence with 2.56 capita-years/year would be the P load expected to come from, on average, 2.56 people in a year.*

[2] *"In cases where usage rates are unknown and where there is no winter road access, MOE recommends using the seasonal rate of 0.69 capita years per year as a default. The extended seasonal rate of 1.27 capita years per year should be used for other non-permanent developments that have reliable year-round access." – MOE (2010)*

[3] *https://www.omresort.ca/images/Map-Opeongo-Mountain-Resort.pdf*

shoreline was described as being “associated with surface outcrops of crystalline limestone” and >25% coverage of bare rock; therefore a value of 0.69 was assumed for Rs, consistent with the aforementioned findings of Robertson et al. (2019). Calcareous inputs were also confirmed through observation of basic lake pH (i.e. pH > 8; see Table 3).

Table 8. Soils Surrounding Lake Clear.

Shoreline Distance (m)	Proportion of Total		Soil Type	Phases	Soil Parent Material
	Excl. Islands	Incl. Islands			
5,692	18.1%	13.4%	Eganville	loam	Calcareous loam till.
6,233	19.8%	14.6%	Westmeath	gravelly sandy loam	Calcareous fine to medium gravel.
19,488	62.0%	45.7%	Tweed	sandy loam	Calcareous till.
11,194	-	26.3%	Tweed	sandy loam	Calcareous till.

Note: Soil data are from Gillespie et al. (1964); linear shoreline coverage for each soil type was calculated using Google Earth.

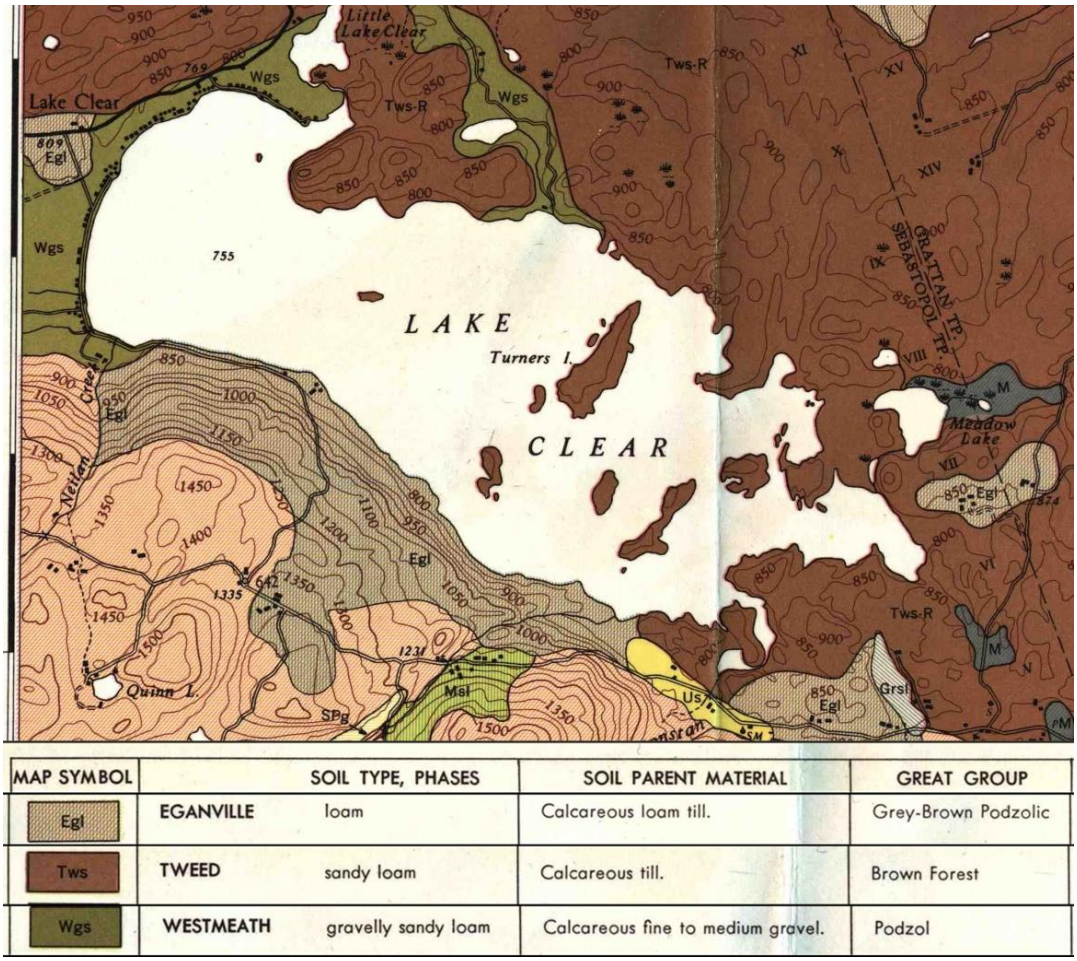


Figure 5. Soils Surrounding Lake Clear.

Note: Map was composed from images in Gillespie et al. (1964).

Table 9. Lakeshore Capacity Model Input Data and Sources.

Category	Input Value	Parameter	Data Source	Note
Shoreline Development	208	Lots occupied all year (1.73 kg-P/lot/y)[1]	MPAC, Google Earth, Opeongo map	Includes 19 farms with residents and the main buildings of each of the 2 resorts.
	267	Lots occupied on an extended seasonal basis (0.88 kg-P/lot/y)[2]	MPAC	
	135	Seasonal lots (0.50 kg-P/lot/year)[3]	Opeongo map	40 from Whispering Pines + 95 seasonal rentals at Opeongo
	46	RVs on existing lots (0.46 kg-P/lot/year)	LCPOA	Same P export as seasonal lots but without stormwater load (largely accounted for in seasonal lot loading as most RVs are on developed lots).
	8	Campgrounds/tent trailers/RV parks (0.28 kg-P/lot/year)[4]	MPAC, Opeongo map	8 rentals of Opeongo Mountain Resort.
	170	Vacant lots of record (0.88 kg-P/lot/year)[5]	MPAC	Vacant lots with RVs included under “RVs on existing lots” (above).
	0.69	Retention by Soil	Gillespie et al. (1964); Robertson et al. (2019)	For calcareous soils.
Catchment	1,727 ha	Lake area	Fish ON-Line (MNRF)	
	7,566 ha	Catchment area	OWIT (MNRF)	Ontario Watershed Information Tool
	10.3 $mg/m^2/y$	Natural P loading	MMA (1986)	P export coefficient for sedimentary watersheds with <15% cleared land
	5.7%	Wetland coverage	OWIT (MNRF)	Wetland export not included in calculation of natural P loading; natural loading based on 10.3 $mg/m^2/yr$ (see above) because of calcareous parent material.
	9.9%	Cleared land	OWIT (MNRF)	Ontario Watershed Information Tool
Hydrological Flow	0.352 m/y	Mean annual runoff	Canada Dept. of Fisheries & Environment	From database recommended for use with LCM.
Sedimentation	7.2 m/y	Settling velocity	MECP and HESL survey data (Section 4.1.4)	Standard settling velocity used in LCM for anoxic hypolimnion.

Monitoring Data	8.72 µg/L	Average TP during spring-overturn	Lake Partner Program (MECP)	Station 2453; Sites #1–5; annual averages (May–June) for 2002–2020.

[1]2.56 capita-y/y × 0.66 kg-P/capita/y + stormwater load of 0.04 kg-P/lot/y; [2]1.27 capita-y/y × 0.66 kg-P/capita/y + stormwater load of 0.04 kg-P/lot/y; [3]0.69 capita-y/y × 0.66 kg-P/capita/y + stormwater load of 0.04 kg-P/lot/y; [4]0.37 capita-y/y × 0.66 kg-P/capita/y + stormwater load of 0.04 kg-P/lot/y; [5]Assumes vacant lots will be converted to extended seasonal.

In addition to the baseline scenario described above (i.e., for the existing lakeshore development density), 4 additional scenarios were modelled based on densities of 1 to 4 RVs per lot (of any type; i.e., permanent + extended seasonal + seasonal lots). In the case of shoreline RVs, the relevant factors are the number of RVs and the method of wastewater treatment and disposal. The modelling assumes that the LCM's recommended phosphorus loading rate for seasonal dwellings of 0.46 kg/year is applicable for the RVs (i.e., 0.69 capita years/year × 0.66 kg-P/capita/year); stormwater loading (0.04 kg/lot/year) is not included for the RVs because it is already accounted for in the model (i.e., because the RVs are assumed to reside on existing lots). The predicted effect of additional RVs on lake TP was also used to predict changes in MVWHDO, as described in Section 4.3.

4.2.2 Model Accuracy

The predicted spring-overturn TP concentration of Lake Clear is 9.27 µg/L, 6.3% higher than the measured spring-overturn concentration of 8.72 µg/L; model output is considered valid if error is ≤20% (MOE 2010).

4.2.3 Predicted Phosphorus Concentrations

The predicted existing TP concentration of Lake Clear during the ice-free season ("TPlake") is 8.64 µg/L. Assuming the vacant lots are converted to extended seasonal use (as recommended by MECP), the predicted future TP concentration ("TPfuture") is 8.99 µg/L. This concentration is ~26% higher than the predicted background (pre-development) concentration of 7.11 µg/L meaning that the lake has additional development capacity based on Lakeshore Capacity Modelling. Without exceeding the PWQO of 10.67 µg/L, the TP load could be increased by 534 kg/y; this is the load that is estimated to come from 146 permanent residences (or 291 extended seasonal residences or 522 seasonal cottages/RVs).

4.3 Dissolved Oxygen Modelling

The empirical models of Molot et al. (1992) were used to predict end-of-summer DO concentrations for Lake Clear and how these would be affected by increases in lake TP concentration from the addition of RVs to existing lakeshore lots.

4.3.1 Modeling Methodology

The lake-specific parameters of the models presented in Molot et al. (1992) are bathymetry, lake area, fetch, and spring TP concentration.

Spring-overturn DO concentration was estimated at a 1-m depth interval based on the relationship:

$$\log_{10}DO(z) = 1.07 - 6.95 \div A_0 - 0.0043 \times z \div MD \quad (1)$$

where A_0 is the area of Lake Clear (1727 ha), z is depth (0–40 m), and MD is fetch ("maximum distance across the lake in any direction on a line through the sampling station"; 8.5 km).

Mean end-of-summer DO concentration was then estimated at a 1-m depth interval for the hypolimnion (14–40 m) based on the relationship:

$$\log_{10}DO(z) = 1.83 - 1.91 \div VSA_z - 7.06 \div DO_z - 0.0013 \times TP^2 \quad (2)$$

where VSA_z is the ratio of the volume of water to sediment area for each 1-m contour, DO_z is the spring oxygen concentration estimated via equation 1, and TP is the spring TP concentration (either measured or predicted by the LCM).

MVWHDO was calculated from the predicted depth-specific DO concentrations based on the same bathymetric data (contour volumes) used in Section 4.1.4.

4.3.2 Predicted Dissolved Oxygen

Based on the models of Molot et al. (1992) and the *measured* long-term spring-overturn TP concentration of 8.72 µg/L, the predicted end-of-summer MVWHDO of Lake Clear is 6.34 mg/L. Based on the *modelled* TP_{SO} of 9.27 µg/L the predicted MVWHDO is 6.15 mg/L (Table 10). Both MVWHDO estimates are within 2% of the measured value of 6.20 mg/L (Table 6), representing very close agreement between modelled and observed data. Based on the modelled TP_{SO} without anthropogenic phosphorus loading (7.73 µg/L), MVWHDO would have been 6.7 mg/L in the absence of lakeshore development, according to the model, which is notable as it is less than the Provincial criterion of 7 mg/L.

The effect of RVs on Lake Clear's MVWHDO is dependent on the RV density, with the predicted MVWHDO ranging from 5.95 mg/L (-3%) at only 1 RV/lot to 5.32 mg/L (-13%) at 4 RVs/lot (Table 10). At 6.2 mg/L, the current late-summer MVWHDO of Lake Clear is already below the 7 mg/L recommended by MNRF for protection of Lake Trout habitat.

Table 10. Predicted TP and MVWHDO as a Function of Additional RV Density on Existing Lots.

RVs (#/lot)	TP_{SO} (µg/L)	TP_{lake} (µg/L)	TP_{future} (µg/L)	TP_{lake}:TP_{bk} (%)	TP_{future}:TP_{bk} (%)	MVWHDO (mg/L)	Decrease in MVWHDO (%)
0	9.27	8.64	8.99	122	126	6.15	–
1	9.85	9.21	9.73	130	137	5.95	3.3
2	10.43	9.78	10.46	138	147	5.74	6.6
3	11.01	10.36	11.2	146	158	5.53	10.0
4	11.58	10.93	11.93	154	168	5.32	13.4

4.4 Summary

The development capacity of Lake Clear has been assessed with respect to concentrations of TP and MVWHDO using the LCM and the oxygen models of Molot et al. (1992). Based on these models:

- 146 permanent residences (or 291 extended seasonal residences or 522 seasonal cottages/RVs) could be added to Lake Clear's shoreline without exceeding the phosphorus PWQO of background+50%;

- Alternatively, 2 RVs could be added to each existing lot (permanent, extended seasonal, and seasonal) without exceeding the phosphorus PWQO (assuming extended seasonal development of vacant lots);

- At 6.20 mg/L, MVWHDO is currently below the 7 mg/L concentration recommended by MNRF for Lake Trout habitat and is therefore at capacity based on that criterion. Based on the modelled TP_{SO} without anthropogenic phosphorus loading (7.73 µg/L), MVWHDO would have been 6.7 mg/L in the absence of lakeshore development which is less than the Lake Trout criterion of 7 mg/L;

- The addition of 2 RVs to each existing lot is predicted to decrease MVWHDO by approximately 7% (~0.4 mg/L) based on additional phosphorus loading to the lake.

These predictions are highly dependent on the assumed rate of attenuation of septic system phosphorus by soil. We calibrated the LCM using a retention coefficient (Rs) of 0.69, based on the findings of Robertson et al. (2019) and the calcareous nature of the soil parent material in the area surrounding Lake Clear. In practice, the degree to which septic system phosphorus is immobilized by soil will depend largely on the type of sewage treatment and on the specific properties of the soil between the infiltration bed and the lake. Non-native (imported) iron-rich soils can be used in the construction of septic drain fields to enhance phosphorus immobilization. Holding tanks are commonly used in RVs and in theory result in the complete removal of effluent and the associated nutrient load from the study area. The importance of properly designed and maintained sewage treatment systems are further discussed in Section 5.1.

5. Waterfront Best Management Practices

Waterfront Best Management Practices (BMPs) are commonly implemented to minimize impacts of development on adjacent water quality and ecological features. The scientific underpinning of common waterfront development BMPs is described in the following paragraphs to provide an understanding of how the underlying mechanisms relate to reducing development-related impacts; information which can be used to help guide RV policy development.

5.1 Sewage Treatment Systems

Research over the past 20 years has consistently shown that a large proportion of septic system phosphorus is immobilized in soils as discussed in Section 4.2.1.1. Proper septic system design and maintenance is important to maximizing phosphorus attenuation in on-site soils and minimizing impacts to Lake Clear. 60% of respondents identified faulty or poorly maintained septic systems as an issue faced by Lake Clear and 55% ranked a septic reinspection program the top action to benefit the lake (Love Your Lake 2022). Proper sewage servicing of existing residences and cottages, as well as future RVs is required to protect the health of Lake Clear.

The County of Renfrew Official Plan (County of Renfrew 2020) contains a number of policies focused on sewage treatment systems on at-capacity lakes:

> *9.3(2)The following provisions shall apply to all lands abutting (within 300 metres) of an At Capacity Lake*
>
> *a) Lot creation shall not be permitted within 300 metres of any at capacity lake unless:*
>
> > *(iii) A site-specific soils investigation prepared by a qualified professional demonstrates that phosphorus can be retained in deep, native, acidic soils on-site. A report, prepared by a qualified professional, is required to demonstrate that there will be no negative impact on the lake water quality as a result of any development. Site plan control may be utilized by the local municipality to implement any recommended mitigation measures.*
>
> *(d) Development on existing lots with lakeshore frontage shall only be permitted under the following conditions:*
>
> > *(ii) All buildings and structures and associated private waste disposal systems shall have a minimum setback of 30 metres from the high water mark of the lake, or in the case or existing lots, where this setback cannot be met, the setback shall be as remote from the high water mark as the lot will permit to the satisfaction of the Local Council and the applicable approval authority for the private waste disposal system.*
> >
> > *(iii) All new permits issued by the applicable approval authority for private waste disposal systems which involve construction of tile beds will be conditional upon the use of a fill material known to have a good phosphorus retention capability.*

5.2 Shoreline Buffers

Shorelines link terrestrial and aquatic ecosystems, acting as a transition zone between land and water. They are biological hotspots and highly productive habitats that provide a myriad of ecological services, including maintenance of water quality, flood protection, and wildlife habitat (HESL 2021b). Residential development is often concentrated around shorelines, and most development-related impacts to freshwater habitats occur in the nearshore environment. Natural shoreline vegetation is commonly cleared during development and replaced partially or completely by manicured lawn. If not properly managed, waterfront development can degrade sensitive shoreline habitats, and alter the ecological integrity of adjacent lakes and rivers. Based on a recent survey, 16% of Lake Clear's shoreline is developed, 79% is natural, and the remaining shoreline is manicured, degraded, or regenerative (Love Your Lake 2022). It has been observed that 15% of Lake Clear's properties are mown to the water's edge and recommended that riparian buffer width be increased on 34% of Lake Clear's shoreline (Love Your Lake 2022).

Shoreline buffers can play an important role in protecting lake health. The physical separation they provide between upland human activity and the aquatic environment can aid in mitigating the effects of development and site alteration on water quality and wildlife habitat, while providing erosion and flood control. In general, larger buffers are better at consistently providing a range of protective functions. A 15 m buffer has been found to be the minimum size necessary to maintain physical and chemical functions while 30 m is the

minimum necessary to maintain biological functions (Beacon et al. 2012; Castelle et al. 1994; HESL 2021b). Efficient removal of some pollutants (notably sediment) can occur in buffers of 10-20 m width, but other pollutants (such as nutrients) may require buffer widths of 30 m or more for effective attenuation. Water quality improvements generally increase with buffer size (e.g., 10 m removes 65% of sediment from overland runoff while 30 m removes 85% of sediment from overland runoff; Sweeney and Newbold 2014). Larger buffers are also better at protecting the diversity of aquatic and terrestrial species that rely on shorelines.

In Section 2.2 (11) of the County of Renfrew Official Plan (County of Renfrew 2020) it is stipulated that, with certain exceptions, buildings and septic systems are to be set back at least 30 m from the water:

> *Generally all buildings and structures and associated private waste disposal systems will be set back a minimum horizontal distance of 30 metres (or approximately 100 feet) from the normal high water mark of a water body.*

It has been reported (Love Your Lake 2022) that 69% of the properties on Lake Clear are within 30 m of shore (i.e., do not meet the policy requirement).

Section 9.3 (2) discusses shoreline buffer requirements on at-capacity lakes:

2(d)(iv) *The property between the shoreline of the lake and the dwelling or private waste disposal system will be retained where possible in its natural state to serve as a buffer which will assist in minimizing the land-surface transport of nutrient laden silt to the lake. The retention of the natural soil mantle and natural vegetation within 30 metres of the shoreline of the lake will be encouraged.*

The scientific literature demonstrates that a 30 m buffer provides a range of ecological services, and this buffer size is commonly recommended in the peer-reviewed literature focused on shoreline development. Existing planning policy recommends that 30 m naturally vegetated buffers and such buffers should be continue to be required on all lots on Lake Clear.

Stormwater management features that include provisions to maximize infiltration and limit stormwater runoff should also be utilized to minimize development-related impacts on Lake Clear. Specific options include proper re-contouring, discharging of roof leaders, use of soak away pits and other measures to promote infiltration, grassed and vegetated swales, filter strips, roof leaders and French drains. Stormwater management options are often site specific, and the best approach will be dictated by site characteristics and the nature of the proposed development.

6. Conclusions

A Lakeshore Capacity Assessment was completed to determine the development capacity of Lake Clear and inform the development of planning policy for the establishment and use of RVs on the lake. The assessment included Lakeshore Capacity Modelling and comparison with the TP PWQO, measured and modelled MVWHDO concentrations and comparison with the Provincial criterion of 7 mg/L to protect Lake Trout habitat, and examination of water quality data to provide a holistic assessment of lake health and capacity.

Lake Clear is under capacity according to Lakeshore Capacity Modelling results and the TP PWQO. It is over capacity with respect to MVWHDO as concentrations are <7 mg/L but modelling indicates that MVWHDO concentrations were slightly below 7 mg/L prior to development. Water quality is good and there are no increasing trends in nutrient concentrations. Cyanobacteria (i.e. blue-green algae) was however observed during site investigations and climate change is increasing the amount of cyanobacteria in oligotrophic lakes (Reinl et al. 2021). While both factors are known to promote cyanobacterial blooms, the future effects of climate change and anthropogenic nutrient loading on algal blooms in Lake Clear cannot be quantitatively assessed based on available data. However, based on what is generally known about climate change effects on lake stratification and the life cycle of cyanobacteria such as *Gloeotrichia* (Cottingham et al. 2021), it is expected that blooms will become more frequent in Lake Clear even if nutrient loading remains unchanged; increased nutrient loading would be expected to promote more frequent and/or more severe blooms. With respect to the potential for interactive effects between increased nutrients and climate, a large-scale (>1,000 lake) US study (Rigosi et al. 2014) found no synergistic effect of temperature and nutrients on cyanobacterial biovolume in oligotrophic lakes (i.e., the combined effect of increased nutrients and increased temperature was not greater than the sum of the individual effects).

Shoreline development, including RV use, can impact a lake through stormwater and wastewater inputs as well as associated recreational uses such as boating. Impacts can be largely mitigated through implementation of BMPs such as properly designed and maintained sewage treatment systems, the retention or establishment of naturally vegetated shoreline buffers and stormwater management features that maximize infiltration and minimize runoff. Currently the use of RVs of Lake Clear is unregulated and therefore it is not known if they are properly serviced via appropriately sized tile beds or holding tanks that are pumped out regularly. We underscore that the impact of RVs on the lake's water quality depends not only on the number of shoreline RVs but also the effectiveness of RV wastewater management in minimizing nutrient loading to the lake.

6.1 Recommendations

The following recommendations were developed to help the Township develop science-based planning policy for RV use on Lake:

- Permit the use of 1 or 2 RVs on each of the 610 existing lots modelled in this study (i.e., permanent + extended seasonal + seasonal occupancy lots; see Table 9) if appropriate BMPs are developed and enforced to ensure that impacts to Lake Clear are minimized. The modelled impact of two additional RVs/lot results in TP concentrations that are less than the PWQO for TP. The lake is at capacity based on MVWHDO but based on modelling results, it appears that MVWHDO concentrations have always been below the 7 mg/L criterion, and BMPs can be utilized to minimize impacts.

- Sewage treatment systems to service the RVs should meet Ontario Building Code requirements. Systems designed to maximize the amount of phosphorus attenuation should be encouraged such as the Waterloo Biofilter with EC-P unit, EcoFlo Biofilter or the use of a tank and bed system that incorporates soils that are high in phosphorus retention, aluminum and iron, and low in calcium carbonate.

- A 30 m naturally vegetated shoreline buffer should be required on all lots, especially lots with RVs that have the potential to generate additional stormwater and wastewater. Continued retention or establishment of natural vegetation over time should be encouraged through stewardship actions and enforced as necessary.

- Stormwater management features that maximize infiltration and limit stormwater runoff should be encouraged on all lots, especially those with RVs that have the potential to generate additional stormwater, to minimize development-related impacts on Lake Clear.

- Water quality and the effectiveness of BMPs should be monitored. Water quality should continue to be monitored through the Lake Partner Program, and dissolved oxygen measurements should be collected annually at the end-of-summer (August 15 – September 15) so that Mean Volume-Weighted Hypolimnetic Dissolved Oxygen concentrations can be calculated and tracked over time. The implementation and management of BMPs should be assessed through visual inspections.

7. References

Amato, M. S., B. R. Shaw, E. Olson, N. Turyk, K. Genskow, and C. F. Moore. 2016. The challenge of motivated cognition in promoting lake health among shoreline property owners: biased estimation of personal environmental impact. Lake and Reservoir Management 32: 386–391.

Beacon Environmental Ltd. (Beacon) 2012. Ecological Buffer Guideline Review. Prepared for Credit Valley Conservation. 139 pp.

Carey, C.C., Ewing, H.A., Cottingham, K.L. et al. 2012. Occurrence and toxicity of the cyanobacterium *Gloeotrichia echinulata* in low-nutrient lakes in the northeastern United States. Aquatic Ecology, 46: 395–409.

Castelle, A. J., A. W. Johnson, and C. Conolly. 1994. Wetland and stream buffer size requirements – a review. Journal of Environmental Quality 23: 878–882.

CISEC Canada. 2011. Certified Inspector of Sediment and Erosion Control Training Manual.

Cottingham, K.L., Weathers, K.C., Ewing, H.A., Greer, M.L. and Carey, C.C. 2021. Predicting the effects of climate change on freshwater cyanobacterial blooms requires consideration of the complete cyanobacterial life cycle. Journal of Plankton Research: 43: 10–19.

County of Renfrew. 2020. County of Renfrew Official Plan. March 26, 2020. Adopted by County Council: March 27, 2002. Approved by the Ministry of Municipal Affairs and Housing: June 16, 2003. Consolidated: January 4, 2023.

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 Reservoir Management, 8: 121–129.

Gartner Lee Ltd. 2005. Recreational Water Quality Management in Muskoka. Prepared for The Department of Planning and Economic Development, District Municipality of Muskoka. June 2005. 145 pages.

Gillespie, J.E., Wicklund, R.E., and Matthews, B.C. 1964. Soil Survey of Renfrew County: Report No. 37 of the Ontario Soil Survey. Canada Department of Agriculture and Ontario Department of Agricultural.

Hutchinson Environmental Sciences Ltd. 2021b. Natural Shorelines and their Role in the Protection of Water Quality and Aquatic Habitat – State of the Science Report. Prepared for the County of Haliburton.

Isenbeck-Schroter, M., U. Doring, A. Moller, J. Schroter and G. Matthe. 1993. Experimental approach and simulation of the retention processes limiting orthophosphate transport in groundwater. J. Contam. Hydrol. 14: 143–161.

Jenkins, D., Ferguson, J.F., and A.B. Menar. 1971. Chemical processes for phosphate removal. Water Research 5: 369–389.

Love Your Lake 2022. Lake Clear Values Survey and Lake Summary Report. A program of Watersheds Canada and the Canadian Wildlife Federation.

Ministry of Environment and Energy (MOEE). 1994. Water Management: Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy. July, 1994. Queen's Printer for Ontario.

Ministry of the Environment (MOE). 2010. Lakeshore Capacity Assessment Handbook – Protecting Water Quality in Inland Lakes on Ontario's Precambrian Shield.

Ministry of Environment and Climate Change (MOECC). 2016. Water Quality and Management of Lake Trout Lakes – County of Renfrew 2011. August 2016. Queen's Printer for Ontario.

Ministry of Municipal Affairs (MMA). 1986. Lakeshore Capacity Study: Trophic Status. Prepared by: Dillon, P.J., Nicholls, K.H., Scheider, W.A., Yan, N.D. and Jefferies, D.S. May 1986. Printed by the Queen's Printer for Ontario. 89 pages.

Ministry of Natural Resources and Forestry (MNRF). 2015. Inland Ontario Lakes Designated for Lake Trout Management.

Mollard, D.G. 1980. Southern Ontario Engineering Geology Terrain Study. Database Map, Muskoka Area. Parry Sound and Muskoka District, Ontario Ministry of Natural Resources. Ontario Geological Survey Open File Report 5323.

Molot, L.A., Dillon, P.J., Clark, B.J., and Neary, B.P. 1992. Predicting end-of-summer oxygen profiles in stratified lakes. Canadian Journal of Fisheries and Aquatic Sciences, 49: 2363–2372.

Ministry of Natural Resources and Forestry (MNRF) 2023. Ontario Watershed Information Tool (gov.on.ca)

Reinl, K.L., et al. 2021. Cyanobacterial blooms in oligotrophic lakes: Shifting the high-nutrient paradigm. Freshwater Biology, 1-14. DOI: 10.1111/fwb.13791.

Rigosi, A., Carey, C.C., Ibelings, B.W., and Brookes, J.D. 2014. The interaction between climate warming and eutrophication to promote cyanobacteria is dependent on trophic state and varies among taxa. Limnology and Oceanography. 59: 99–114.

Robertson, W.D., Schiff, S.L. and C.J. Ptacek. 1998. Review of phosphate mobility and persistence in 10 septic system plumes. Ground Water, 36: 1000–1010.

Robertson, W.D., 2003. Enhanced attenuation of septic system phosphate in noncalcareous sediments. Groundwater, 41: 48–56.

Robertson, W.D. 2012. Phosphorus Retention in a 20-Year-Old Septic System Filter Bed. Journal of Environmental Quality 41: 1437–44.

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

Semlitsch, R. D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12: 1113–1119.

Stumm and Morgan, 1970. Aquatic Chemistry – An Introduction Emphasizing Chemical Equilibria in Natural Waters. Wiley Interscience, New York, 583 pp.

Sweeney, B. W. and J. D. Newbold. 2014. Streamside forest buffer width needed to protect stream water quality, habitat, and organisms: a literature review. Journal of the American Water Resources Association 50: 560–584.

Willman, B.P., G.W. Petersen and D.D. Frinton. 1981. Renovation of septic tank effluent in sand-clay mixtures. Journal of Environmental Quality 10: 439–444.

Zanini, K., Robertson, W.D., Ptacek, C.J., Schiff, S.L. and T. Mayer. 1998. Phosphorus Characterization in Sediments Impacted by Septic Effluent at Four Sites in Central Canada. Journal of Contaminant Hydrology, 33: 405–429.

Appendix A. Temperature & Dissolved Oxygen Profiles

HESL Profiles - 7 September 2022

	LC-1		LC-2		LC-3		LC-4		LC-5		LC-6	
m	Deg. C	mg-O2/L	Deg. C	mg-O2/L	Deg. C	mg-O2/L	Deg. C	mg-O2/L	Deg. C	mg-O2/L	Deg. C	mg-O2/L
0.5	21.7	9.73	21.4	9.79	21.7	9.31	21.6	9.61	21.5	9.59	21.3	9.15
1.0	21.5	9.78	21.3	9.87	21.4	9.51	21.4	9.70	21.3	9.64	21.2	9.23
2.0	21.3	9.83	21.2	9.89	21.3	9.57	21.3	9.73	21.3	9.65	21.2	9.28
3.0	21.3	9.84	21.2	9.91	21.2	9.58	21.2	9.73	21.2	9.65	21.2	9.32
4.0	21.2	9.82	21.1	9.90	21.2	9.61	21.2	9.77	21.2	9.65	21.1	9.40
5.0	21.2	9.84	21.1	9.85	21.2	9.64	21.2	9.78	21.2	9.65	21.1	9.46
6.0	21.2	9.83	21.1	9.82	21.1	9.66	21.2	9.76	21.2	9.64	21.1	9.50
7.0	21.1	9.82	21.1	9.77	21.1	9.70	21.1	9.75	21.2	9.63	21.1	9.52
8.0	21.1	9.86	21.1	9.82	21.1	9.68	21.1	9.72	21.2	9.58	21.1	9.59
9.0	21.1	9.89	21.0	9.87	21.0	9.65	21.0	9.70	21.1	9.57	21.1	9.60
10.0	21.1	9.93	21.0	9.88	21.0	9.63	20.9	9.66	20.6	9.37	21.0	9.54
11.0	19.9	10.05	20.2	9.83	19.2	9.21	20.1	9.46	19.5	9.30	19.7	9.13
12.0	15.1	8.83	14.1	9.46	14.6	8.71	15.9	9.44	15.1	9.52	15.8	9.37
13.0	12.7	6.57	11.9	8.63	12.7	8.35	12.8	9.21	12.6	9.43	12.5	9.23
14.0	11.4	5.57	11.2	8.17	11.2	7.82	11.0	8.40	10.9	8.69	11.0	8.79
15.0	10.5	5.38	10.4	7.80	10.2	7.62	10.1	7.67	9.9	7.41	10.6	7.96
16.0	10.1	5.38	9.9	7.40	9.6	6.93	9.7	7.16	9.6	6.93	9.5	7.42
17.0	9.6	5.55	9.5	6.92	9.3	6.45	9.0	6.36	9.1	6.53	9.1	6.40
18.0	9.1	5.70	9.2	6.46	9.1	5.94	8.9	6.20	8.9	6.25	8.9	6.25
19.0	9.0	5.44	9.0	6.09	9.0	5.81	8.8	6.16	8.7	5.93	8.7	6.30
19.5	-	-	-	-	8.8	4.70	-	-	-	-	-	-
20.0	8.8	5.06	8.8	5.75	-	-	8.6	5.97	8.6	5.72	8.5	6.29
21.0	-	-	8.6	4.89	-	-	8.5	5.85	8.5	5.54	8.4	5.78
22.0	-	-	8.6	4.36	-	-	8.3	5.81	8.4	5.36	8.2	5.84
23.0	-	-	8.5	4.06	-	-	8.2	5.69	8.3	5.30	8.1	5.90
24.0	-	-	8.3	3.60	-	-	8.1	5.41	8.2	5.21	8.0	6.15
24.5	-	-	8.1	2.55	-	-	-	-	-	-	-	-
25.0	-	-	-	-	-	-	-	-	8.0	5.00	7.9	6.07
26.0	-	-	-	-	-	-	-	-	7.9	4.85	7.8	6.29
27.0	-	-	-	-	-	-	-	-	7.9	4.71	7.8	6.13
28.0	-	-	-	-	-	-	-	-	7.8	4.64	7.7	5.83
29.0	-	-	-	-	-	-	-	-	7.8	4.63	7.6	5.40
30.0	-	-	-	-	-	-	-	-	7.7	4.57	7.6	5.29
31.0	-	-	-	-	-	-	-	-	7.6	4.44	7.5	5.09
32.0	-	-	-	-	-	-	-	-	7.5	4.38	7.4	4.91
33.0	-	-	-	-	-	-	-	-	7.4	4.32	7.4	4.50
34.0	-	-	-	-	-	-	-	-	-	-	7.3	4.07
35.0	-	-	-	-	-	-	-	-	-	-	7.3	3.61
36.0	-	-	-	-	-	-	-	-	-	-	7.3	3.23
37.0	-	-	-	-	-	-	-	-	-	-	7.2	2.52
38.0	-	-	-	-	-	-	-	-	-	-	7.2	1.17

MECP Profiles - Main Basin Site

	2003-09-05		2010-09-16		2011-09-12		2018-09-26	
m	Deg. C	mg-O2/L	Deg. C	mg-O2/L	Deg. C	mg-O2/L	Deg. C	mg-O2/L
0	19.4	8.95	17.7	8.91	20.9	8.98	18.1	9.05
1	19.5	8.91	17.7	8.90	20.8	9.08	18.1	8.97
2	19.5	8.92	17.7	8.88	20.5	9.13	18.1	8.95
3	19.5	8.96	17.7	8.86	20.1	9.19	18.1	8.94
4	19.5	8.94	17.7	8.85	20.0	9.16	18.1	8.94
5	19.5	8.96	17.7	8.85	20.0	9.12	18.0	8.92
6	19.5	8.92	17.7	8.83	19.9	9.10	18.0	8.91
7	19.5	8.96	17.7	8.81	19.9	9.11	18.0	8.90
8	19.5	8.98	17.7	8.81	19.8	9.01	18.0	8.90
9	19.5	8.92	17.7	8.82	19.7	8.97	18.0	8.90
10	19.5	8.95	17.7	8.79	19.7	8.92	17.7	8.75
11	19.5	8.90	17.7	8.77	19.2	8.78	15.9	8.16
12	13.2	7.31	16.9	8.11	14.4	8.11	14.3	6.35
13	11.2	6.32	13.6	6.35	12.0	7.47	11.6	5.68
14	10.1	5.31	11.5	3.68	10.7	6.82	10.3	4.77
15	9.6	4.61	11.4	3.15	10.0	6.00	9.6	4.43
16	9.0	3.90	11.1	2.50	9.6	5.15	9.0	4.03
17	8.9	3.52	11.0	2.37	9.2	4.34	8.6	3.17
18	8.8	3.31	10.7	2.02	9.1	3.92	8.4	2.94
19	8.7	3.28	10.6	1.74	9.0	3.44	8.3	2.80
20	8.5	3.20	10.5	1.52	8.9	3.22	8.1	2.72
21	8.5	2.91	10.5	1.48	8.8	3.16	8.1	2.62
22	8.4	2.86	10.3	1.38	8.7	3.00	8.0	2.61
23	8.3	2.77	10.1	1.34	8.6	2.89	7.9	2.62
24	8.3	2.57	10.0	1.27	8.5	2.79	7.8	2.50
25	8.2	2.52	9.9	1.14	8.4	2.74	7.7	2.28
26	8.2	2.45	9.8	1.03	8.3	2.66	7.6	2.23
27	8.1	2.39	9.6	0.90	8.2	2.29	7.6	2.21
28	8.1	2.29	9.4	0.50	8.1	2.19	7.5	2.16
29	8.1	2.27	9.4	0.34	8.1	2.02	7.5	2.00
30	7.9	1.98	9.3	0.19	8.0	1.86	7.4	1.80
31	7.9	1.88	9.3	0.18	7.9	1.71	7.4	1.71
32	7.8	1.72	9.1	0.09	7.7	1.56	7.3	1.59
33	7.7	1.61	9.1	0.06	7.6	1.31	7.3	1.42
34	7.7	1.18	9.0	0.05	7.6	0.85	7.2	0.99
35	7.6	1.07	8.7	0.05	7.6	0.66	7.2	0.74
36	7.6	0.29	-	-	7.5	0.50	7.1	0.34
37	-	-	-	-	-	-	7.0	0.24

Appendix B. Lakeshore Capacity Model Results

Lakeshore Capacity Model

Lake Clear

Anthropogenic Supply

Shoreline Development Type	Number	Usage (capita years/yr)
Permanent	208	2.56
Extended Seasonal	267	1.27
Seasonal	135	0.69
Resort	0	1.18
Trailer Parks	46	0.69
Youth Camps	0	0.125
Campgrounds/Tent trailers/RV parks	8	0.37
Vacant Lots of Record	170	1.27

no stormwater runoff incl. (most on non-vacant lots)
kg/capita/yr

Retention by soil (Rs) (0-1): 0.69

Catchment

Lake Area (Ao)	1727.0	ha	
Catchment Area (Ad)	7566.0	ha	
Wetland	0.0	%	% wetland set to zero; used 10.3 mg-P/m2/yr
Cleared	9.9	%	as recommended for sedimentary watersheds

Upstream Lakes

Hydrological Flow

Mean annual runoff	0.352	m/yr
Lake outflow discharge (Q)	32711360	m3/yr
Areal water loading rate (qs)	1.89	m/yr
Inflow 1		m3/yr
Inflow 2		m3/yr
Inflow 3		m3/yr

Natural Loading

Atmospheric Load	288.41	kg/yr
Runoff Load	779.30	kg/yr

Upstream Loading

Background Upstream Load 1	kg/yr
Background Upstream Load 2	kg/yr
Background Upstream Load 3	kg/yr
Current Total Upstream Load 1	kg/yr
Current Total Upstream Load 2	kg/yr
Current Total Upstream Load 3	kg/yr
Future Upstream Load 1	kg/yr
Future Upstream Load 2	kg/yr
Future Upstream Load 3	kg/yr

Anthropogenic Loading

Current Anthropogenic Load	229.20	kg/yr
Future Anthropogenic Load	282.01	kg/yr

Areal Load Rate

Current Total Areal Loading Rate (L_T)	75.10	mg/m2/yr
Future Total Areal Loading Rate (L_{FT})	78.15	mg/m2/yr

Sedimentation

Is the lake anoxic?	y	
Settling velocity (v)	7.2	m/yr
In lake retention (Rp)	0.79	

Monitoring Data

Years of spring TP data	19	
Average Measured TPso	8.72	µg/L
Measured vs. Predicted TPso	6.3	%
Is the model applicable?	y	
Over or under predicted?	over	

Modeling Results

TPlake	8.64	µg/L
TPout	8.26	µg/L
TPso	9.27	µg/L
TPfuture	8.99	µg/L

Phosphorus Thresholds

TPbk	7.11	µg/L
TPbk+40	9.96	µg/L
TPbk+50	10.67	µg/L
TPbk+60	11.38	µg/L

*if TPbk+40% < TPlake < TPbk+60% cell is orange
*if TPlake > TPbk+60% cell is red

No. of allowable residences to reach capacity:

# Permanent OR	146
# Extended seasonal OR	291
# Seasonal cottages OR	522

Loads

Natural Load w/no development	1067.71	kg/yr
Background + 50% Load	1601.56	kg/yr
Current Load	1296.91	kg/yr
Future Load	1349.72	kg/yr

Outflow Loads

Background Outflow Load	222.38	kg/yr
Current Outflow Load	270.12	kg/yr
Future Outflow Load	281.12	kg/yr

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