# HYDROGEOLOGICAL INVESTIGATION

# 11210 LAKESHORE ROAD

## TOWNSHIP OF WAINFLEET
## REGION OF NIAGARA

**PREPARED FOR:**

**MOVERIGHT REAL ESTATE BROKERAGE**

**PREPARED BY:**

**C.F. CROZIER & ASSOCIATES INC.**
**2800 HIGH POINT DRIVE, SUITE 100**
**MILTON, ON L9T 6P4**

**DECEMBER 2022**

**CFCA FILE NO. 2292-6449**



CROZIER
CONSULTING ENGINEERS

| Revision Number | Date | Comments |
|---|---|---|
| Rev.0 | December 23, 2022 | Issued for first submission. |

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# 1.0 Background

C. F. Crozier & Associates Inc (Crozier) was retained by MoveRight Real Estate (MoveRight) to complete a hydrogeological assessment to support the proposed residential development located at 11210 Lakeshore Road in Wainfleet, Niagara Region, Ontario. The subject property (Site) is located along the northeast shoreline of Lake Erie, west of the City of Port Colborne (Figure 1).

The following hydrogeological assessment has been prepared in accordance with the Terms of Reference approved by Niagara Region on August 12, 2022. A copy of the Terms of Reference and email approval is included in Appendix A. In summary, the following elements are outlined in the Hydrogeological Assessment Report in accordance with the Terms of Reference:

- Characterize the geology, topography, hydrogeology, hydrostratigraphy, and environmental features around the Site.
- Conduct and evaluate MECP water well records within 500 m of the Site.
- Complete a door-to-door survey within at least 100 m of the Site.
- Complete an impact assessment of the proposed onsite sewage works and subsurface disposal systems.
- Complete a small-scale testpitting program across the Site to confirm soil conditions and potential presence of shallow bedrock.

The following background studies and reports have been reviewed in preparation for this report:

- Lake Erie North Shore Watershed Plan, prepared by Niagara Peninsula Conservation Authority (November 2010)
- Niagara Peninsula Source Protection Area Section 36 Workplan Proposal Final Report, prepared by Niagara Peninsula Conservation Authority (Campbell, November 2017)
- Water Availability Study for the Lake Erie North Shore Watershed Plan Area Niagara Peninsula Source Protection Area, prepared by AquaResource Inc and Niagara Peninsula Conservation Authority (January 2009)
- Township of Wainfleet Official Plan (January 2016)
- The Physiography of Southern Ontario (Chapman and Putnam, 1984)

The Site, located in a rural residential area, is approximately 1.3 ha in size and is currently vacant. The property is pie-shaped and bounded by residential properties to the north and west, and Lakeshore Road to the east and south. Lake Erie is located approximately 0.7 km to the southeast of the Site.

The property is proposed to be severed into three (3) residential lots, each approximately 0.40 to 0.49 ha in size. It is Crozier's understanding that each lot will contain a single residential dwelling and will be serviced by an individual onsite sewage system and cistern. Access to each lot will be provided by driveways to Lakeshore Road.

## 2.0 Source Protection Information

According to the Ministry of Environment, Conservation and Parks (MECP) Source Protection, the Site is located within the Niagara Peninsula Source Protection Area and therefore, all the policies outlined in the Approved Source Protection Plan for Niagara Peninsula Source Protection Area (Niagara Peninsula Source Protection Committee, December 2013) have legal effect in the Province of Ontario as per Section 31 of the Clean Water Act.

The entire footprint of the Site is located within a Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6. The Site is not noted to be within any Wellhead Protection Areas (WHPA), Intake Protection Zone (IPZ) or within a Significant Groundwater Recharge Area (SGRA).

It is indicated by the Approved Source Protection Plan for Niagara Peninsula Source Protection Area Approved Assessment Report that the Site is located within a Highly Sensitive Area (HSA). A HSA in the Niagara Peninsula Source Protection Area is defined as an area where the bedrock aquifer has less than 2 m of overburden. Since the Site is located within a HSA, a groundwater impact assessment is required to ensure that nitrate does not exceed 10 mg/L at the lot boundary. A groundwater impact assessment was completed for each proposed lot and is provided in Section 6.0 and Appendix E.

It is also noted that the Site is entirely located within an Issue Contributing Area (ICA) for nitrate. An ICA is an area of 25-year time-of-travel for a capture zone of a municipal water supply well or municipal surface water intake. If a Site is determined to be within an ICA for nitrate, all drinking water threats related to nitrate are significant drinking water threats. Therefore, the following drinking water threats are identified for the subject property:

- The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.
- The establishment, operation, or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.
- The handling and storage of a dense non-aqueous phase liquid.
- The storage or application of agricultural source material to land.
- The handling, storage or application of commercial fertilizer to land.
- The handling, storage or application of non-agricultural source material to land.
- The storage of snow.
- The use of land as livestock grazing or pasturing land, an outdoor confinement area or a farm-animal yard (O. Reg. 385/08, s. 3.).

However, no policies related to the ICA are identified within the Niagara Source Protection Plan and best management practices must be adhered to in the operation of and establishment of the onsite sewage systems on the property.

According to the Approved Source Protection Plan for Niagara Peninsula Source Protection Area, the storage of, handling of and application of Dense Non-Aqueous Phase Liquids (DNAPLs) is not permitted within an HVA with a vulnerability score of 6 under Section 31 of the Clean Water Act.

With the exception of the storage and handling of DNAPLs, no additional prescribed activities are not permitted on the Site. However, there are numerous activities identified in the Niagara Source Protection Plan that pose low to moderate threats to drinking water.

The low to moderate threat activities and associated policies have been identified below to ensure a best practices approach to development is adhered to:

- The handling, storage or application of pesticide to land.
- The handling, storage or application of road salt.
- The handling and storage of an organic solvent.
- The handling and storage of fuel.
- The management of runoff that contains chemicals used in the de-icing of aircraft.
- The storage of snow.
- The establishment and operation of a liquid hydrocarbon pipeline.

No other threats to local drinking water are identified in the Niagara Peninsula Source Protection Plan however, the plans for development should maintain a best practices approach for all conditions that apply from the aforementioned list.

# 3.0 Existing Conditions

## 3.1 Physiography, Drainage & Topography

According to Chapman and Putnam, the Site is located within the Haldimand Clay Plain as shown in Figure 2. The Haldimand Clay Plain is the area between the Niagara Escarpment and Lake Erie and is primarily comprised of clay-rich and poorly drained soils deposited in the deep-water stages of Glacial Lakes Whittlesey and Warren. The topography of this region ranges from about 218 m in the northwest near Caledonia to 172 m in the south at Lake Erie. The thickness of the clays and silts of this region ranges from less than 1 m near the Onondaga escarpment (west of Hagersville) to 40 m near Caledonia.

Surface water drains in a southernly direction towards Lake Erie. Localized deflections of surface water drainage occur at creeks and streams. Topography on the subject property is relatively flat, with ground surface elevations ranging from 176.5 masl to 177.5 masl.

## 3.2 Regional Geology

Based on Ontario Geological Survey (OGS) mapping, the Site is located on the Bertie Formation, which is described as the dolostone, limestone, shale, and sandstone. The bedrock in the area is overlain by fine-textured glaciolacustrine silt/clay and fluvial clay, silt and sand. According to the MECP well record database, surficial drift thickness in the area ranges from 3 to 10 meters below ground surface (mbgs). The bedrock geology and the surficial geology of the study area are shown in Figures 3 and 4, respectively.

### 3.3 Local Geology

A small-scale testpit program was conducted by Crozier in October 2022 to confirm the surficial soils and the depth to bedrock geology on the subject property. Detailed testpit logs are provided in Appendix B. Additional details about the program are described in Section 5.1.

In general, the following surficial geology was encountered during the testpitting program:

- 0 mbgs to 0.1 mbgs: moist, dark brown silty clay with sand, topsoil with rootlets and angular gravel
- 0.1 mbgs to 0.5 mbgs: moist, reddish brown clayey silt to silt, fissle
- 0.5 mbgs to 0.7 mbgs: moist, grey, clayey silt to silt, fissle
- 0.7 mbgs to 1.0 mbgs: grey, bedrock; no vugs or dissolution features observed

The surficial materials encountered during the field investigation are consistent with OGS mapping.

## 4.0 Hydrogeology

### 4.1 MECP Well Records

A review of MECP Well Record Database identified a total of 75 well records within 500 m of the subject property. A summary table is provided in Appendix C and a spatial representation of the wells within 500 m is shown on Figure 5.

In general, the following can describe the well records identified within 500 m of the site boundary:

- Many of the well records are identified as domestic supply wells with the exception of two (2) wells that are indicated to be used for irrigation purposes.
- In general, the geological materials outlined in the well records are limestone bedrock overlain by clay to sandy clay. This is consistent with OGS mapping and the observations during the testpit program.
- All the identified wells within 500 m of the Site are installed within limestone bedrock and range in depth from 5.5 mbgs to 25.6 mbgs.
- The average static water level in the wells around the area is 4.8 mbgs, with a maximum of 17.1 mbgs and a minimum of 0.6 mbgs.
- The average pumping rate is 38.3 litres per minute (lpm), with a maximum of 227 lpm and a minimum of 3.8 lpm. It should be noted that many of the wells were indicated to be installed before 1990, prior to the implementation of the Ontario Well Regulation, O. Reg. 903. Therefore, the reported pumping rates for the nearby wells could be inflated due to unstandardized methods of well quantity testing (i.e., via bailer).

According to the Niagara Peninsula Source Protection Plan, the Town of Port Colborne's municipal water supply is provided through surface water intake from Lake Erie. It is noted that although there are some private surface water intakes in the study area, many of the properties around the Site are serviced by private water well and/or cistern.

### 4.2 Groundwater Properties

According to the Niagara Peninsula Source Protection Plan, the Site is located within an issue contributing area (ICA) for nitrate. Given the thin layer of surficial material and the fractured and porous nature of the bedrock aquifer, the groundwater in the Township of Wainfleet area is susceptible to contamination. Any household that utilizes groundwater in the Township of Wainfleet is under boil water advisory according to the Township of Wainfleet website.

Groundwater flow in the Wainfleet area is interpreted to follow topography and flow in a southerly direction towards Lake Erie. Shallow groundwater flow across the Site is interpreted to be southeast.

### 4.3 Aquifer Properties

The hydrostratigraphy of the Wainfleet Area is outlined in detailed within Hydrogeology of Southern Ontario, Second Edition (Singer et. al., 2003). Table 1 below summarizes the hydrostratigraphy of the Site and the surrounding area.

**Table 1: Hydrostratigraphy of the Wainfleet Area**

| Layer | ID | Material | Function | Notes |
|---|---|---|---|---|
| Youngest - 1 | Recent Glaciolacustrine Deposits | clay, silt | Aquitard | |
| 2 | Wainfleet Aquifer | sand, gravel | Aquifer | Domestic Supply |
| 3 | Weathered Bedrock | shale | Aquifer/Aquitard | |
| Oldest - 4 | Bertie Formation | limestone, dolostone | Aquifer | Domestic Supply |

In general, there are two (2) primary water supply aquifers within the Township of Wainfleet area (Singer et. al., 2003) – the Wainfleet Aquifer and the Bertie Formation. The Wainfleet Aquifer is defined by sand and gravel and is located north of the Lake Erie shoreline. According to Singer et. al., the majority of the domestic supply wells installed within this unit have a specific capacity of 10 -50 lpm per meter.

Closer to the shoreline, the Wainfleet Aquifer unit thins out and is not encountered under the regionally extensive clay glaciolacustrine deposits. The Bertie Formation is interpreted to be the primary water supply aquifer in the area around the Site. The dolostones of the Bertie Formation are fractured, allowing this unit to be a viable aquifer unit.

Groundwater is expected to be encountered at a minimum of 1 mbgs or an elevation of 175 masl on the Site based on the static water levels of nearby water supply wells and the depth to bedrock. Water encountered earlier than 175 masl is interpreted to be as a results of pore water within the clayey silt to silty clay unit above the bedrock.

# 5.0 Field Work

The following sections describe the field work conducted by Crozier in October of 2022 to support the hydrogeological assessment. Field work was undertaken to determine subsurface conditions, including soil type and depth, on the property and inform the detailed engineering design for the proposed development.

## 5.1 Test Pitting Program

On October 20, 2022, Crozier staff supervised the excavation and sampling of three (3) on the subject property (Figure 6) to determine the soil and groundwater conditions on the Site. The locations of the testpits were chosen to reflect potential onsite sewage system locations within each proposed lot. Detailed testpit logs are included at Appendix B.

All three (3) testpits were advanced to until bedrock was encountered. For testpit 1 (TP1), testpit 2 (TP2) and testpit 3 (TP3), this corresponds to a total excavation depth of 1.0 mbgs, 1.06 mbgs and 1.3 mbgs, respectively. In general, the following observations were made during the testpitting program:

- In stratigraphic order, approximately 0.1 m of topsoil, 0.5 m of reddish-brown clayey silt and 0.2 m of grey clayey silt surficial material was encountered during excavation.
- Bedrock was encountered at a minimum depth of 1.0 mbgs at TP1 and a maximum depth of 1.3 mbgs at TP3. The surface of the bedrock was grey and free from vugs and fractures.
- No evidence of groundwater seepage was observed during excavation.

One (1) representative soil sample was collected from TP2 at a depth of approximately 0.9 mbgs and sent to a certified soil analysis laboratory, Chung and Vander Doelen Ltd, for grain size analysis. The soil sample was noted to contain 1.0 % gravel, 8.5 % sand and 90.5 % silt and/or clay, characterizing the shallow surficial soils as primarily silt clay to clayey silt.

## 5.2 Door-to-Door Well & Onsite Sewage System Survey

### 5.2.1 Methodology

Crozier completed a door-to-door survey within approximately 500 m of the Site on October 20, 2022. The door-to-door survey was conducted to confirm the existence, condition of and location of private services on the nearby properties. A copy of the door-to-door questionnaire and detailed survey results are provided in Appendix D. Figure 7 presents the addresses visited during the door-to-door survey.

Of the 68 properties visited on October 20, 2022, a total of eight (8) responses were received. The findings of the survey are summarized in Section 5.2.2.

### 5.2.2 Results

Many of the responses received were from properties located along Habourview Road and Churchill Avenue. Most respondents indicated that drinking water to their property is provided via private drinking water well, installed to depths ranging from approximately 9 mbgs to 13 mbgs. The water supply wells were identified to be older than 30 years old by the property owners.

Many homeowners on wells in the area reported to having an external water treatment system in the basement of their home. The treatment units indicated by respondents include UV, filtration, water softener, and/or hydrogen peroxide water treatment system. Only sulphur has been mentioned by survey respondents as affecting water quality. No well water samples were able to be collected by the time of this report.

Several property owners note that they have an external cistern on their property and two (2) property owners indicated that the cistern supplies their drinking water – 11209 Habourview Road and 11278 Habourview Road. It was indicated by the property owners that a cistern is the primary source of water on the property with no private water supply wells.

A few questions pertaining to onsite sewage systems were asked to determine the location, age, and type of system they have. In general, many homeowners have a raised leaching bed with a septic tank on the front or in the side yard of the property. The average age of onsite sewage systems in the area around the Site is over 30 years old.

## 6.0 Groundwater Impact Assessment

Municipal wastewater servicing is not available in the vicinity of the Site; therefore, it is proposed that the development will be serviced with individual onsite sewage systems. The following section provides a groundwater impact assessment for the proposed development. The purpose of this assessment is to evaluate the cumulative impact of the proposed sewage systems on the local groundwater regime. The potential for impacts to occur depends on the local hydrogeological setting, the volume of effluent discharged as well as the concentration of nutrients discharged in the effluent. The nutrient of concern is typically nitrate-nitrogen.

The groundwater impact assessment was completed in accordance with MECP Procedure D-5-4 Technical Guidelines for Individual Onsite Sewage Systems: Water Quality Impact Risk Assessment (Procedure D-5-4). In addition, given that the Site is in a Hydrogeologically Sensitive Area, the assessment was also prepared in consideration of Section 22.5.8 of the MECP Design Guidelines for Sewage Works (Chapter 22), as required by Niagara Region.

Crozier has completed a mass balance calculation to predict the concentration of nitrate-nitrogen at each lot boundary, using the following general assumptions for MECP Procedure D-5-4 and Chapter 22:

- The average volume of effluent generated by each residence is approximately 1,000/day.
- A conceptual leaching bed footprint of 500 $m^2$ for the onsite sewage systems was assumed for the purposes of this assessment.
- The only dilution mechanism is by infiltration of surface precipitation. An infiltration value of 100 mm/year has been assigned based on the soils encountered on the Site (clayey silt).
- A dilution area was calculated for each lot based on the methodology outlined in MECP Chapter 22. The dilution areas are based on the interpreted southeasterly shallow groundwater flow direction and the downgradient receiver (lot property boundaries). Refer to Figure 8 for the dilution areas.
- The background concentration of nitrogen (as N) was assumed to be 0 mg/L in the absence of groundwater analytical results, consistent with MECP's Chapter 22.

According to MECP Procedure D-5-4, the maximum allowable concentration of nitrate-nitrogen at the downgradient property boundary is 10 mg/L. A typical conventional onsite sewage system produces an effluent concentration approximately 40 mg/L of nitrate-nitrogen. Using the approach outlined above, 75% nitrogen removal (effluent concentration of 10 mg/L) will be required to satisfy MECP Procedure D-5-4. Detailed calculations are included in Appendix E. Therefore, the onsite sewage systems will need to be equipped with Level IV treatment units per CAN/BNQ 3680-600 that also meet the required dentification requirements (75% removal). Several treatment technologies are available to achieve this level of denitrification, such as Waterloo Biofilter treatment systems.

Design of the onsite sewage systems will take place once the plans for each dwelling have been determined. However, the onsite sewage systems will require Level IV treatment units that achieve the 75% denitrification.

## 7.0 Conclusions & Recommendations

Based on the information provided above, Crozier is prepared to make the following conclusions:

- The subject property is located within a highly vulnerable aquifer (HVA) with a vulnerability score of 6 and an issue contributing area (ICA) for nitrate. Therefore, under Section 31 of the Clean Water act, the handling and storage of any quantity of DNAPLs on the Site is not permitted. Best management practices must be maintained while any activities listed as a prescribed low to moderate drinking water threat are conducted on the Site.

- The surficial soils on the subject property are primarily reddish-brown clayey silt to silty clay. Grey bedrock is encountered at a minimum depth of 1 mbgs on the Site.

- No evidence of groundwater seepage was noted during the testpitting program.

- Regional groundwater studies indicate that shallow groundwater flow is south across the area towards Lake Erie. Groundwater across the Site is interpreted to flow southeasterly towards the lake.

- Groundwater is expected to be encountered at a minimum of 1 mbgs or an elevation of 175 masl on the Site based on the static water levels of nearby water supply wells and the depth to bedrock. Water encountered earlier than 175 masl is interpreted to be as a results of pore water within the clayey silt to silty clay unit above the bedrock.

- Many homeowners near the Site are serviced by private water supply well and private onsite sewage system. Some homeowners rely on cistern to supply their onsite drinking water.

- Sulphur issues with groundwater was noted by respondents in the door-to-door survey.

- Based on MECP procedure D-5-4, 75% nitrate removal is required to meet a sewage effluent boundary condition of 10 mg/L. Therefore, Level IV treatment units will be required for the proposed onsite sewage systems since the Site is located in a hydrogeologically sensitive area.

If you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,

**C.F. CROZIER & ASSOCIATES INC.**

Caitlyn MacPhee, EIT, GIT
Hydrogeology Intern

**C.F. CROZIER & ASSOCIATES INC.**

Jessica Doherty, P.Eng.
Project Manager

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Reports\FINAL HYDROGEOLOGY REPORT\2022.12.23_(2292-6449)_ Wainfleet Hydrogeological Report.docx

# APPENDIX A

## Terms of Reference

## Caitlyn MacPhee

**From:** Lambert, Phill <Phill.Lambert@niagararegion.ca>
**Sent:** August 12, 2022 4:23 PM
**To:** Caitlyn MacPhee
**Cc:** Godfrey, Nicholas; Jessica Doherty; Katherine Rentsch; Chris Gerrits
**Subject:** RE: Hydrogeological Terms of Reference: 11210 Lakeshore Road/Roll No. 271400000318810

Hi Caitlyn

Thanks for sending the scope of work for review.

It will be important to understand groundwater flow direction for these properties as well.

The scope of work looks good.

Thanks

***Phill Lambert. P. Eng.***
Director, Infrastructure Planning & Development Engineering
Planning & Development Services Department
1815 Sir Isaac Brock Way, PO Box 1042
Thorold ON L2V 4T7
Direct: 905-984-3627 Toll Free: 1-800-263-7215


**From:** Caitlyn MacPhee <cmacphee@cfcrozier.ca>
**Sent:** July 29, 2022 9:25 AM
**To:** Lambert, Phill <Phill.Lambert@niagararegion.ca>
**Cc:** Godfrey, Nicholas <Nicholas.Godfrey@niagararegion.ca>; Jessica Doherty <jdoherty@cfcrozier.ca>; Katherine Rentsch <krentsch@cfcrozier.ca>; Chris Gerrits <cgerrits@cfcrozier.ca>
**Subject:** Hydrogeological Terms of Reference: 11210 Lakeshore Road/Roll No. 271400000318810



Good Morning Phill,

My name is Caitlyn MacPhee and I am part of the hydrogeology team at C.F. Crozier & Associates Inc. I was forwarded your contact information from Jessica Doherty, who has been in contact with you regarding preparing a Hydrogeological Terms of Reference for the property located at 11210 Lakeshore Rd/Roll No. 271400000318810 for the Region's review. The following workplan has been prepared based on the information you provided in your previous email to

Jessica and the Region's general requirements for these type of studies. Please see the proposed workplan for the Hydrogeological Study for the aforementioned property outlined below.

**Background**
The proposed development plan includes the severance of the property at 11210 Lakeshore Road/Roll No. 271400000318810 (Site) into three (3) separate lots. Each lot is proposed to be serviced by individual sewage systems and cisterns.

**Proposed Workplan**

1. Complete a small-scale test pitting program across the Site to confirm soil conditions and potential presence of shallow bedrock. According to the Ministry of Environment, Conservation and Parks (MECP) Well Record database, overburden thickness in the area ranges from 3 – 6 meters thick. The test pits will be advanced to between 2 and 3 meters below ground surface (mbgs) at locations to optimize site coverage and in the vicinity of future onsite sewage systems. Shallow soil samples will be collected from the test pits and submitted to a third-party laboratory for grain size analysis to support the onsite sewage system design.

2. Conduct and evaluate MECP water well records within 500 m of the Site.

3. Complete a door-to-door survey within at least 100 m of the property. The door-to-door survey will ask homeowners basic information about their sewage system and water supply well, such as the type of sewage system (e.g., holding tank or septic tank with leaching bed), well depth/size, and ask the homeowners to identify any water quantity or quality issues they may have experienced. All the results will be compiled, and Crozier staff will use their best efforts to follow up with individuals if any issues are noted on the survey. If allowable by the homeowner, Crozier will collect a water sample for laboratory analysis of nitrate-nitrogen and E. Coli. The nitrate-nitrogen analytical results will be used to establish background concentrations.

4. Completion of an impact assessment of the proposed onsite sewage works and subsurface disposal systems on the downgradient boundary in accordance with MECP procedure D-5-4 and/or Chapter 22 of the MECP Design Manual.

5. Since cisterns are proposed to service the lots, completion of MECP procedure D-5-5 is not required for the proposed development.

6. Provide discussion on the local hydrogeologic setting, geology, past and present land uses, local environmental features, local well records, etc. Crozier will review the MECP Source Water Protection Information Atlas to confirm the hydrogeologically sensitive areas and confirm any Source Water Protection Policies that apply.

7. Crozier will complete a Hydrogeological Investigation Report for the subject property. The report will describe the hydrogeological setting and include the results of the door-to-door survey, analytical results (if available), and impact assessment calculations. The report will be complete with supporting figures using the available information.

We are looking forward to hearing your comments on the proposed workplan. Please let us know if you have any questions or concerns.

Thanks and have a wonderful long weekend,
Caitlyn

**Caitlyn MacPhee**, EIT | Engineering Intern
2800 High Point Drive, Suite 100 | Milton, ON L9T 6P4
T: 905.875.0026


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# APPENDIX B

## Testpit Logs

# TESTPIT LOG

**Project Name:** 11210 Lakeshore Rd
**Project Number:** 2292-6449
**Address:** 11210 Lakeshore Rd, Wainfleet
**Date:** 2022-11-07
**Field Technician:** C. MacPhee
**Weather:** hail, rain, -1° to 2°C

| | Depth | Soil Description | Soil Sample | USCS Soil Classification | Groundwater Observations |
|---|---|---|---|---|---|
| Testpit No. 1 | 0 m - 0.1 m | **Topsoil:** dark brown, moist, silty clay to clay with angular gravel, rootlets | TP1-A | - | No groundwater observed, testpit sidewalls were stable, soil was very moist |
| | 0.1 m - 0.5 m | **Clayey silt:** moist, reddish brown silt, minor clay to clayey silt, fissle | TP1-B | - | |
| | 0.5 m - 0.711 m | **Clayey silt:** moist, grey silt, minor clay to clayey | - | - | |
| | 0.711 m - 1 m | **Bedrock:** grey, rock, no dissolution features noted | - | - | |
| | | | | | |
| Testpit No. 2 | 0 m - 0.05 m | **Topsoil:** brown, moist, silty clay, trace gravel, rootlets | - | - | No groundwater observed, testpit sidewalls were stable |
| | 0.05 m - 0.5 m | **Clayey silt:** moist, reddish brown, clayey silt, fissle, some plasticity, moist to dry, sample at | TP2-A | - | |
| | 0.5 m - 0.9 m | **Clayey silt:** moist, grey clayey silt, sample at 0.9m | TP2-B | - | |
| | 0.9 m - 1.06 m | **Bedrock:** grey, rock, no dissolution features noted, termination at approximately 1.06 mbgs | - | - | |
| | | | | | |
| Testpit No. 3 | 0 m - 0.1 m | **Topsoil:** dark, blackish-brown, moist, silty clay with rootlets | - | - | No groundwater observed, testpit sidewalls were stable |
| | 0.1 m - 0.5 m | **Clayey silt:** moist, reddish-brown, silty clay to clayey silt, minor gravel, fissle | - | - | |
| | 0.5 m - 1.3 m | **Bedrock:** grey rock, testpit termination at 1.3 mbgs | - | - | |

# APPENDIX C

## MECP Summary Table

**MECP WATER WELL RECORDS**

Project Number: 2292-6449
Prepared by: AC

Address: 11210 Lakeshore Road, Port Colborne
Date completed: 07/13/2022

| Well ID | Inside Diameter (mm) | Depth (m) | Static Level (m) | Pumping Water Level (m) | Rate (L/min) | Material | Clay Thickness (m) | Depth to Bedrock (m) | Aquifer[1] | Location | Use | Date of Completion (MM/DD/YYYY) | Notes[2,3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6601982 | 127.0 | 11.0 | N/A | N/A | N/A | clay/rock | 9.14 | 9.14 | BR | Lot 11, Concession 1 | domestic | 05/14/1947 | |
| 6601983 | 152.4 | 7.3 | 2.7 | N/A | N/A | clay/limestone | 5.49 | 5.49 | BR | Lot 11, Concession 1 | domestic | 07/16/1947 | |
| 6601984 | 152.4 | 10.7 | N/A | N/A | N/A | clay/limestone | 6.10 | 6.10 | BR | Lot 11, Concession 1 | domestic | 07/18/1947 | |
| 6601994 | 127.0 | 6.1 | 2.1 | 2.7 | 15.1 | clay/limestone | 3.05 | 3.05 | BR | Lot 11, Concession 1 | domestic | 06/10/1958 | |
| 6601997 | 127.0 | 6.7 | 1.2 | 3.7 | 26.5 | sandy clay/limestone | 2.44 | 2.44 | BR | Lot 11, Concession 1 | domestic | 05/22/1963 | |
| 6602003 | 152.4 | 9.4 | 4.3 | N/A | N/A | sand/limestone | - | 2.44 | BR | Lot 12, Concession 1 | domestic | 11/09/1948 | |
| 6602005 | 152.4 | 10.1 | N/A | N/A | N/A | sand/limestone | - | 3.35 | BR | Lot 12, Concession 1 | domestic | 06/07/1950 | |
| 6602006 | 152.4 | 14.3 | 4.6 | 4.6 | 15.1 | clay/limestone | 0.91 | 0.91 | BR | Lot 12, Concession 1 | domestic | 06/25/1952 | |
| 6602019 | 152.4 | 6.4 | 3.7 | 3.7 | 56.8 | clay/limestone | 1.52 | 1.52 | BR | Lot 12, Concession 1 | domestic | 08/28/1965 | |
| 6602635 | 152.4 | 8.5 | 3.0 | 5.5 | 26.5 | clay/limestone | 3.05 | 3.05 | BR | Lot 11, Concession 1 | domestic | 10/07/1971 | |
| 6602993 | 152.4 | 7.6 | 3.7 | 4.3 | 56.8 | clay/limestone | 5.18 | 5.18 | BR | Lot 11, Concession 1 | domestic | 08/23/1974 | |
| 6603597 | 152.4 | 13.4 | 1.5 | 9.1 | 3.8 | loam/clay/limestone | 2.13 | 2.44 | BR | Lot 11, Concession 1 | domestic | 11/04/1983 | |
| 6603941 | 152.4 | 14.0 | 3.7 | 13.4 | 15.1 | topsoil/clay/limestone | 5.49 | 6.10 | BR | Lot 11, Concession 1 | domestic | 04/26/1990 | |
| 6603993 | 158.8 | 8.5 | 3.4 | 3.4 | 60.6 | topsoil/gravel/limestone | - | 3.35 | BR | Lot 11, Concession 1 | domestic | 02/27/1991 | |
| 6604012 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | - | Lot 11, Concession 1 | not used | 03/01/1991 | |
| 6604571 | 139.7 | 11.6 | 8.5 | 10.7 | 37.9 | topsoil/clay/limestone | 1.22 | 1.52 | BR | Lot 12, Concession 1 | domestic | 09/20/2001 | |
| 6601985 | 139.7 | 5.8 | 2.1 | N/A | N/A | clay/limestone | 3.35 | 3.35 | BR | Lot 11, Concession 1 | domestic | 10/28/1947 | |
| 6601986 | 139.7 | 14.3 | 5.2 | N/A | N/A | clay/limestone | 6.40 | 6.40 | BR | Lot 11, Concession 1 | domestic | 10/31/1947 | |
| 6601987 | 139.7 | 6.7 | 3.0 | N/A | N/A | clay/limestone | 3.35 | 3.35 | BR | Lot 11, Concession 1 | domestic | 11/08/1947 | |
| 6601989 | 139.7 | 12.2 | 2.4 | N/A | N/A | clay/limestone | 5.18 | 5.18 | BR | Lot 11, Concession 1 | domestic | 12/15/1947 | |
| 6601990 | 158.8 | 5.8 | 1.8 | N/A | 15.1 | clay/limestone | 3.35 | 3.35 | BR | Lot 11, Concession 1 | domestic | 11/04/1953 | |
| 6601991 | 152.4 | 13.4 | 1.8 | 2.4 | 113.6 | clay/limestone | 2.44 | 2.44 | BR | Lot 11, Concession 1 | domestic | 11/26/1955 | |
| 6601992 | 158.8 | 7.9 | 3.7 | 4.9 | 37.9 | loam/clay/limestone | 3.05 | 3.35 | BR | Lot 11, Concession 1 | domestic | 04/14/1956 | |
| 6601993 | 127.0 | 9.1 | 2.4 | 3.0 | 18.9 | clay/rock/limestone | 2.74 | 2.74 | BR | Lot 11, Concession 1 | domestic | 06/07/1958 | |
| 6601995 | 127.0 | 5.8 | 3.0 | 3.7 | 11.4 | clay/limestone | 3.66 | 3.66 | BR | Lot 11, Concession 1 | domestic | 11/19/1958 | |
| 6601996 | 127.0 | 9.1 | 4.0 | 7.3 | 18.9 | clay/limestone | 3.66 | 3.66 | BR | Lot 11, Concession 1 | domestic | 12/10/1958 | |
| 6601998 | 127.0 | 8.5 | 4.3 | 5.5 | 18.9 | clay/limestone | 2.44 | 2.44 | BR | Lot 11, Concession 1 | domestic | 06/18/1963 | |
| 6602007 | 158.8 | 7.9 | 2.4 | 2.4 | 18.9 | gravel/shale | - | 3.35 | BR | Lot 12, Concession 1 | domestic | 05/28/1953 | |
| 6602009 | 158.8 | 9.8 | 2.7 | 8.5 | 56.8 | sand | - | - | OB | Lot 12, Concession 1 | domestic | 05/24/1955 | |
| 6602012 | 127.0 | 9.1 | 2.4 | 3.0 | 11.4 | topsoil/limestone | - | 3.66 | BB | Lot 12, Concession 1 | domestic | 07/31/1958 | |
| 6602013 | 127.0 | 8.2 | 3.0 | 7.0 | 18.9 | gravel+sand/limestone | - | 3.35 | BR | Lot 12, Concession 1 | domestic | 11/06/1958 | |
| 6602014 | 127.0 | 5.5 | 4.0 | 4.0 | 18.9 | sand+gravel/limestone | - | 2.13 | BR | Lot 12, Concession 1 | domestic | 05/18/1959 | |
| 6602015 | 127.0 | 8.2 | 5.5 | 5.5 | 30.3 | sand/limestone | - | 3.66 | BR | Lot 12, Concession 1 | domestic | 10/20/1959 | |
| 6602016 | 127.0 | 8.2 | 3.7 | 4.9 | 18.9 | sand+gravel/limestone | - | 3.66 | BR | Lot 12, Concession 1 | domestic | 05/11/1960 | |
| 6602017 | 158.8 | 8.2 | 4.6 | 4.6 | 37.9 | clay shale/flint rock | 3.05 | 3.05 | BR | Lot 12, Concession 1 | domestic | 11/04/1963 | |
| 6602018 | 152.4 | 7.6 | 3.7 | 3.7 | 56.8 | gravel/limestone | - | 2.74 | BR | Lot 12, Concession 1 | domestic | 08/24/1965 | |
| 6602020 | 152.4 | 8.8 | 4.3 | 5.5 | 37.9 | clay loam/flint/limestone | 0.61 | 0.61 | BR | Lot 12, Concession 1 | domestic | 09/27/1965 | |
| 6602021 | 158.8 | 8.5 | 4.6 | 4.9 | 60.6 | sand/flint rock | - | 2.74 | BR | Lot 12, Concession 1 | domestic | 09/01/1966 | |
| 6602025 | 152.4 | 9.8 | 4.3 | N/A | N/A | sand/flint rock | - | 1.83 | BR | Lot 13, Concession 1 | domestic | 04/24/1948 | |
| 6602026 | 152.4 | 9.1 | 4.3 | N/A | N/A | sand+gravel/flint rock | - | 2.74 | BR | Lot 13, Concession 1 | domestic | 06/17/1948 | |
| 6602027 | 152.4 | 8.8 | 3.0 | N/A | N/A | clay/flint rock | 1.52 | 1.52 | BR | Lot 13, Concession 1 | domestic | 06/17/1948 | |
| 6602028 | 152.4 | 6.1 | 3.7 | N/A | N/A | sand+gravel/flint rock | - | 2.74 | BR | Lot 13, Concession 1 | domestic | 06/30/1948 | |
| 6602037 | 127.0 | 14.6 | 9.1 | 11.9 | 7.6 | loam/clay/limestone | 1.83 | 2.44 | BR | Lot 13, Concession 1 | domestic | 11/07/1955 | |
| 6602038 | 127.0 | 11.9 | 7.6 | 9.1 | 26.5 | rock/flint | - | 0.00 | BR | Lot 13, Concession 1 | domestic | 04/06/1956 | |
| 6602041 | 127.0 | 16.2 | 14.0 | 14.0 | 227.1 | clay/rock/flint | 1.22 | 1.22 | BR | Lot 13, Concession 1 | domestic | 05/26/1956 | |
| 6602049 | 127.0 | 16.2 | 11.6 | 11.6 | 37.9 | clay/rock/flint/limestone | 1.52 | 1.52 | BR | Lot 13, Concession 1 | domestic | 05/06/1960 | |
| 6602050 | 127.0 | 16.8 | 12.5 | 12.5 | 56.8 | clay/rock/flint | 1.22 | 1.22 | BR | Lot 13, Concession 1 | domestic | 08/27/1958 | |
| 6602052 | 127.0 | 16.2 | 11.6 | 11.6 | 37.9 | clay/rock/flint/limestone | 1.52 | 1.52 | BR | Lot 13, Concession 1 | domestic | 04/30/1960 | |
| 6602161 | 139.7 | 7.9 | 2.1 | 2.1 | 15.1 | soil/flint | - | 0.91 | BR | Lot 13, Concession 1 | domestic | 11/28/1950 | |
| 6602330 | 158.8 | 7.9 | 4.3 | 4.9 | 56.8 | gravel/rock | - | 3.05 | BR | Lot 12, Concession 1 | domestic | 01/25/1968 | |
| 6602428 | 152.4 | 13.1 | 3.7 | 7.6 | 26.5 | clay/limestone | 5.18 | 5.18 | BR | Lot 10, Concession 1 | domestic | 05/10/1969 | |
| 6602442 | 152.4 | 8.8 | 3.7 | 6.1 | 45.4 | gravel/flint | - | 2.13 | BR | Lot 12, Concession 1 | domestic | 06/10/1969 | |
| 6602466 | 152.4 | 8.5 | 3.7 | 4.6 | 56.8 | gravel/limestone | - | 3.35 | BR | Lot 12, Concession 1 | domestic | 08/01/1969 | |
| 6602969 | 127.0 | 9.1 | 3.0 | 3.7 | 68.1 | topsoil/limestone | - | 0.61 | BR | Lot 12, Concession 1 | irrigation | 07/09/1974 | |
| 6602995 | 152.4 | 9.8 | 3.0 | 3.7 | 45.4 | clay/limestone | 1.83 | 1.83 | BR | Lot 12, Concession 1 | domestic | 09/30/1974 | |
| 6603128 | 152.4 | 12.5 | 0.6 | 6.1 | 30.3 | clay/limestone | 5.49 | 5.49 | BR | Lot 12, Concession 1 | domestic | 11/07/1975 | |
| 6603312 | 152.4 | 17.1 | 12.2 | 13.7 | 37.9 | clay/limestone | 1.07 | 1.07 | BR | Lot 13, Concession 1 | domestic | 11/17/1978 | |
| 6603827 | 133.4 | 13.4 | 3.4 | 1.2 | 11.4 | clay/limestone | 2.44 | 2.44 | BR | Lot 11, Concession 1 | domestic | 08/22/1988 | |
| 6603885 | N/A | 21 | 14.0 | 2.1 | 18.9 | clay/limestone | 1.52 | 1.52 | BR | Lot 13, Concession 1 | domestic | 08/15/1989 | |
| 6604155 | 139.7 | 11.9 | 3.4 | 11.0 | 7.6 | topsoil/clay/limestone | 5.33 | 5.94 | BR | Lot 11, Concession 1 | domestic | 10/12/1993 | |
| 6604230 | 139.7 | 14.6 | 6.4 | 7.3 | 68.1 | topsoil/shale/limestone | - | 1.52 | BR | Lot 13, Concession 1 | domestic | 10/02/1995 | |
| 6604235 | 129.5 | 11.9 | 4.6 | 9.1 | 22.7 | clay/limestone | 1.68 | 1.68 | BR | Lot 13, Concession 1 | domestic | 02/16/1990 | |
| 6604384 | 139.7 | 25.6 | 17.1 | 17.4 | 53.0 | topsoil/shale/limestone | - | 0.61 | BR | Lot 13, Concession 1 | domestic | 10/28/1999 | |
| 6604424 | 129.5 | 9.1 | 4.3 | 5.2 | 68.1 | topsoil/gravel/sand/limestone | - | 1.22 | BR | Lot 13, Concession 1 | domestic | 03/22/2000 | |
| 7298378 | 158.8 | 19.8 | 4.9 | 17.7 | 18.9 | topsoil/rock | - | 2.13 | BR | Lot 12, Concession 1 | irrigation | 10/12/2017 | |
| 7314563 | 158.8 | 9.8 | 2.4 | 8.2 | 30.3 | sand/rock | - | 2.44 | BR | N/A | N/A | 06/18/2018 | |
| 7314564 | 158.8 | 19.8 | 6.4 | 17.4 | 37.9 | clay/rock | 11.58 | 11.58 | BR | N/A | domestic | 06/12/2018 | |

Data Source: Ministry of the Environment, Conservation, and Parks
1.BR — bedrock aquifer
OB — overburden aquifer

# APPENDIX D

## Door-to-Door Survey Results

**OCTOBER 20, 2022**

**PROJECT NO: 2292 - 6449**

**SENT VIA: HAND DELIVERED**

**Attention:** **Property Owner/Tenant**

**RE:** **DOOR TO DOOR WELL AND SEPTIC SURVEY**
**TOWNSHIP OF WAINFLEET, ONTARIO**

To whom it may concern,

C.F. Crozier & Associates Inc. (Crozier) has been retained to complete a detailed study of the nearby area to assess groundwater conditions and potential impacts occurring to the shallow groundwater system. Hence, Crozier is conducting a door-to-door survey to determine the location of any water supply wells, cisterns and private sewage systems in your area. We would appreciate participation in this survey to assist us in our study.

Attached is a questionnaire concerning your property and private well, cistern and/orseptic system (if applicable). Please review and provide your responses using the forms located in the QR code below or via email to cmacphee@cfcrozier.ca. Alternatively, please feel free to call our office to provide us with your questionnaire responses. Please provide your response by November 20 if possible. Rest assured, we will not share your contact information with any third parties and the information provided in this questionnaire will only be used for the purposes of this study.

The Township of Wainfleet provides great resources on maintaining private wells and good water quality on your property and can be accessed at the following site:

https://www.wainfleet.ca/en/living-here/water-services.aspx#:~:text=For%20more%20information%2C%20call%20the,%2D866%2D282%2D7376

Should you have any questions or require any further information, please do not hesitate to contact the undersigned.

Scan QR Code below to Access the form

Sincerely,

**CROZIER CONSULTING ENGINEERS**

Caitlyn MacPhee, EIT/GIT
Hydrogeology
SS/CM/cj

Enclosure

2800 High Point Dr., Suite 100
Milton, ON L9T 6P4
T. 905.875.0026
F. 905.875.4915
cfcrozier.ca

CROZIER CONSULTING ENGINEERS

## Door to Door Well & Septic Survey Questionnaire

1. What is your address?

**The following questions 2 – 8 pertain to private water supply wells. If you do not have a well on your property, you may skip to question 9.**

2. Do you have a private well on your property?

3. Does your well supply your drinking water?

4. What is the age of your well?

5. Is it a dug or drilled well?

6. How deep is your well?

7. Have you had any quantity or quality issues with your well? Briefly describe any issues.

8. Would you be willing to allow us to collect a sample of your water for laboratory analysis at no cost to you? All results will be provided to you for your records.

**The following questions 9 - 10 pertain to cisterns. If you do not have a cistern on your property, you may skip to question 11.**

9. Do you have a cistern on your property?

10. Does the cistern supply your drinking water?

11. What size is your cistern? Is it external or internal?

12. Do you have a surface water intake on your property?

13. Do you have any water treatment systems (e.g., water softener, chlorinator etc.)?

14. Do you have a septic system on your property?

15. Where is your sewage system located (i.e., front of your home, side yard etc.)?

16. What type of sewage system is it (i.e., septic tan with a leaching bed or holding tank)?

17. What is the age of your septic system?

If you are willing, please provide your contact information for any follow up questions we may have. If you answered yes to question 8, please provide your preferred method of contact so we may coordinate sampling:

*Reminder: Your contact information will not be shared with any third parties.*

# DOOR TO DOOR SURVEY QUESTIONNAIRE RESPONSES

**Project Name:** 11210 Lakeshore Rd, Wainfleet
**Project Number:** 2292-6449

**Date:** 2022-12-22
**Filled By:** LS
**Checked By:** CM

input required

| What is your address? | Do you have a private well on your property? | How deep is your well (ft)? | Does your well supply your drinking water? | What is the age of your well (yrs)? | Is it a dug or drilled well? | Any water treatment systems? |
|---|---|---|---|---|---|---|
| 11221 Harbourview Rd | Yes | unknown | Yes | 30 | Drilled | Peroxide and water softner |
| 11169 Churchill Ave | Yes | 32 | Yes | 50 | Drilled | Yes |
| 11232 Harbourview Rd | Yes | 30 | Yes | 40 | Drilled | Water softener, UV light, carbon filters, RO system and peroxide system |
| 11225 Harbourview Rd | Yes | 35 | Yes | unknown | Dug | 5mm filtration & UV light system in the basement |
| 11219 Harbourview Rd | Yes | unknown | Yes | 50 | Drilled | Peroxide and water softner |
| 11205 Habourview Rd | Yes | 27 | Yes | 35+ | Drilled | Peroxide and water softner |
| 11209 Habourview Rd | No | N/A | N/A | N/A | N/A | N/A |
| 11278 Harourview Rd | No | N/A | N/A | N/A | N/A | N/A |

# DOOR TO DOOR SURVEY QUESTIONNAIRE RESPONSES

**Project Name:** 11210 Lakeshore Rd, Wainfleet
**Project Number:** 2292-6449

**Date:** 2022-12-22
**Filled By:** LS
**Checked By:** CM

| What is your address? | Have you had any quantity or quality issues with your well? | Do you have a cistern on your property? | Does your cistern supply drinking water? | What size is your cistern? Is it an internal or external tank? |
|---|---|---|---|---|
| 11221 Harbourview Rd | No | Yes | No | 500 Gallon |
| 11169 Churchill Ave | No | No | N/A | N/A |
| 11232 Harbourview Rd | Yes. Use UV light and filters and RO for drinking | No | N/A | N/A |
| 11225 Harbourview Rd | No | No | N/A | N/A |
| 11219 Harbourview Rd | No | No | N/A | N/A |
| 11205 Habourview Rd | No | NO | N/A | N/A |
| 11209 Habourview Rd | N/A | Yes | Yes | 2 x 800 Gallon external tanks |
| 11278 Harourview Rd | N/A | Yes | Yes | 3000 Gallon external tank |

# DOOR TO DOOR SURVEY QUESTIONNAIRE RESPONSES

**Project Name:** 11210 Lakeshore Rd, Wainfleet
**Project Number:** 2292-6449

**Date:** 2022-12-22
**Filled By:** LS
**Checked By:** CM

| What is your address? | Do you have a surface water intake at your property? | Do you have a septic system on your property? | Where is your system located? | What type of sewage system do you have? | What is the age of your sewage system? |
|---|---|---|---|---|---|
| 11221 Harbourview Rd | No | Yes | Front | Septic Tank with Leaching Bed | 50 |
| 11169 Churchill Ave | No | Yes | Side Yard | Septic Tank with Leaching Bed | 40+ |
| 11232 Harbourview Rd | No | Yes | Front | Septic Tank with Leaching Bed | 4 |
| 11225 Harbourview Rd | No | Yes | Front | Holding Tank | 9 or 10 |
| 11219 Harbourview Rd | No | Yes | Side Yard | Septic Tank with Leaching Bed | 50 |
| 11205 Habourview Rd | No | Yes | Front | Septic Tank with Leaching Bed | 13 |
| 11209 Habourview Rd | No | Yes | Backyard | Septic Tank with Leaching Bed | 19 |
| 11278 Harourview Rd | No | Yes | Backyard | Septic Tank with Leaching Bed | 20 |

## Door to Door Well & Septic Survey Questionnaire

1. What is your address?

11209 Harbourview Rd., R.R. #2
Port Colborne, Ontario
L3K 5V4

**The following questions 2 – 8 pertain to private water supply wells. If you do not have a well on your property, you may skip to question 9.**

2. Do you have a private well on your property?

3. Does your well supply your drinking water?

4. What is the age of your well?

5. Is it a dug or drilled well?

6. How deep is your well?

7. Have you had any quantity or quality issues with your well? Briefly describe any issues.

8. Would you be willing to allow us to collect a sample of your water for laboratory analysis at no cost to you? All results will be provided to you for your records.

**The following questions 9 - 10 pertain to cisterns. If you do not have a cistern on your property, you may skip to question 11.**

9. Do you have a cistern on your property? Y/N

10. Does the cistern supply your drinking water? Y/N

11. What size is your cistern? Is it external or internal?

2 - 900 GAL EXTERNAL CONCRETE TANKS.

12. Do you have a surface water intake on your property?

NO

13. Do you have any water treatment systems (e.g., water softener, chlorinator etc.)?

NO

14. Do you have a septic system on your property?

YES.

15. Where is your sewage system located (i.e., front of your home, side yard etc.)?

FAC. BACK.

16. What type of sewage system is it (i.e., septic tank with a leaching bed or holding tank)?

RAISED BED WITH TANKS

17. What is the age of your septic system?

19.

If you are willing, please provide your contact information for any follow up questions we may have. If you answered yes to question 8, please provide your preferred method of contact so we may coordinate sampling:

*Reminder: Your contact information will not be shared with any third parties.*

OCTOBER 20, 2022

PROJECT NO: 2292 - 6449

SENT VIA: HAND DELIVERED

**Attention:** **Property Owner/Tenant**

**RE:** **DOOR TO DOOR WELL AND SEPTIC SURVEY**
**TOWNSHIP OF WAINFLEET, ONTARIO**

To whom it may concern,

C.F. Crozier & Associates Inc. (Crozier) has been retained to complete a detailed study of the nearby area to assess groundwater conditions and potential impacts occurring to the shallow groundwater system. Hence, Crozier is conducting a door-to-door survey to determine the location of any water supply wells, cisterns and private sewage systems in your area. We would appreciate participation in this survey to assist us in our study.

Attached is a questionnaire concerning your property and private well, cistern and/orseptic system (if applicable). Please review and provide your responses using the forms located in the QR code below or via email to cmacphee@cfcrozier.ca. Alternatively, please feel free to call our office to provide us with your questionnaire responses. Please provide your response by November 20 if possible. Rest assured, we will not share your contact information with any third parties and the information provided in this questionnaire will only be used for the purposes of this study.

The Township of Wainfleet provides great resources on maintaining private wells and good water quality on your property and can be accessed at the following site:

https://www.wainfleet.ca/en/living-here/water-services.aspx#:~:text=For%20more%20information%2C%20call%20the,%2D866%2D282%2D7376

Should you have any questions or require any further information, please do not hesitate to contact the undersigned.

Scan QR Code below to Access the form

Sincerely,

**CROZIER CONSULTING ENGINEERS**

Caitlyn MacPhee, EIT/GIT
Hydrogeology
SS/CM/cj

Enclosure

2800 High Point Dr., Suite 100
Milton, ON L9T 6P4
T. 905.875.0026
F. 905.875.4915
cfcrozier.ca

CROZIER
CONSULTING ENGINEERS

## Door to Door Well & Septic Survey Questionnaire

1. What is your address? [redacted]
11278 Harbourview St
RR 2
Port Colborne ON L3K 5V4

**The following questions 2 – 8 pertain to p[illegible] supply wells. If you do not have a well on your property, you may skip to question 9.**

2. Do you have a private well on your property?

3. Does your well supply your drinking water?

4. What is the age of your well?

5. Is it a dug or drilled well?

6. How deep is your well?

7. Have you had any quantity or quality issues with your well? Briefly describe any issues.

8. Would you be willing to allow us to collect a sample of your water for laboratory analysis at no cost to you? All results will be provided to you for your records.

**The following questions 9 - 10 pertain to cisterns. If you do not have a cistern on your property, you may skip to question 11.**

9. Do you have a cistern on your property?

YES

10. Does the cistern supply your drinking water?

YES

11. What size is your cistern? Is it external or internal?

3000 GALLONS EXTERNAL

12. Do you have a surface water intake on your property?

NO

13. Do you have any water treatment systems (e.g., water softener, chlorinator etc.)?

NO

14. Do you have a septic system on your property?

YES

15. Where is your sewage system located (i.e., front of your home, side yard etc.)?

BACK YARD

16. What type of sewage system is it (i.e., septic tan with a leaching bed or holding tank)?

SEPTIC TAN WITH LEACHING

17. What is the age of your septic system?

20 YEARS

If you are willing, please provide your contact information for any follow up questions we may have. If you answered yes to question 8, please provide your preferred method of contact so we may coordinate sampling:

WATER IS TRUCKED IN

*Reminder: Your contact information will not be shared with any third parties.*

# APPENDIX E

## Groundwater Impact Assessment Calculations

**Table 1A: D-5-4 Impact Assessment (Lot 1)**

CROZIER CONSULTING ENGINEERS

| | |
|---|---|
| **Project Name:** | 11210 Lakeshore Road, Wainfleet |
| **Project Number:** | 2292-6449 |
| **Date:** | 2022-12-13 |
| **Designed By:** | JD |
| **Checked By:** | KR |

## D-5-4 IMPACT ASSESSMENT

**Calculate the Nitrate Concentration at a Boundary (Property *or* Surface Water)**

| Parameter | Value | Unit | Notes: |
|---|---|---|---|
| **Infiltration Volume** | | | |
| Area of Dilution = | 0.0927 | ha | Total area of site |
| Background Nitrate Quality in Groundwater = | 0.00 | mg/L | In the absence of groundwater analytical results, assumed to be 0 mg/L (per MECP Chapter 22 Reasonable Use Approach) |
| Annual Infiltration Rate = | 100 | mm/m2/yr | MECP infiltration rate for clay |
| | 2,739.73 | L/ha/day | |
| Annual Infiltration Volume = | 93 | $m^3$/year | |
| Total Average Background Nitrate = | 0 | mg/day | |
| **Sewage Effluent Volume** | | | |
| Proposed Number of Lots | 1 | | |
| Average Daily Volume of Sewage Effluent = | 1,000 | L/day | For residential, 1,000 L/home/day |
| Number of Days of Operation/Use = | 365 | days/year | |
| Annual Volume of Sewage Effluent = | 365 | $m^3$/year | |
| Nitrate Concentration in wastewater = | **10.0** | mg/L | |
| Total Average Nitrate Loading = | 10,000 | mg/day | |
| **Totals** | | | |
| Total Dilutant = wastewater V + infiltration V = | 458 | $m^3$/year | |
| Nitrate Concentration in Percolate = | **7.97** | **mg/L** | Less than 10 mg/L, sufficient for D-5-4 Impact Assessment |

**Table 1B: D-5-4 Impact Assessment (Lot 2)**

CROZIER CONSULTING ENGINEERS

| | |
|---|---|
| **Project Name:** | 11210 Lakeshore Road, Wainfleet |
| **Project Number:** | 2292-6449 |
| **Date:** | 2022-12-13 |
| **Designed By:** | JD |
| **Checked By:** | KR |

## D-5-4 IMPACT ASSESSMENT

**Calculate the Nitrate Concentration at a Boundary (Property *or* Surface Water)**

| Parameter | Value | Unit | Notes: |
|---|---|---|---|
| **Infiltration Volume** | | | |
| Area of Dilution = | 0.1398 | ha | Total area of site |
| Background Nitrate Quality in Groundwater = | 0.00 | mg/L | In the absence of groundwater analytical results, assumed to be 0 mg/L (per MECP Chapter 22 Reasonable Use Approach) |
| Annual Infiltration Rate = | 100 | mm/m2/yr | MECP infiltration rate for clay |
| | 2,739.73 | L/ha/day | |
| Annual Infiltration Volume = | 140 | $m^3$/year | |
| Total Average Background Nitrate = | 0 | mg/day | |
| **Sewage Effluent Volume** | | | |
| Proposed Number of Lots | 1 | | |
| Average Daily Volume of Sewage Effluent = | 1,000 | L/day | For residential, 1,000 L/home/day |
| Number of Days of Operation/Use = | 365 | days/year | |
| Annual Volume of Sewage Effluent = | 365 | $m^3$/year | |
| Nitrate Concentration in wastewater = | **10.0** | mg/L | |
| Total Average Nitrate Loading = | 10,000 | mg/day | |
| **Totals** | | | |
| Total Dilutant = wastewater V + infiltration V = | 505 | $m^3$/year | |
| Nitrate Concentration in Percolate = | **7.23** | **mg/L** | Less than 10 mg/L, sufficient for D-5-4 Impact Assessment |

**Table 1C: D-5-4 Impact Assessment (Lot 3)**

CROZIER CONSULTING ENGINEERS

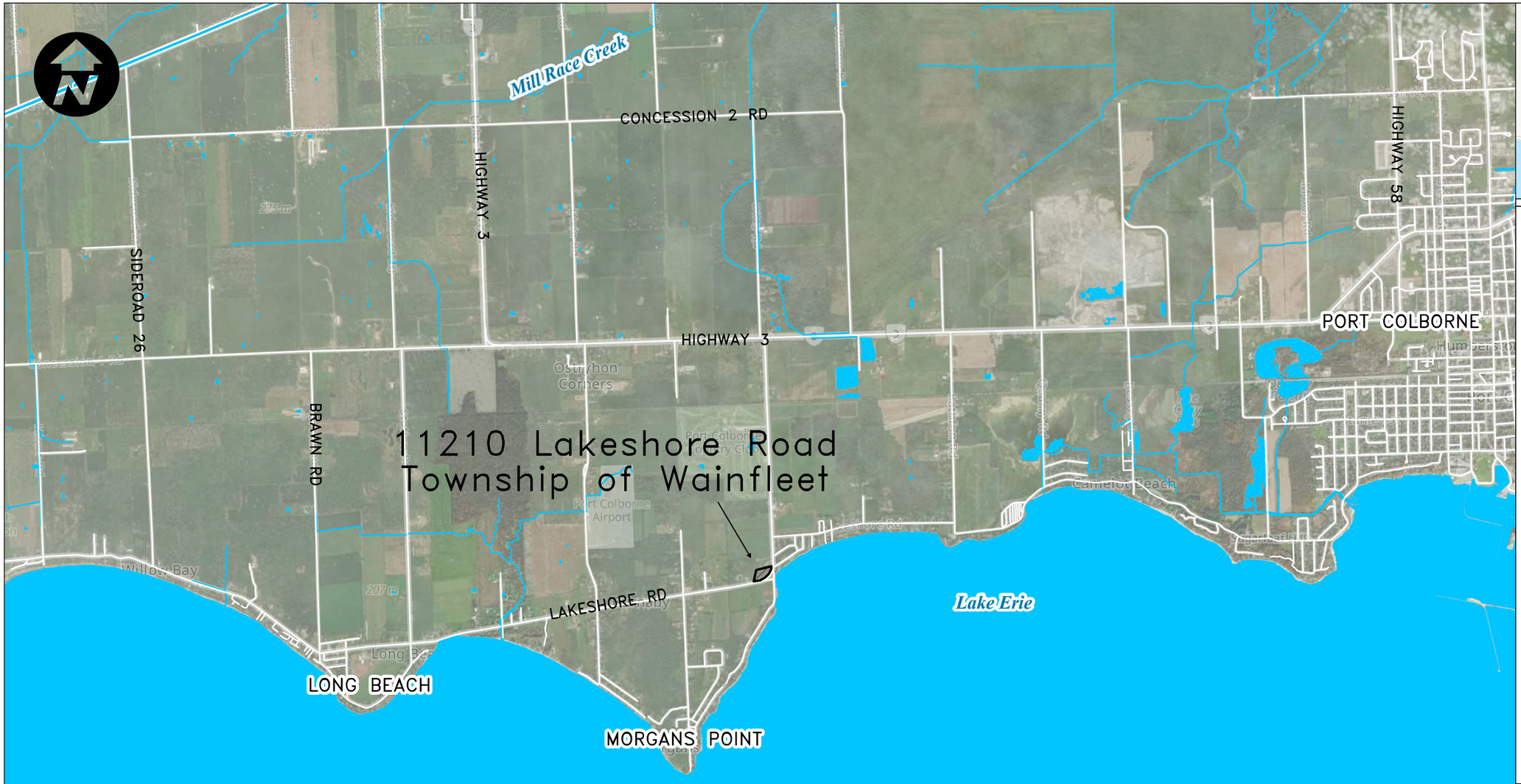
| | |
|---|---|
| **Project Name:** | 11210 Lakeshore Road, Wainfleet |
| **Project Number:** | 2292-6449 |
| **Date:** | 2022-12-13 |
| **Designed By:** | JD |
| **Checked By:** | KR |

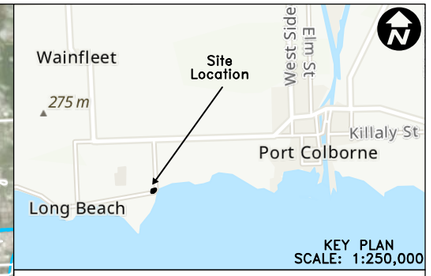
## D-5-4 IMPACT ASSESSMENT

**Calculate the Nitrate Concentration at a Boundary (Property *or* Surface Water)**

| Parameter | Value | Unit | Notes: |
|---|---|---|---|
| **Infiltration Volume** | | | |
| Area of Dilution = | 0.0892 | ha | Total area of site |
| Background Nitrate Quality in Groundwater = | 0.00 | mg/L | In the absence of groundwater analytical results, assumed to be 0 mg/L (per MECP Chapter 22 Reasonable Use Approach) |
| Annual Infiltration Rate = | 100 | mm/m2/yr | MECP infiltration rate for clay |
| | 2,739.73 | L/ha/day | |
| Annual Infiltration Volume = | 89 | $m^3$/year | |
| Total Average Background Nitrate = | 0 | mg/day | |
| **Sewage Effluent Volume** | | | |
| Proposed Number of Lots | 1 | | |
| Average Daily Volume of Sewage Effluent = | 1,000 | L/day | For residential, 1,000 L/home/day |
| Number of Days of Operation/Use = | 365 | days/year | |
| Annual Volume of Sewage Effluent = | 365 | $m^3$/year | |
| Nitrate Concentration in wastewater = | **10.0** | mg/L | |
| Total Average Nitrate Loading = | 10,000 | mg/day | |
| **Totals** | | | |
| Total Dilutant = wastewater V + infiltration V = | 454 | $m^3$/year | |
| Nitrate Concentration in Percolate = | **8.04** | **mg/L** | Less than 10 mg/L, sufficient for D-5-4 Impact Assessment |

# FIGURES




## LEGEND

- Site Location
- Road
- Watercourse
- Waterbody
- City/Town Name
- Street Name
- Waterbody/Watercourse Name

Basemap Sources: Province of Ontario, Haldimand County, Niagara Region, Esri Canada, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, USDA, NRCan, Parks Canada, Province of Ontario, Haldimand County, Esri Canada, Esri, HERE, Garmin,

0 0.5 1 2 km

DRAWING NOTES:



THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.

THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT. DO NOT SCALE THIS DRAWING.

ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

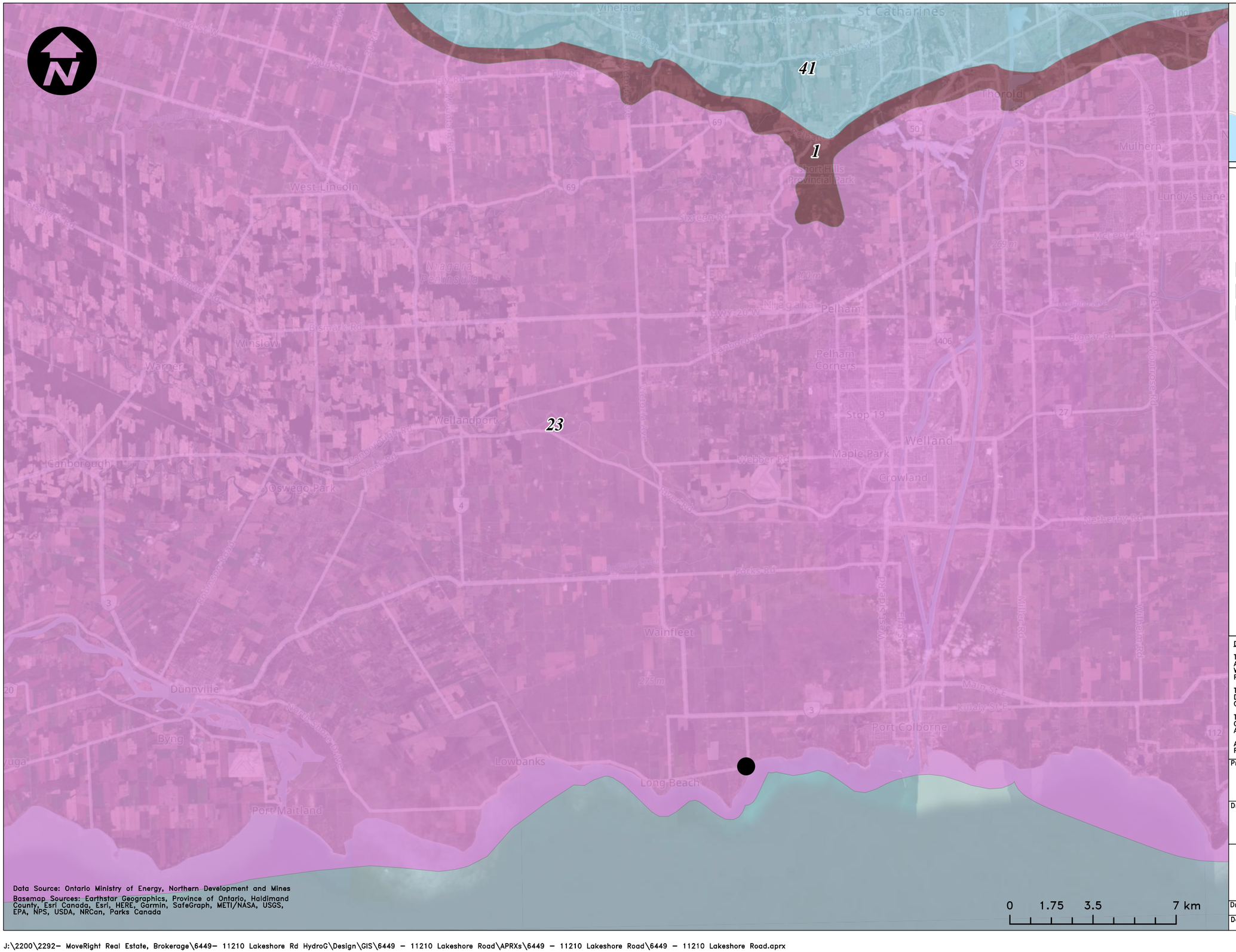
Drawing

SITE LOCATION PLAN

CROZIER
CONSULTING ENGINEERS
2800 High Point Drive
Suite 100
Milton, ON L9T 6P4
905-875-0026 T
905-875-4915 F
www.cfcrozier.ca

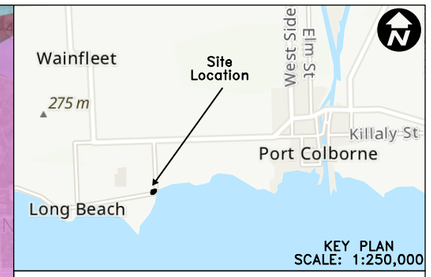
| | | | |
|---|---|---|---|
| Drawn C.M. | Design C.G. | Project No. | 2292-6449 |
| Date 2022-11-08 | Projection EPSG:26917 | Scale 1:40,000 | Dwg. FIG. 01 |

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Design\GIS\6449 - 11210 Lakeshore Road\APRXs\6449 - 11210 Lakeshore Road\6449 - 11210 Lakeshore Road.aprx




Data Source: Ontario Ministry of Energy, Northern Development and Mines

Basemap Sources: Earthstar Geographics, Province of Ontario, Haldimand County, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, NRCan, Parks Canada




LEGEND

Site Location

**PHYSIOGRAPHIC REGION**

- 1: Niagara Escarpment
- 23: Haldimand Clay Plain
- 41: Iroquois Plain

DRAWING NOTES:



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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

Drawing

PHYSIOGRAPHY

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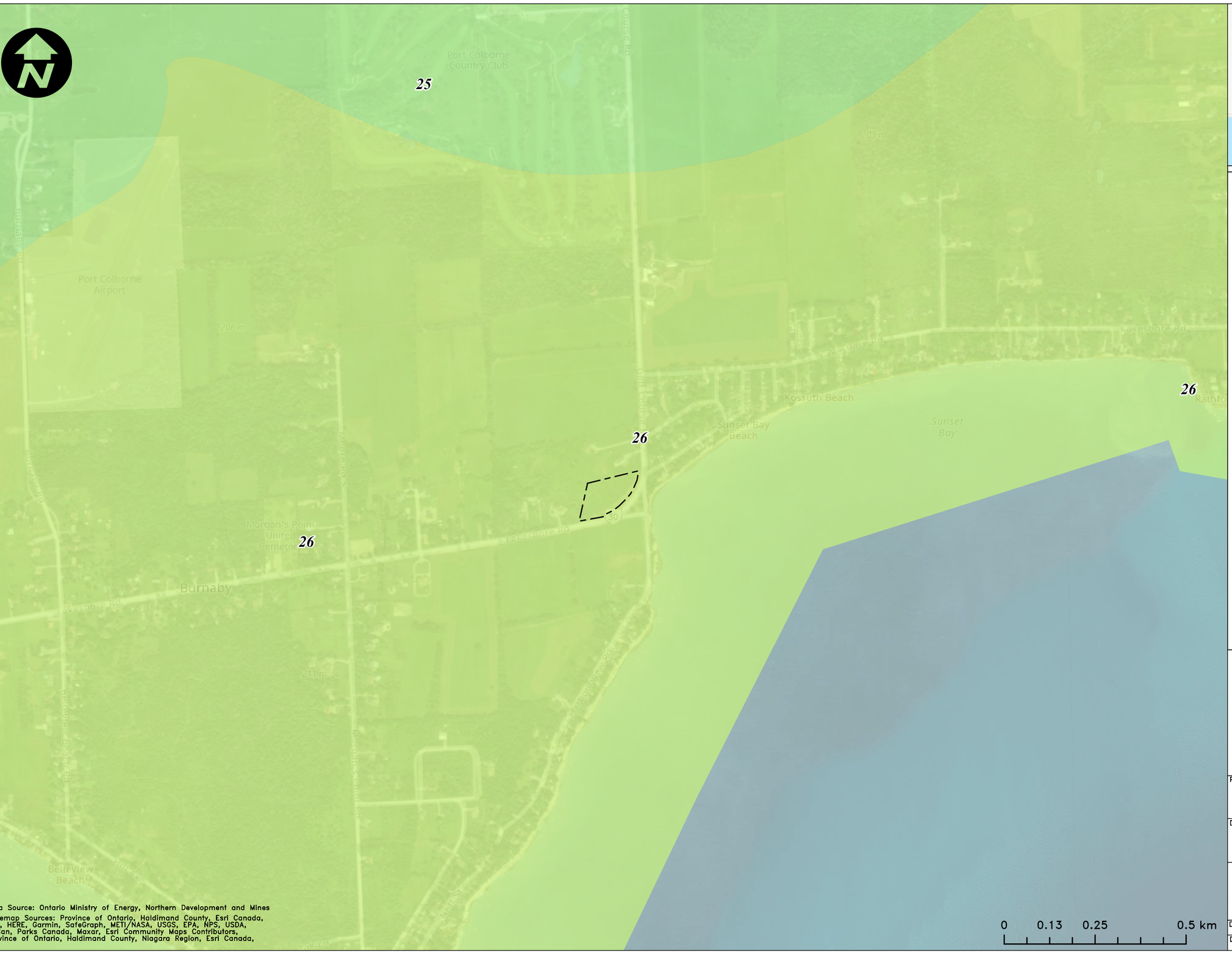
| 2022-11-08 | EPSG:26917 | 1:150,000 |

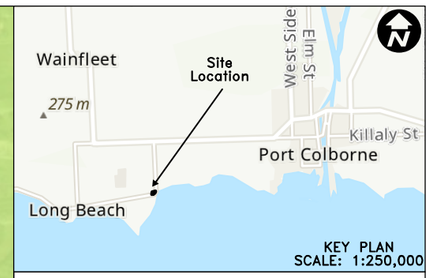
Dwg. FIG. 02

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Design\GIS\6449 - 11210 Lakeshore Road\APRXs\6449 - 11210 Lakeshore Road\6449 - 11210 Lakeshore Road.aprx




Data Source: Ontario Ministry of Energy, Northern Development and Mines

Basemap Sources: Province of Ontario, Haldimand County, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, NRCan, Parks Canada, Maxar, Esri Community Maps Contributors, Province of Ontario, Haldimand County, Niagara Region, Esri Canada,




LEGEND

Site Location

**BEDROCK GEOLOGY**

- 26 Onondaga Formation: fossiliferous limestone, variably cherty
- 25 Bois Blanc Formation: grey to brown, cherty limestone and dolostone, localized sandstone
- 22 Bertie Formation: brown to grey, laminated dolostone

DRAWING NOTES:



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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

Drawing

BEDROCK GEOLOGY

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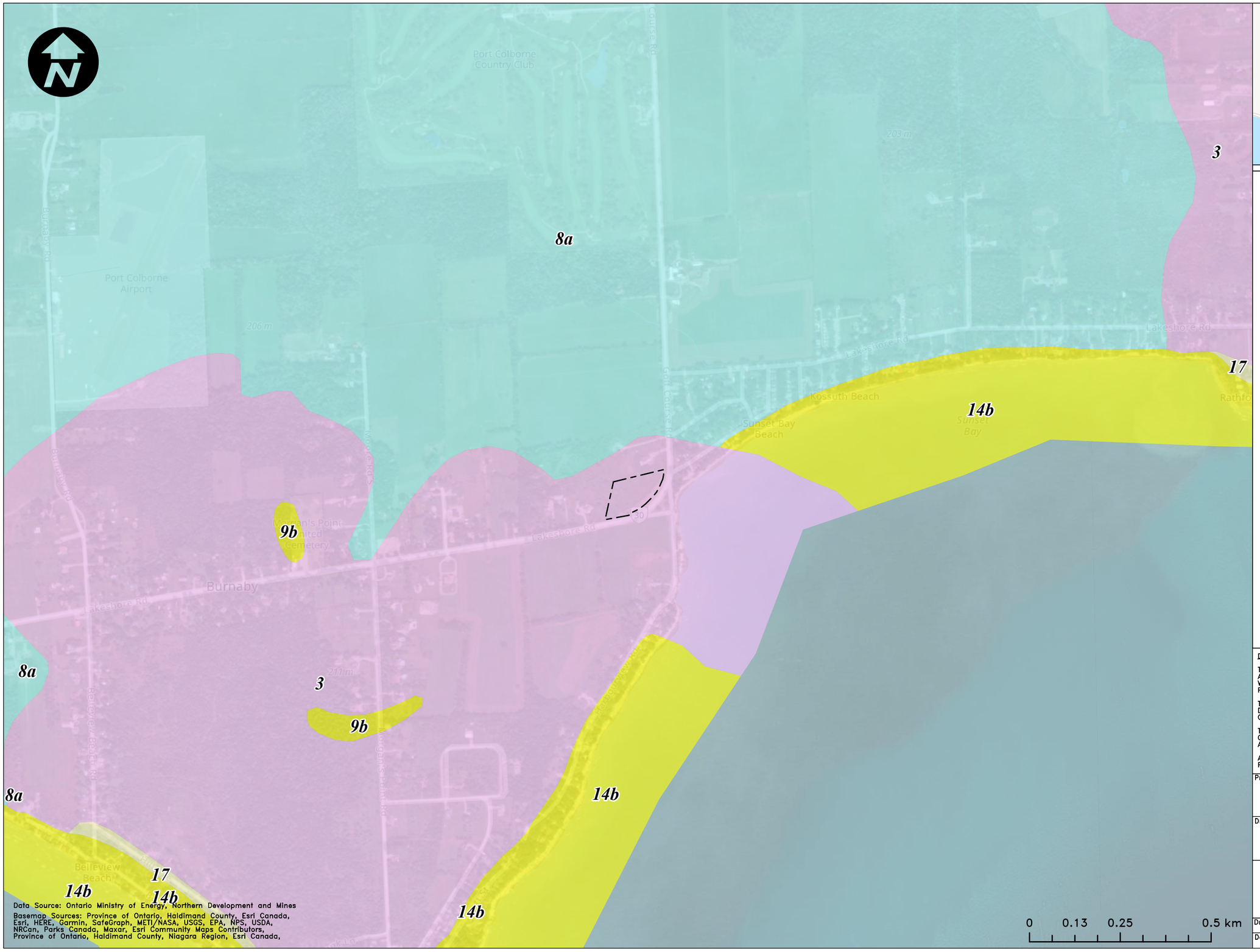
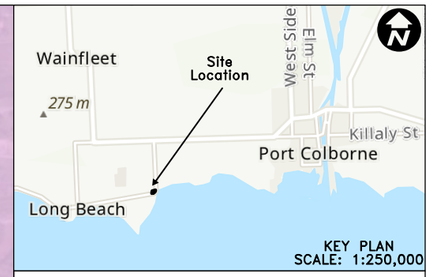
| Date | Projection | Scale / Dwg. |
| 2022-11-08 | EPSG:26917 | 1:10,000 / FIG. 03 |

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Design\GIS\6449 - 11210 Lakeshore Road\APRXs\6449 - 11210 Lakeshore Road\6449 - 11210 Lakeshore Road.aprx




## LEGEND

Site Location

### SURFICIAL GEOLOGY

- 17: Aeolian sand
- 14b: Lacustrine sand and gravel
- 9: Glaciolacustrine silt and sand
- 9b: Glaciolacustrine sand and gravel
- 8a: Glaciolacustrine clay and silt
- 5d: Glacial silty clay to clayey silt till
- 3: Paleozoic limestone and dolostone

DRAWING NOTES:



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Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

Drawing

SURFICIAL GEOLOGY

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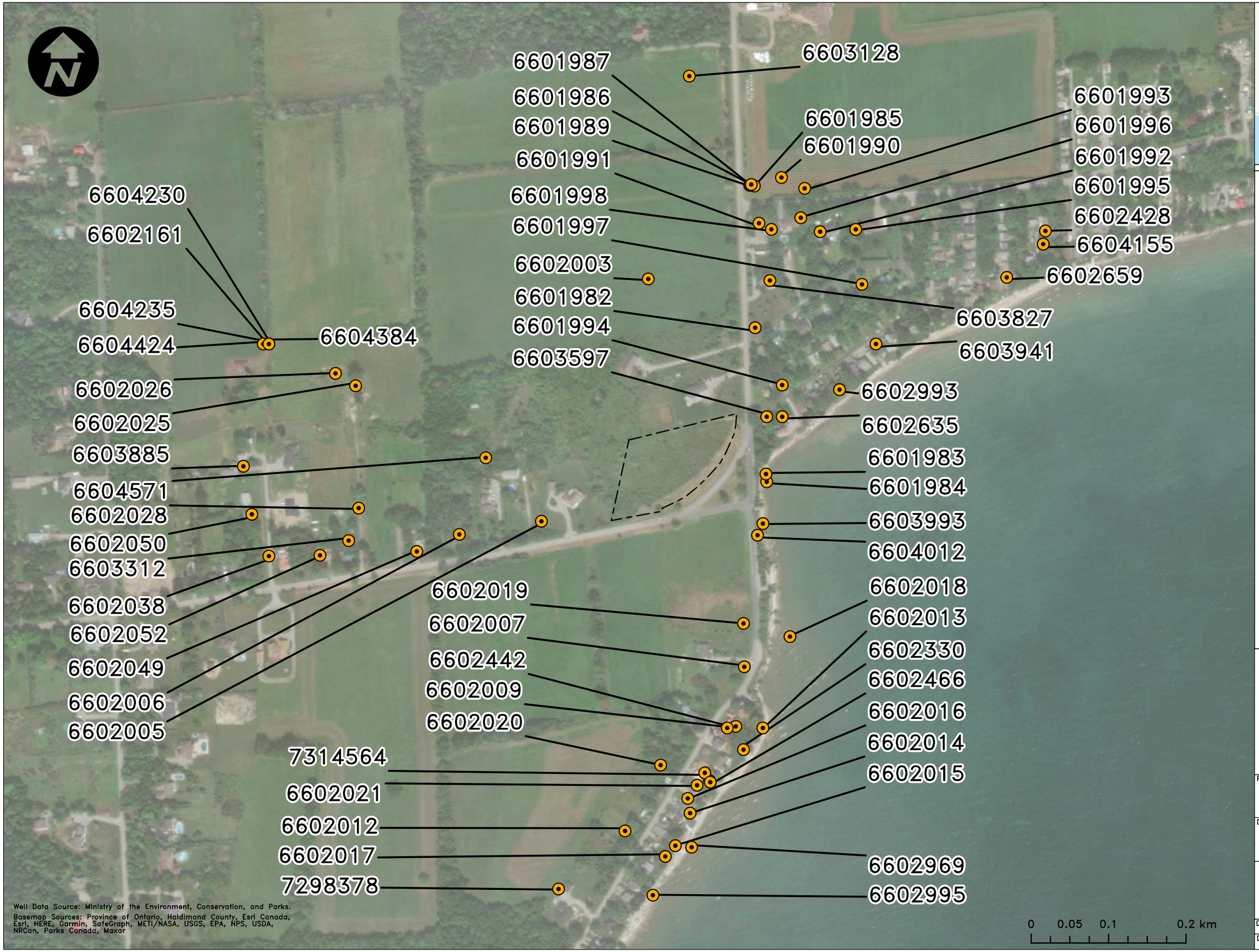
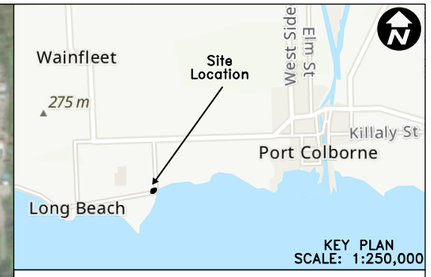
| Date | Projection | Scale | Dwg. |
| 2022-11-08 | EPSG:26917 | 1:10,000 | FIG. 04 |

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Design\GIS\6449 - 11210 Lakeshore Road\APRXs\6449 - 11210 Lakeshore Road\6449 - 11210 Lakeshore Road.aprx




Well Data Source: Ministry of the Environment, Conservation, and Parks.

Basemap Sources: Province of Ontario, Haldimand County, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, NRCan, Parks Canada, Maxar




## LEGEND

- Site Location
- MECP Well
- 6602659 Well ID

DRAWING NOTES:

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Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

Drawing

MECP WELL LOCATION PLAN

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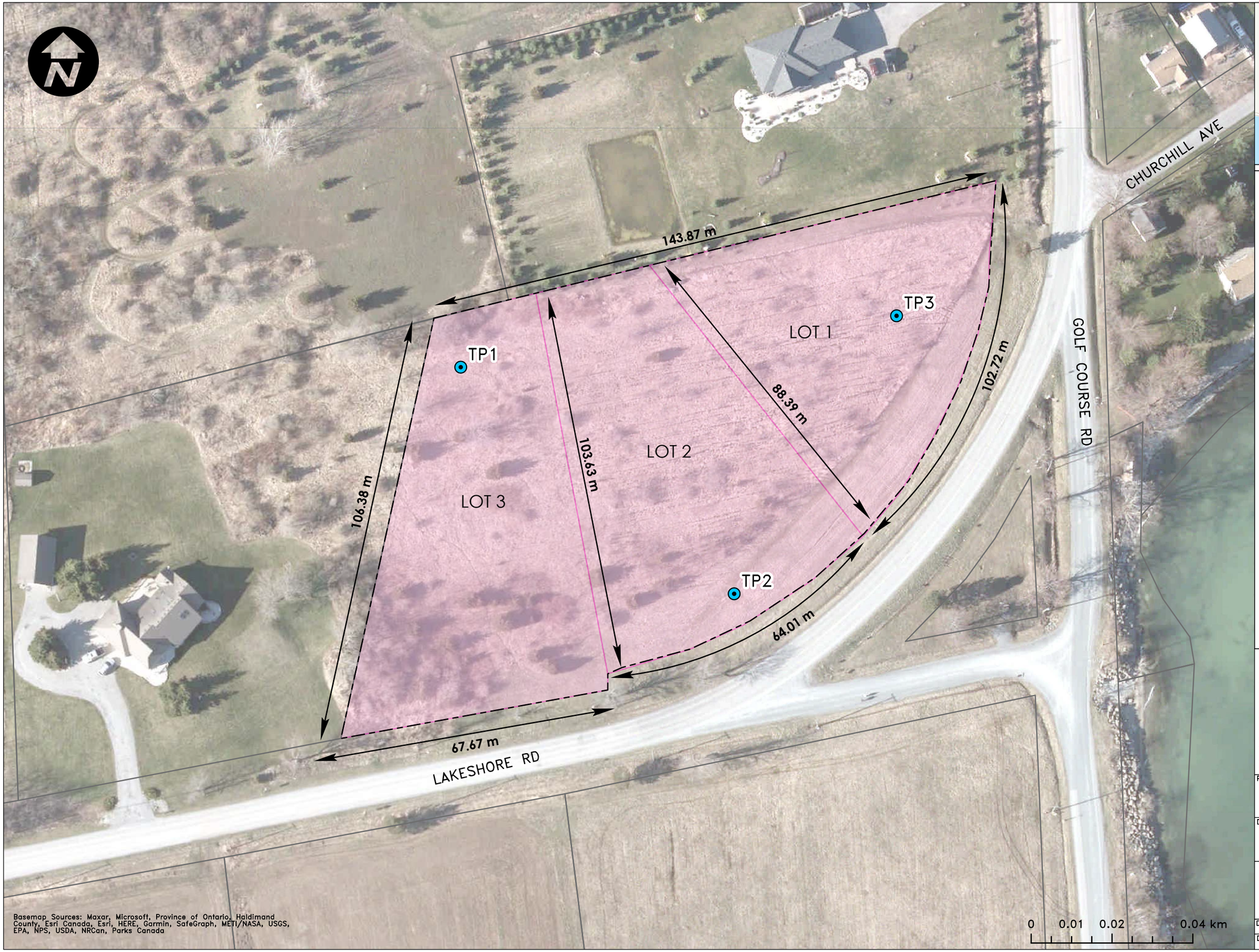
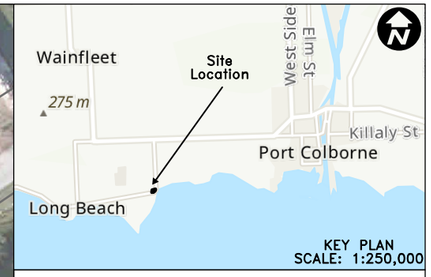
Dwg. FIG. 05

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Design\GIS\6449 - 11210 Lakeshore Road\APRXs\6449 - 11210 Lakeshore Road\6449 - 11210 Lakeshore Road.aprx




Basemap Sources: Maxar, Microsoft, Province of Ontario, Haldimand County, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, NRCan, Parks Canada




## LEGEND

- Site Location
- Assessment Parcel (Niagara Region, 2017)
- Testpit Location
- Approximate Lot Area

DRAWING NOTES:



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Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

Drawing

TESTPIT LOCATION PLAN

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| C.M. | C.G. | 2292-6449 |
| Date | Projection | Scale |
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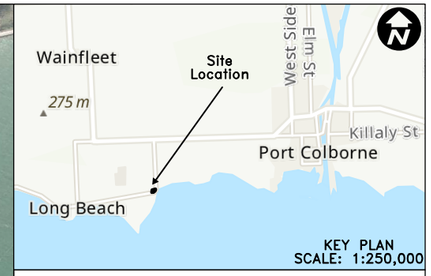
Dwg. FIG. 06

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Design\GIS\6449 - 11210 Lakeshore Road\APRXs\6449 - 11210 Lakeshore Road\6449 - 11210 Lakeshore Road.aprx


Basemap Sources: Province of Ontario, Haldimand County, Esri Canada, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA, NRCan, Parks Canada, Maxar




## LEGEND

- Site Location
- Door-to-Door Survey Location

DRAWING NOTES:



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Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

Drawing

DOOR-TO-DOOR SURVEY LOCATIONS

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|---|---|---|
| C.M. | C.G. | 2292-6449 |
| Date | Projection | Scale / Dwg. |
| 2022-11-08 | EPSG:26917 | 1:5,500 / FIG. 07 |

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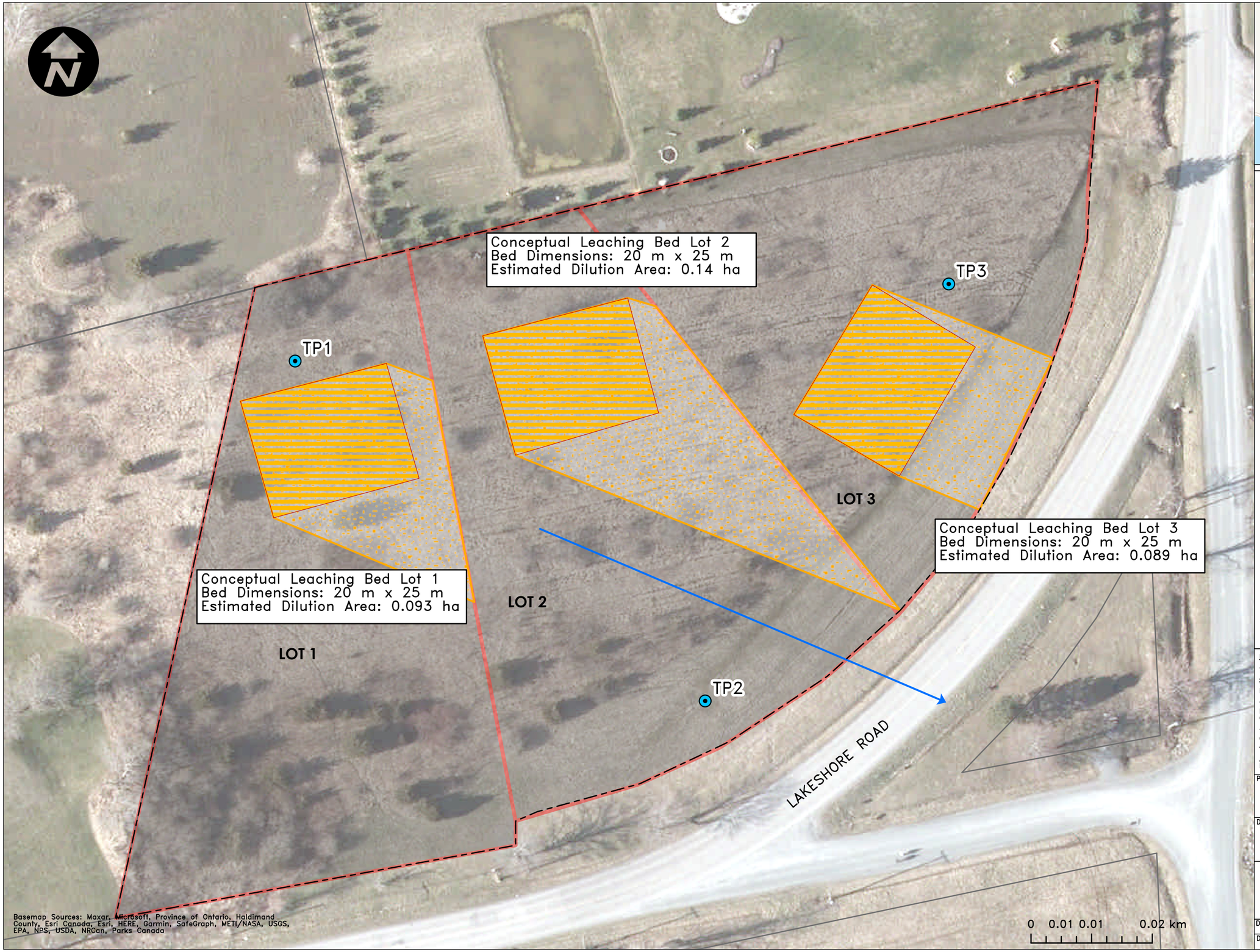


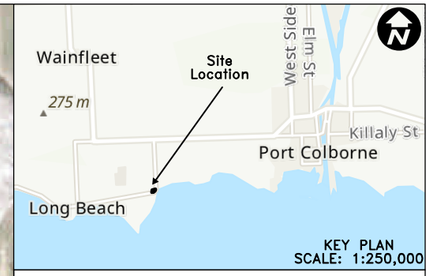


## LEGEND

- Site Location
- Assessment Parcel (Niagara Region, 2017)
- Interpreted Groundwater Flow Direction
- Conceptual Leaching Bed Footprint (0.05 ha)
- Dilution Area
- Testpit Location
- Approximate Lot Area

DRAWING NOTES:



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Project

11210 LAKESHORE ROAD
TOWNSHIP OF WAINFLEET

Drawing

ATTENUATION ZONES

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|---|---|---|
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| Date | Projection | Scale |
| 2022-12-22 | EPSG:26917 | 1:600 |

Dwg. FIG. 08

J:\2200\2292- MoveRight Real Estate, Brokerage\6449- 11210 Lakeshore Rd HydroG\Design\GIS\6449 - 11210 Lakeshore Road\APRXs\6449 - 11210 Lakeshore Road\6449 - 11210 Lakeshore Road.aprx