

FUNCTIONAL SERVICING REPORT

211 DOCK ROAD
CITY OF BARRIE
COUNTY OF SIMCOE



PEARSON
ENGINEERING

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(Revised December 2024)

October 2023

22047



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FUNCTIONAL SERVICING REPORT

211 DOCK ROAD - BARRIE

1. INTRODUCTION

PEARSON Engineering Ltd. has been retained by 1000067364 Ontario Inc. (Client) to prepare a Functional Servicing Report (FSR) in support of five (5) proposed single detached dwellings on severed lots located at 211 Dock Road in the City of Barrie (City), County of Simcoe (County).

The subject property is approximately 1.25 ha in size and is currently partially treed lot with one single detached house under construction at the west limit fronting Dock Road. The lot generally slopes from southwest to northeast with runoff flowing towards Tynhead Road. The Project Site is bounded to the northwest by Tyndale Park, southeast by Dock Road Park, and existing residential properties to the northeast, east, south and west. Kempenfelt Bay (Lake Simcoe) is located approximately 150 m east of the property. The location of the site can be seen in Figure 1.

This FSR assesses the existing municipal infrastructure in the vicinity of the Project and internal services required to service the proposed Project. The report also includes preliminary design calculations and a brief outline of the proposed internal services, as well as comments regarding the ability of the various secondary utilities to service the site.

2. SUPPORTING DOCUMENTS

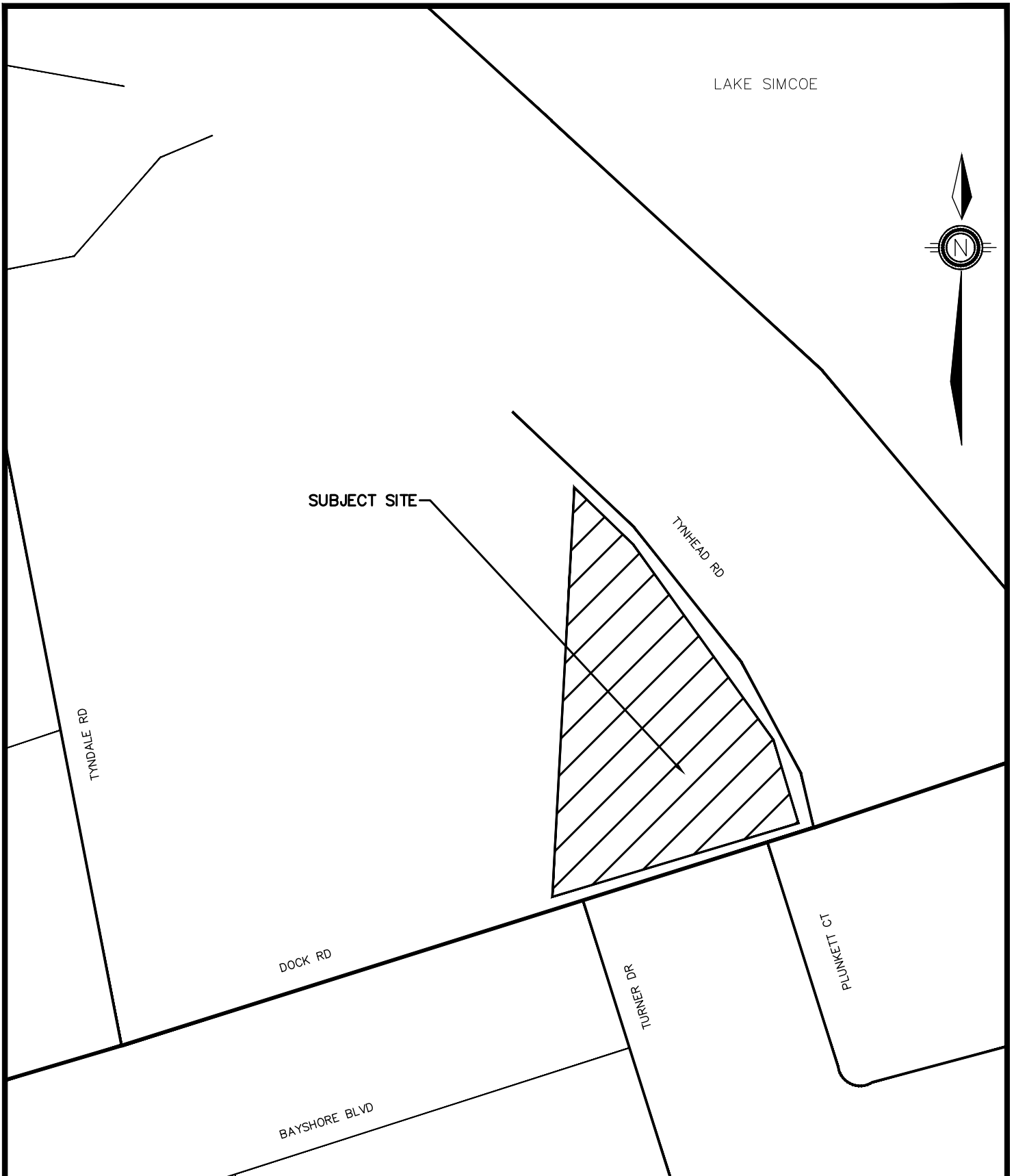
The following documents have been referenced in the preparation of this report:

- Ministry of the Environment, Design Guidelines for Sewage Works, 2008
- Ministry of the Environment, Design Guidelines for Drinking-Water Systems, 2008
- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- City of Barrie, Sanitary Sewage Collection System Policies and Design Guidelines, October 2017
- City of Barrie, Water Distribution Specification, December 2017
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines, December 2017
- Lake Simcoe Region Conservation Authority (LSRCA), Technical Guidelines for Stormwater Management Submissions, April 2022
- LSRCA Phosphorus Offsetting Policy (May 2023)
- LSRCA Water Balance Recharge Offsetting Policy (May 2023)

3. DESIGN POPULATION

The proposed development is to consist of five (5) single family detached dwellings. Based on City of Barrie Residential Flows data, a design population of 3.13 persons per unit was selected. This results in a maximum projected design population of 16 people. Refer to Appendix A for calculations.

C:\Users\jmoore\AppData\Local\Temp\AcPublish_47740\22047 - FSR_rev1.dwg Layout:FIG-1 Plotted Dec 10, 2024 @ 1:29pm by jmoore © PEARSON ENGINEERING LTD.



100067364 ONTARIO INC.
211 DOCK ROAD
CITY OF BARRIE

SITE LOCATION PLAN



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DESIGNED BY	AMC	HORIZ SCALE	NTS	PROJECT #	22047
DRAWN BY	WT	VERT SCALE	NTS	DRAWING #	FIG-1
CHECKED BY	MWD	DATE	OCTOBER 2023	REVISION #	0



4. WATER SUPPLY AND DISTRIBUTION

4.1. WATER SERVICING DESIGN CRITERIA

Utilizing the City of Barrie Guidelines for domestic water use of 225 L/capita/day, an Average Day Demand (ADD) of 0.04 L/s is required. The Peak Rate factor of 14.3 was used in calculating a Peak Hour Demand (PHD) of 0.58 L/s for the development. Calculations for the domestic water requirements for the site can be found in Appendix A.

Existing fire hydrants on Dock Road fronting the project provide adequate firefighting coverage as per the City of Barrie Standards. As such, no additional hydrant is proposed for the development.

4.2. WATER SERVICING

The Project will be serviced by municipal water for domestic service and will be designed as per City standards. A 200 mm diameter municipal watermain is located on the north side of Dock Road within Pressure Zone 1. The lots will be serviced by connecting five individual 25 mm domestic water services to the existing 200 mm diameter watermain. These service connections will be designed and constructed in accordance with the standards and criteria prepared by the City of Barrie. Refer to Figure 2 for the water servicing layout.

We suggest that the City review the water design flow from this Project with respect to the City's water treatment capacities and confirm that capacity allocation is available for this development.

4.3. FIRE FLOW REQUIREMENTS

The Fire Underwriters Survey (FUS) assessment was used to calculate the required fire flow and was determined to be approximately 200 L/s (3,168 GPM) which is the same as the City of Barrie Standards of a minimum required fire flow of 200 L/s (3,168 GPM) for residential sites. The building construction consists of wood frame construction where structural elements, walls, arches, floors, and roofs are constructed entirely or partially of wood or other material. The FUS calculation was completed for lot 2 with a footprint area of 280 m². Fire flow calculations are indicated in Appendix A.

A hydrant flow test was performed by Vipond Inc., dated April 17th, 2024, on the existing hydrant on the north side of Dock Road to ensure that the existing hydrants provide adequate fire flow to the proposed development. The test result indicates pitot pressure of 64 psi was available at the existing hydrant (Hydrant #3131). The flow test was conducted on hydrant #3105. This flow test demonstrated that a flow of approximately 19 L/s at a residual pressure of 62 psi can be supplied. Through the extrapolation of the hydrant results, it was determined that 252 L/s (4,008 GPM) of flow is available at a minimum residual pressure of 20 psi for the proposed development.

Given that the hydrant on Dock Road can supply 252 L/s of fire flow, which is more than the FUS requirements (200 L/s) for the site, the available fire flow meets FUS requirements and is deemed acceptable as per the City of Barrie guidelines. Detailed FUS calculations and hydrant flow test can be seen in Appendix A.

5. SANITARY SERVICING OVERVIEW

5.1. SANITARY DESIGN CRITERIA

The site is to have a total population of 16 people. Utilizing the City of Barrie Guidelines for domestic sewer use of 225 L/capita/day, an Average Daily Flow (ADF) of 0.04 L/s was calculated. Using the Max Peaking Factor of 4.0 for this project, and an Infiltration Allowance of 0.02 L/s a Peak Flow of 0.18 L/s was calculated for the project site. Sanitary design flow calculations can be found in Appendix B.



5.2. SANITARY SERVICING

The existing sanitary sewer on Dock Road will be extended westerly from its existing terminus at the intersection of Plunkett Court and Dock Road fronting Lot 5. The proposed sanitary sewer will consist of a 250 mm diameter pipe and will be designed to meet minimum design grades and the required minimum and maximum velocities under flow conditions. Sanitary sewers be constructed in accordance with the City of Barrie and the MECP guidelines to service the project. Each residential unit will be provided with a separate 100 mm diameter service connection. The proposed sanitary sewer system layout for the site can be seen in Figure-2.

The existing 300 mm diameter sanitary sewer on Dock Road runs west to east and has a capacity of 43.3 L/s at a slope of 0.20%. As the residential flow from the project site is 0.40% of the capacity of the existing sewer, it is expected to have sufficient capacity to convey the sanitary design flows and have no adverse effects on the existing sanitary sewer system.

6. STORMWATER MANAGEMENT

A key component of the development is the need to address environmental and related SWM issues. These are examined in a framework aimed at meeting the City, LSRCA, and MECP requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems. This FSR focuses on the necessary measures to satisfy the MECP and LSRCA's SWM requirements.

It is understood the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion;
- Maintain water quality for ecological integrity, recreational opportunities, etc.;
- Protect and maintain groundwater flow regime(s);
- Protect aquatic and fishery communities and habitats by reducing phosphorous loading;
- Maintain and protect significant natural features;
- Provide stormwater quantity control to reduce concentrations of outflows to existing infrastructure;
- Provide water balance for groundwater table recharge;
- Provide a volume control.

6.1. ANALYSIS METHODOLOGY

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment Stormwater Management Planning and Design Manual, March 2003
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines, December 2017
- Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Submissions April 2022

In order to design the facilities to meet these requirements, it is essential to select the appropriate modeling methodology for the storm system design. Given the size of the site, the Modified Rational Method is appropriate for the design for the SWM system.



6.2. EXISTING DRAINAGE CONDITIONS

The existing Project site is currently a partly treed vacant lot with one single detached house under construction. The property generally drains its storm runoff northerly as sheet flows to an existing ditch located on the west side of Tynhead Road and crossing Tynhead Road in a 300 mm diameter CSP culvert between Lot 6 and Lot 7 on Tynhead Road ultimately outletting to Kempenfelt Bay. An existing ditch and culvert on the north side of Dock Road conveys Dock Road runoff easterly along the front of the property and crosses under Tynhead Road via a 600 mm diameter culvert and outlets downstream directly into Kempenfelt Bay.

According to the Geotechnical Investigation Report completed by Peto MacCallum Ltd., dated May 2018, the project site consists of a layer of sandy silt which followed by sand and gravels; therefore, it is assumed that the soils have adequate infiltration rates. However, the seasonal groundwater elevations are generally located within close proximity, ranging from 0.1 to 2.8 m of the existing surface.

Given the size of the site, the Modified Rational Method is used to determine the pre-development peak flows. Table 1 and Table 2 below show the pre-development peak flows to Tynhead Road and to the aforementioned 600mm culvert at Tynhead and Dock Road. The pre-development peak flow calculations can be found in Appendix C.

Refer to Figure 5 for additional details regarding the existing drainage condition in vicinity of the proposed development concept.

Table 1: Pre-Development Peak Flows to Tynhead Road

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Total Peak Flow to Tynhead Road (m ³ /s)	0.02	0.03	0.04	0.05	0.06	0.06

Table 2: Pre-development Peak Flows to Dock Road Culvert

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Total Peak Flow to Dock Road (m ³ /s)	0.02	0.02	0.03	0.04	0.04	0.05

6.3. PROPOSED STORM DRAINAGE SYSTEM

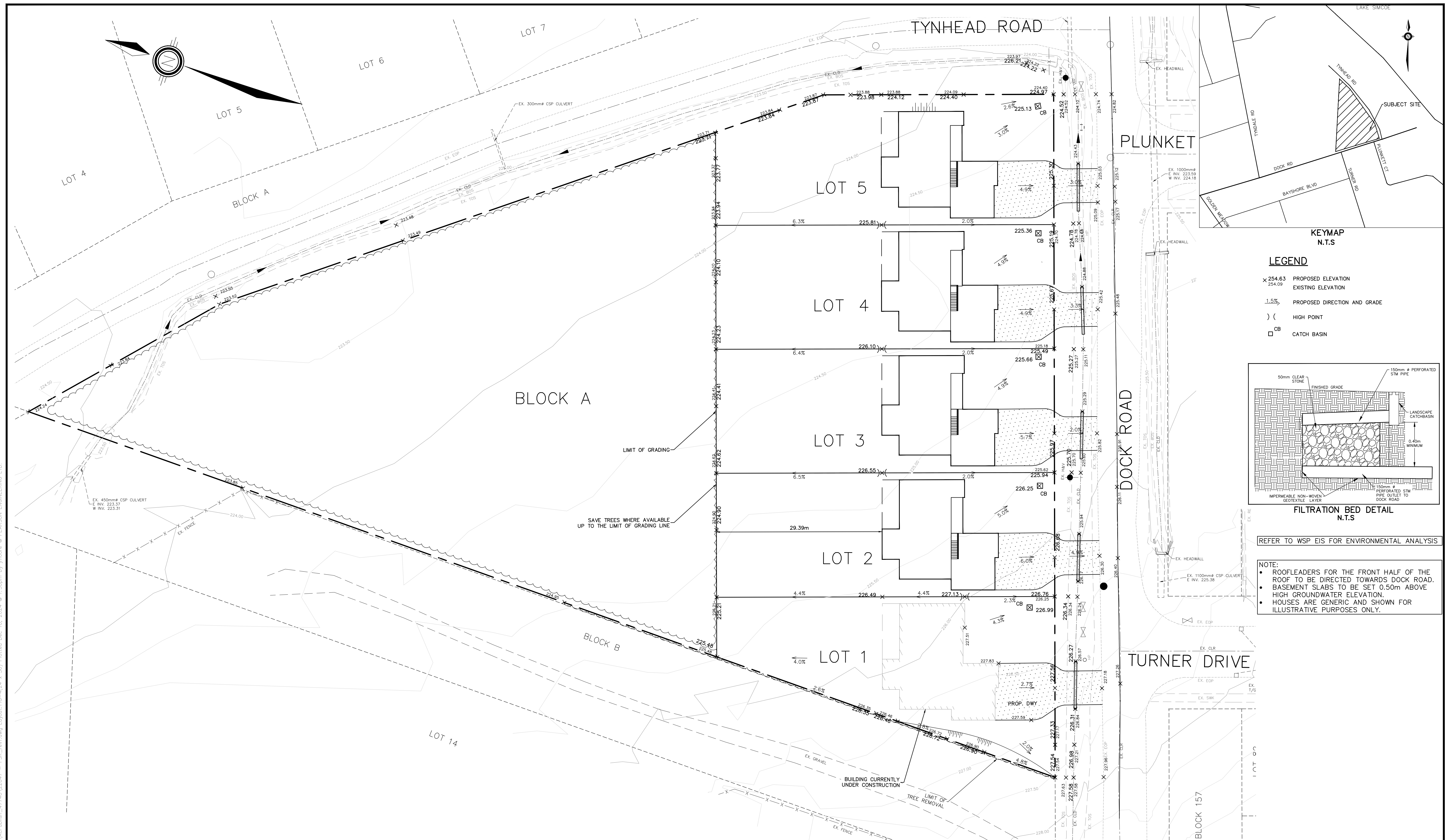
The post-development storm drainage for the project will generally follow pre-development conditions. Rear yards of the lots will drain north to Tynhead Road and the houses and front yards will drain to the ditch on Dock Road. The storm catchment areas and storm drainage patterns can be seen on Figure 6.

6.4. STORMWATER QUANTITY CONTROL

6.4.1. DRAINAGE TO TYNHEAD ROAD

Rear yard drainage under post-development conditions will be conveyed to the existing roadside ditch located on Tynhead Road. In pre-development conditions, 1.26 ha of the property is directed to the Tynhead Road ditch with a peak flow of 0.06 m³/s in the 100-year storm.

The area contributing to the Tynhead Road roadside ditch will decrease from 1.26 ha to 0.94 ha under post-development conditions. While the contributing area will decrease, the runoff coefficient will increase from 0.08 to 0.10 due to the forest area being replaced by grassed area.



1.	REVISED AS PER CITY COMMENTS	12/10/24	JM
1.	REVISED AS PER CITY COMMENTS	10/29/24	NP
NO.	REVISION NOTE	DATE	BY

BENCHMARK:
ELEVATIONS SHOWN ON THIS PLAN ARE RELATED TO GEODETIC DATUM AND ARE DERIVED FROM BENCHMARK NO 03120080014 HAVING A PUBLISHED ELEVATION OF 220.029 METERS.

1000067364 ONTARIO INC.
211 DOCK ROAD
CITY OF BARRIE

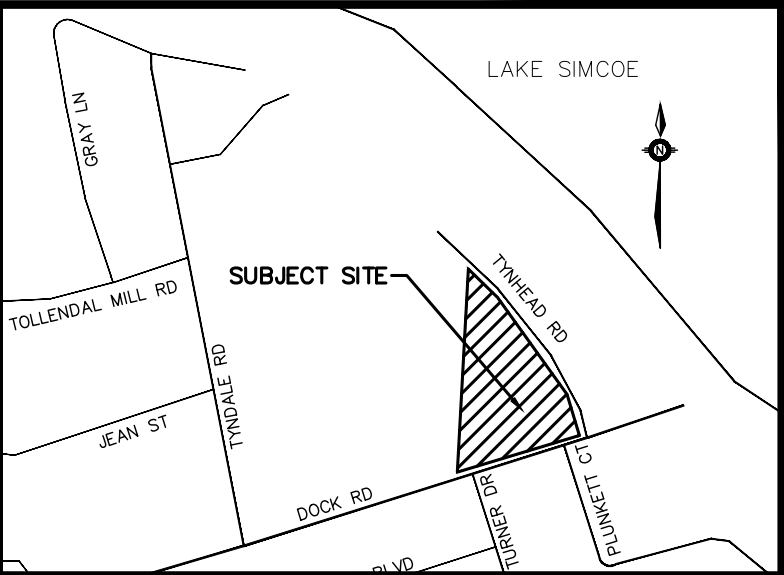
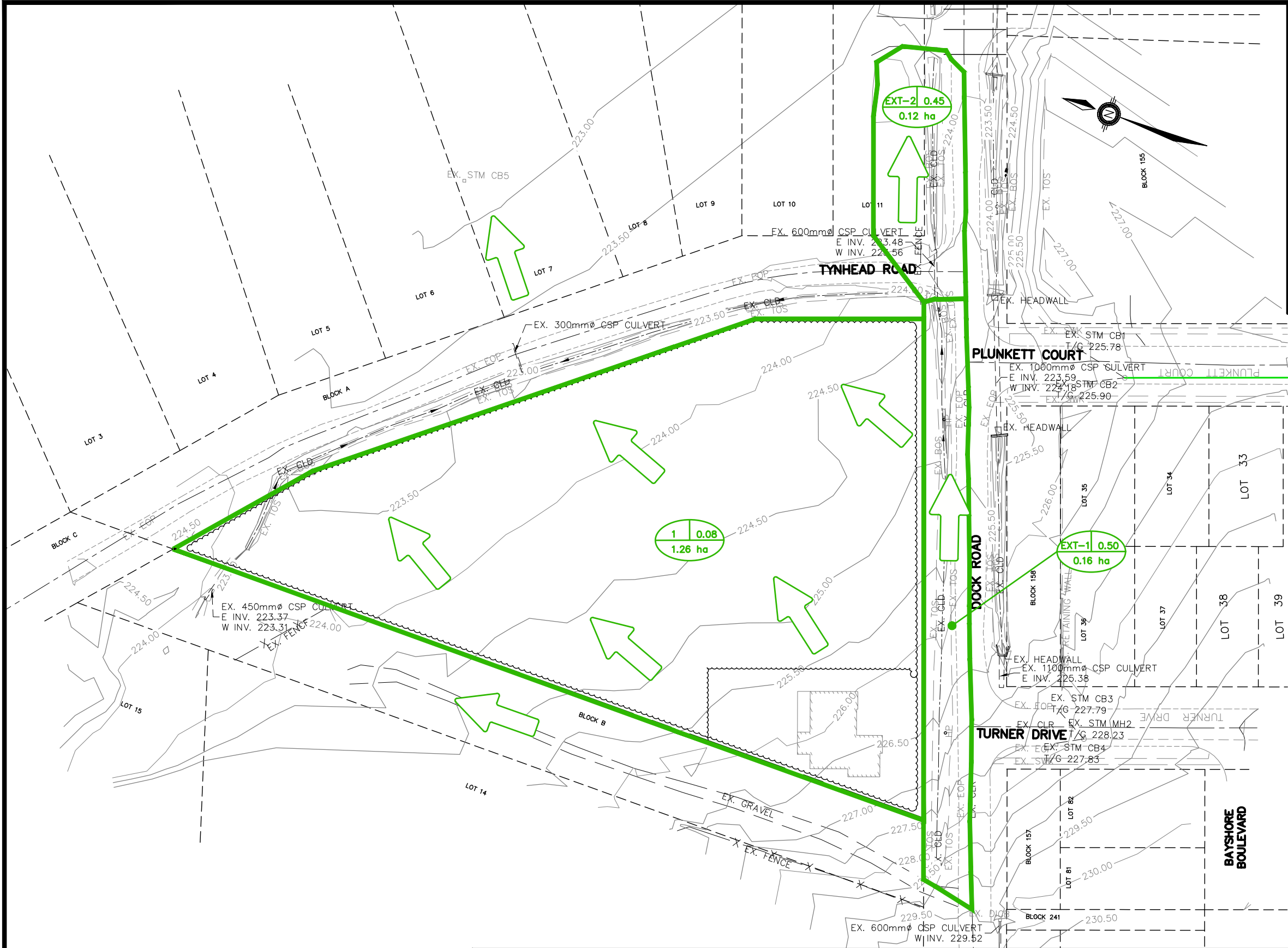
SITE GRADING PLAN



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DESIGNED BY	AMC	HORIZ SCALE	1:300	PROJECT #	22047
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KEY MAP
NTS

LEGEND

- OVERLAND FLOW DIRECTION
- CATCHMENT AREA
- 1 0.08 1.26 ha
- 1 0.75 1.00 ha
- RUNOFF COEFFICIENT
- AREA IN HECTARES
- CATCHMENT BOUNDARY

2.	REVISED AS PER CITY COMMENTS	12/10/24	JM
1.	REVISED AS PER CITY COMMENTS	10/29/24	NP
NO.	REVISION NOTE	DATE	BY

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211 DOCK ROAD
CITY OF BARRIE

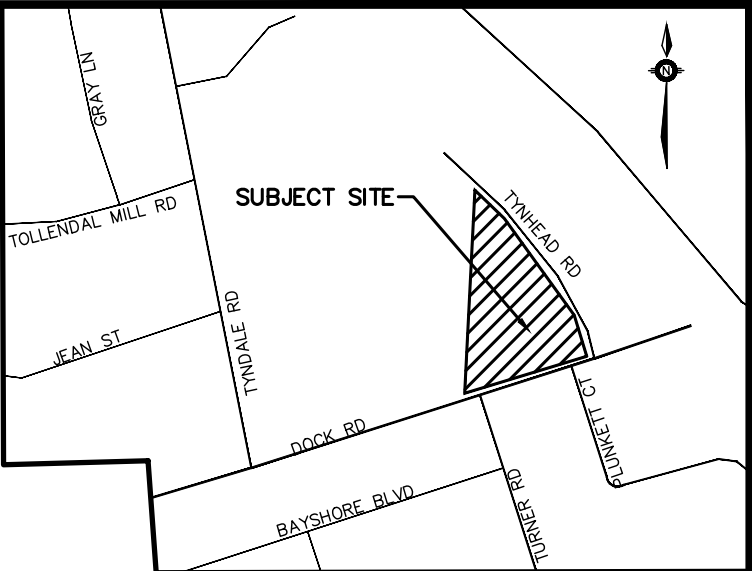
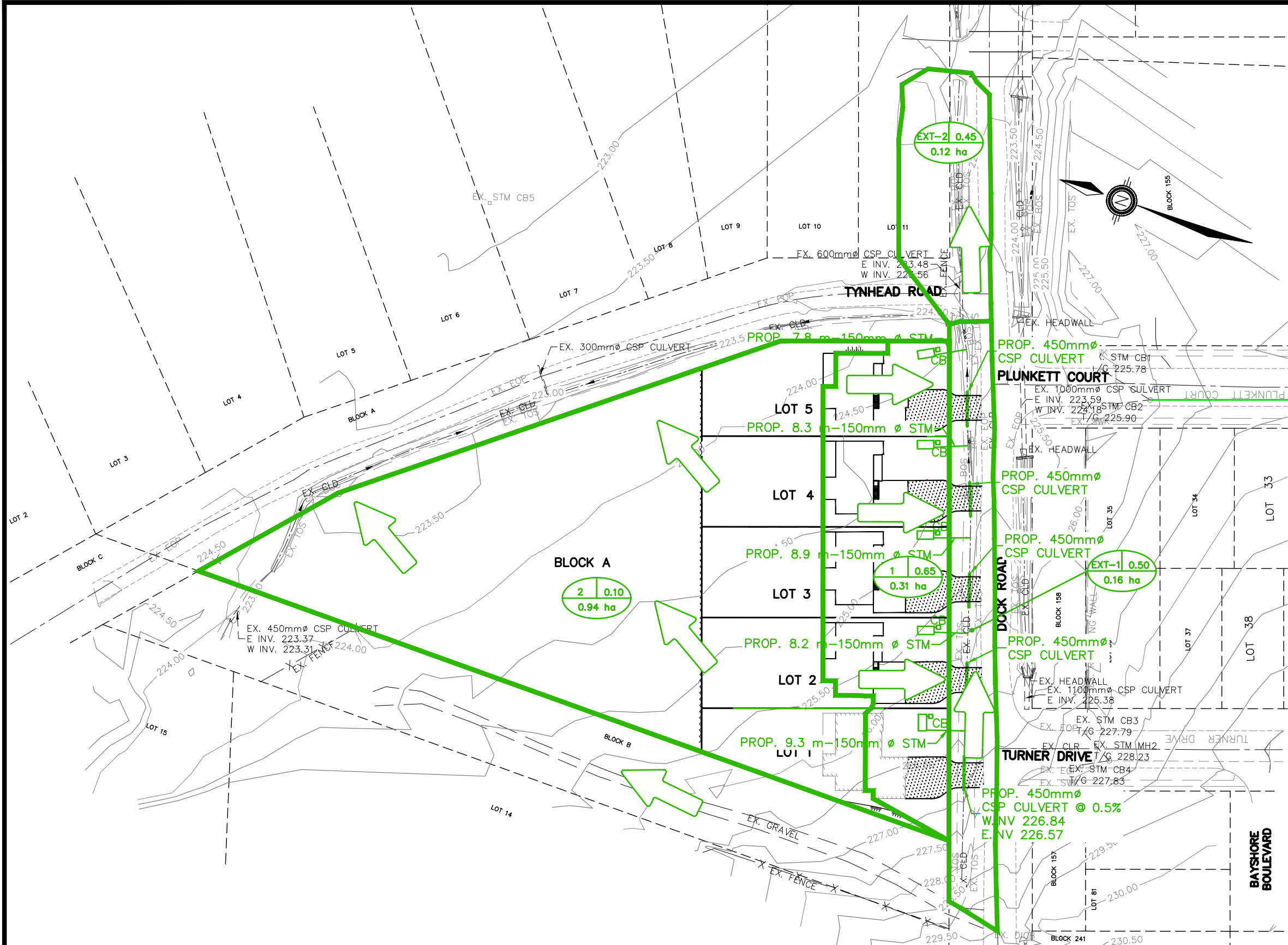
PRE-DEVELOPMENT STORM
DRAINAGE PLAN



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DESIGNED BY	AMC	HORIZ SCALE	1:1000	PROJECT #	22047
DRAWN BY	WT	VERT SCALE	N/A	DRAWING #	FIG-5
CHECKED BY	MWD	DATE	OCTOBER 2023	REVISION #	2

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KEY MAP
NTS

LEGEND

- OVERLAND FLOW DIRECTION
- CATCHMENT AREA
- RUNOFF COEFFICIENT
- AREA IN HECTARES
- CATCHMENT BOUNDARY

2.	REVISED AS PER CITY COMMENTS	12/10/24	JM
1.	REVISED AS PER CITY COMMENTS	10/29/24	NP
NO.	REVISION NOTE	DATE	BY

1000067364 ONTARIO INC.
211 DOCK ROAD
CITY OF BARRIE

POST-DEVELOPMENT STORM
DRAINAGE PLAN



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DESIGNED BY	AMC	HORIZ SCALE	1:1000	PROJECT #	22047
DRAWN BY	WT	VERT SCALE	N/A	DRAWING #	FIG-6
CHECKED BY	MWD	DATE	OCTOBER 2023	REVISION #	2



However, the post-development peak flows up to the 100-year storm will remain unchanged. The post-development peak flows are shown below in Table 3.

Table 3: Post-Development Peak Flows to Tynhead Road

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Uncontrolled to Tynhead Road (m ³ /s)	0.02	0.03	0.03	0.04	0.05	0.06

By comparing Table 1 to Table 3, it can be seen that the post-development flows are controlled to or below pre-development flow values. Detailed calculations can be seen in Appendix C.

6.4.2. DRAINAGE TO DOCK ROAD

As per the City of Barrie Lot Grading Policies, it is required that the front yard drainage slope towards the road and this therefore conveyed to the Dock Road roadside ditch.

The drainage area conveyed to Dock Road under post-development conditions consists of 0.31 ha. with a runoff coefficient of 0.65. The roadside ditch conveys flows easterly towards existing 600 mm culvert located underneath of Tynhead Road. The Dock Road ditch and culvert capacity calculations demonstrate that the existing ditch and culvert have sufficient capacity to convey 100-year peak flows. Post-development peak flows to are shown in Table 4 below.

Table 4: Post Development Peak Flows to Dock Road Culvert

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Total Flow to Dock Road Culvert (m ³ /s)	0.07	0.09	0.10	0.13	0.16	0.18

The area contributing to the ditch downstream of the existing 600 mm culvert is 0.60 ha, with a runoff coefficient of 0.57. and is shown on Figure 6. As per the calculations in Appendix C the Dock Road ditch downstream of Tynhead Road has sufficient capacity to convey the post development peak flows.

6.5. QUALITY CONTROL

The Ministry of the Environment, Conservation, and Parks (MECP) in March 2003 issued a "Stormwater Management Planning and Design Manual". This manual has been adopted by a variety of agencies including the City of Barrie. The objective of our Stormwater Quality Control will be to ensure Enhanced Protection quality control as stated in the MECP manual. To achieve enhanced protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

6.5.1. PERMANENT QUALITY CONTROL

The proposed development consists of five dwellings and associated driveways and will not create new roadways. Most of the runoff from the development can be considered clean as it originates from roofs and landscaped areas. The construction of 5 new driveways will not significantly increase the impervious areas that contribute to a reduction in stormwater quality for the project site when compared to the existing condition. Furthermore, any runoff from the driveways will be conveyed across the front yards or within vegetated swales/ditches providing opportunity for nutrient uptake and deposition of sedimentation. Considering the impact of 5 driveways on the quality of storm runoff for reasons stated above is expected to be minimal, no quality control measures are proposed.



6.5.2. DURING CONSTRUCTION ACTIVITIES

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure stormwater runoff's quality.

Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of silt fence along the entire perimeter of the site to reduce sediment migration onto surrounding properties;
- Installation of a construction entrance mat to minimize transportation of sediment onto roadways;
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit. The duration in which surfaces are disturbed/exposed shall not exceed 30 days;
- Reduce stormwater drainage velocities where possible; and
- Minimize the amount of existing vegetation removed.

7. VOLUME CONTROL

Since the project site meets the definition of Major Development as per LSRCA Guidelines, considerations were taken to meet the volume control criteria which states that the 25 mm storm event from the total impervious area of the site is to be retained and treated, with flexible alternatives if this criterion cannot be met. The project site has an impervious area of 2048 m², resulting in a storage volume requirements of 51.2 m³ using 25 mm storm. Due to the high groundwater level throughout the site, this volume cannot be infiltrated, filtered or reused on site.

Low Impact Development options such as the following were considered to provide volume control:

- Bioretention swale
- Soakaway pits
- Infiltration galleries
- Surface ponding
- SWM pond

Soakaway pits are often proposed to capture runoff from the building rooftops and infiltrate stormwater providing volume control. A typical soakaway pit is generally 0.8 to 1m deep. As per the groundwater levels provided by Azimuth, the groundwater ranges in elevation from 233.8 to 225.0 (about 0.1m to 1m below existing) across the site. As such, implementation of these features will not be able to obtain the minimum separation of 1.0m. Similarly, Biotrention swales and infiltration galleries are not able to achieve the required separation from groundwater.

City of Barrie guidelines require a minimum of 2% slope on swales and yards and no ponding on private property. Surface ponding can often be utilized in City parks, industrial/commercial properties but leads to homeowner complaints when incorporated on private residential properties and is therefore not implemented on this project.

Given the small size of the site, it's freehold nature and infill style of this project, there is limited opportunity to provide a centralized SWM Pond to reduce peak flows and provide volume control.



However, a filtration bed (2.0 m x 4.0 m x 0.40 m) is proposed within the front yard of all lots. The runoff from the front half of the rooftop and front yard will be captured by a landscape catchbasin which will direct the stormwater into the filter bed. A 0.40 m thick stone layer is proposed for the filtration bed to detain and slow the release of storm runoff from the site prior to outletting to the roadside ditch on Dock Road. This equates to capturing runoff equivalent to 3.2 mm of runoff over the impervious area considered acceptable as a Best Efforts for volume control considering the above noted site constraints. Refer to Appendix C for detailed filtration bed calculations.

8. WATER BALANCE

Since the post-development state will increase the imperviousness of the site, considerations were taken in regard to groundwater recharge to satisfy the LSRCA's water balance criteria. Calculations were completed by Azimuth Environmental Consulting Inc., to indicate that the pre-development infiltration volume is 3,406 m³ per year and will be decreased by 15% from pre-development values to 2,892 m³ in post development. For the proposed development scenario, all roof leaders are to be directed towards the pervious surface resulting a deficit volume of 51 m³, representing a 2% of reduction compared to the pre-development scenario. Refer to Appendix E for detailed water balance calculations completed by Azimuth Environmental Consulting Inc.

9. PHOSPHORUS CALCULATIONS

Local conservation authorities have determined the importance of reducing phosphorus levels in water courses in this area. The reduction was based on conservative values derived from the LSRCA guidelines. As such, best efforts are to be employed in order to reduce phosphorus levels to pre-development levels or better.

The existing site generates approximately 0.04 kg of phosphorus annually and the proposed Project will generate approximately 0.87 kg of phosphorus annually, if uncontrolled. However, to minimize the site's phosphorus discharge, a treatment train approach will be implemented. The front half of the development area will drain overland to landscape catchbasins proposed in each lot complete with a filter bed before outletting stormwater to Dock Road. The rear yard of the north of the five single detached dwellings leads to vegetated filter strips located within the lots, ultimately outletting stormwater to the roadside ditch on Tynhead Road.

According to the LSRCA Phosphorus Loading Development tool, the typical phosphorus reduction for vegetated buffer strips is 65% and it is assumed to be 45% for the filter bed. Therefore, the controlled post-development phosphorus can be reduced to 0.51 kg. The following Table 5 details the anticipated phosphorus loadings for the pre- and post-development conditions.

Table 5: Phosphorus Loadings

	Total P (Annual kg)
Pre-Development	0.04
Uncontrolled post-development	0.87
Controlled post-development	0.51
Controlled Deficit	0.47

Detailed calculations can be found in Appendix E.



10. LAKE SIMCOE COMPENSATION FEES

The LSRCA has implemented a Phosphorous Offsetting Policy in September 2017 with the latest revision in May 2023 which has a goal that all new developments must reduce 100% of the phosphorous above pre-development leaving the property. A fee of \$89,425 per annual kg is charged for post-development levels exceeding the pre-development levels of phosphorus leaving the site. The difference between pre-development and post-development phosphorus was calculated to be 0.47 kg, as such, the required fee for the proposed development is \$48,056.

The LSRCA has also implemented a Water Balance Recharge Policy (WBRP) for the Lake Simcoe Protection Plan in July 2021 with the latest revision in May 2023 which states that post-development recharge must equal pre-development. The water balance calculations provided by Azimuth Environmental Consulting Inc. demonstrates the difference between pre-development and post-development infiltration, and was calculated to be 51 m³, as such, the required fee for the proposed development is \$5,865.

As per LSRCA guidelines, if both Phosphorus and Water Balance offsetting Policies are applied to an application, the greater of these two to be paid. Therefore, the phosphorus fee will govern for the development.

11. SECONDARY UTILITIES

Letters have been sent to all secondary utilities to notify them of the proposed development, gain information on the availability of their services for the site and ensure they are able to adequately support the proposed development. Utilities are expected to be available because the surrounding areas have already been developed. Copies of these letters have been included in Appendix F.

12. CONCLUSIONS

The proposed development will require the extension of the existing sanitary sewer westerly within the Dock Road right of way and individual sanitary services to each lot.

Each lot will connect a water service to the existing watermain on the north side of Dock Road.

Storm drainage for the development will generally follow the existing drainage flows to the north of the site with a small portion of the site draining to the south.

The downstream infrastructures have sufficient capacity to convey nominal increase in post-development flows, as such, no quantity controls measures are proposed for the development.

Due to the infill residential nature of the development no quality control measures are proposed for the development.

As the groundwater level across the site is high, no infiltration is proposed.

The analysis and designs outlined in this report demonstrates that the servicing is feasible.

All of which is respectfully submitted,

PEARSON ENGINEERING LTD.

Taylor Arkell, P.Eng.
Senior Project Manager/Engineer

Mike Dejean, P.Eng.
Partner, Manager of Engineering Services





APPENDIX A

WATER SERVICING CALCULATIONS

211 Dock Road, Barrie Water Flow Calculations

Design Criteria

Demand per capita (Q):	225 L/cap/day	
Peak Rate Factor (Max. Hour)	4.13	(Table 3-3: Peaking Factors, MOE Design Guidelines for Drinking-Water Systems)
Max. Day Factor	2.75	(Table 3-3: Peaking Factors, MOE Design Guidelines for Drinking-Water Systems)

Site Data

Description	Density	Units	Flow Rate	Peaking Factors
Single Family Detached	3.13 people/unit	5 units	225 L/cap/d	MAX DAY FACTOR* 2.75 PEAK RATE FACTOR* 4.13
				*From MOE Manual based on Population of 500 - 1,000

Calculate Population

Pop. Townhouse	=	3.13	x	5
Pop. Total	=	16	people	

Calculate Average Day Demand (ADD)

ADD	=	225	x	16
ADD	=	3,521	L/day	
ADD	=	0.04	L/s	

Calculate Max Day Flow

MDF	=	0.04	x	2.75
MDF	=	0.11	L/s	

Calculate Peak Hour Demand

PHD	=	0.04	x	4.13
PHD	=	0.17	L/s	

211 Dock Road, Barrie Fire Flow Calculations - Lot 2

Required fire flow calculations as per the Fire Underwriters Survey's Water Supply for Public Fire Protection - 2020:

Location:	211 Dock Road, Barrie
OBC Occupancy:	Residential Occupancy - Class C
Building Foot Print:	280 m ²
# of Stories:	2

Date: 2024-05-24
Project: 211 Dock Road, Barrie
Project Number: 22047

Type	Construction Class	Charge
5	Wood Frame	1.50
4	Heavy Timber (A-D)	0.80 - 1.50
3	Ordinary	1.00
2	Non-Combustible	0.80
1	Fire Resistive	0.60

Construction Class: Type 5 Wood Frame

Automated Sprinkler Protection:

NFPA 13 sprinkler standard
 Standard Water Supply
 Fully Supervised System

	Credit	Total
No	0%	0%
No	0%	
No	0%	

Contents	Charge
Non-Combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Contents Factor: Combustible

Charge: 0%

Exposure Side & Building	Length - Height Ratio	Distance to Exposure Building (m)	Charge
North Ex. Residential	>100	>30.1	0%
East Prop. Residential	>100	2.4	25%
South Ex. Residential	>100	>30.1	0%
West Prop. Residential	>100	2.4	25%
Total:			50%

Separation Distance	Charge
0.0 - 3.0 m	20% - 25%
3.1 - 10.0 m	15% - 20%
10.1 - 20.0 m	10% - 15%
20.1 - 30.0 m	0% - 10%
> 30.1 m	0%

Note: As per FUS 2020 Table 6, Charges for Type V were used for Wood Frame Class

Are Buildings Contiguous? No

Fire Resistant Building: Are vertical openings and exterior vertical communications protected with a minimum one (1) hr rating? No

Calculations: C = 1.50 Wood Frame

Required Fire Flow: $RFF = 220 \times C \times \sqrt{A}$

Where: *RFF* = required fire flow in liters per minute

C = Coefficient related to the type of construction

A = the total effective area in square meters for Construction Coefficient 1.0-1.5 (excluding basements in building considered).

Note: 100% of all Floor Areas were considered to determine the effective area.

Total Effective Area:

A = Single Largest Floor + 100% of All Floors Areas
 A = 280 + 280
 A = 560 m²

RFF = 7,809 L/min

Round to Nearest 1000 L/min

RFF = 8,000 L/min

* Must be > 2,000 L/min or < 45,000 L/min

Correction Factors:

Contents Charge		0	L/min
RFF Adjusted for Contents	E =	8,000	L/min
Reduction For Sprinkler	F =	0	L/min
RFF w/ Sprinkler Reduction		8,000	L/min

Exposure Charge	G =	4,000	L/min
RFF w/ Exposure Charge		12,000	L/min

Required Fire Flow: RFF = 12,000 L/min

Round to Nearest 1,000 L/min

RFF =	12,000	L/min
-------	--------	-------

RFF=	3,168	GPM
------	-------	-----

RFF =	200	L/s
-------	-----	-----

As per "Water Supply for Public Fire Protection" pg.20 note H:

$$RFF = E - F + G$$

$$RFF = 8000 \text{ L/min} - 0 \text{ L/min} + 4000 \text{ L/min}$$

$$RFF = 12000 \text{ L/min}$$

FLOW TEST RESULTS



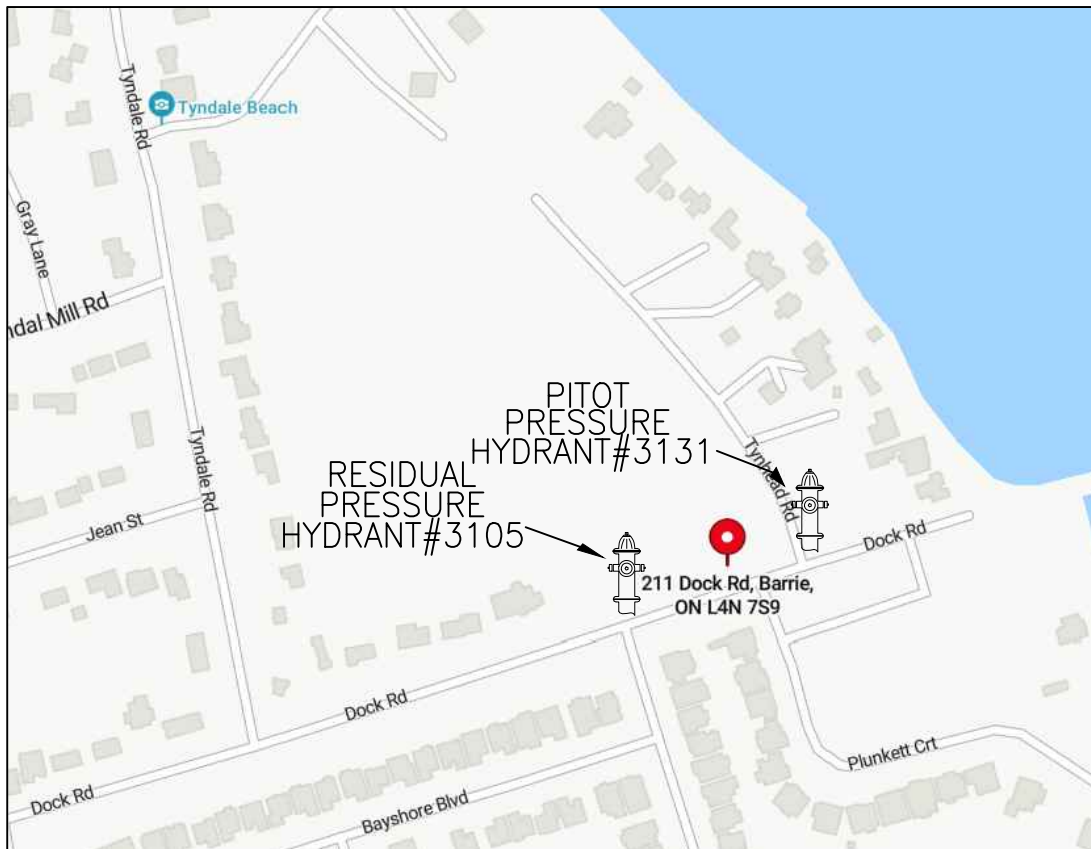
DATE : APR 17, 2024

LOCATION : 211 DOCK RD

BARRIE

ONTARIO

TEST BY : LEN. K



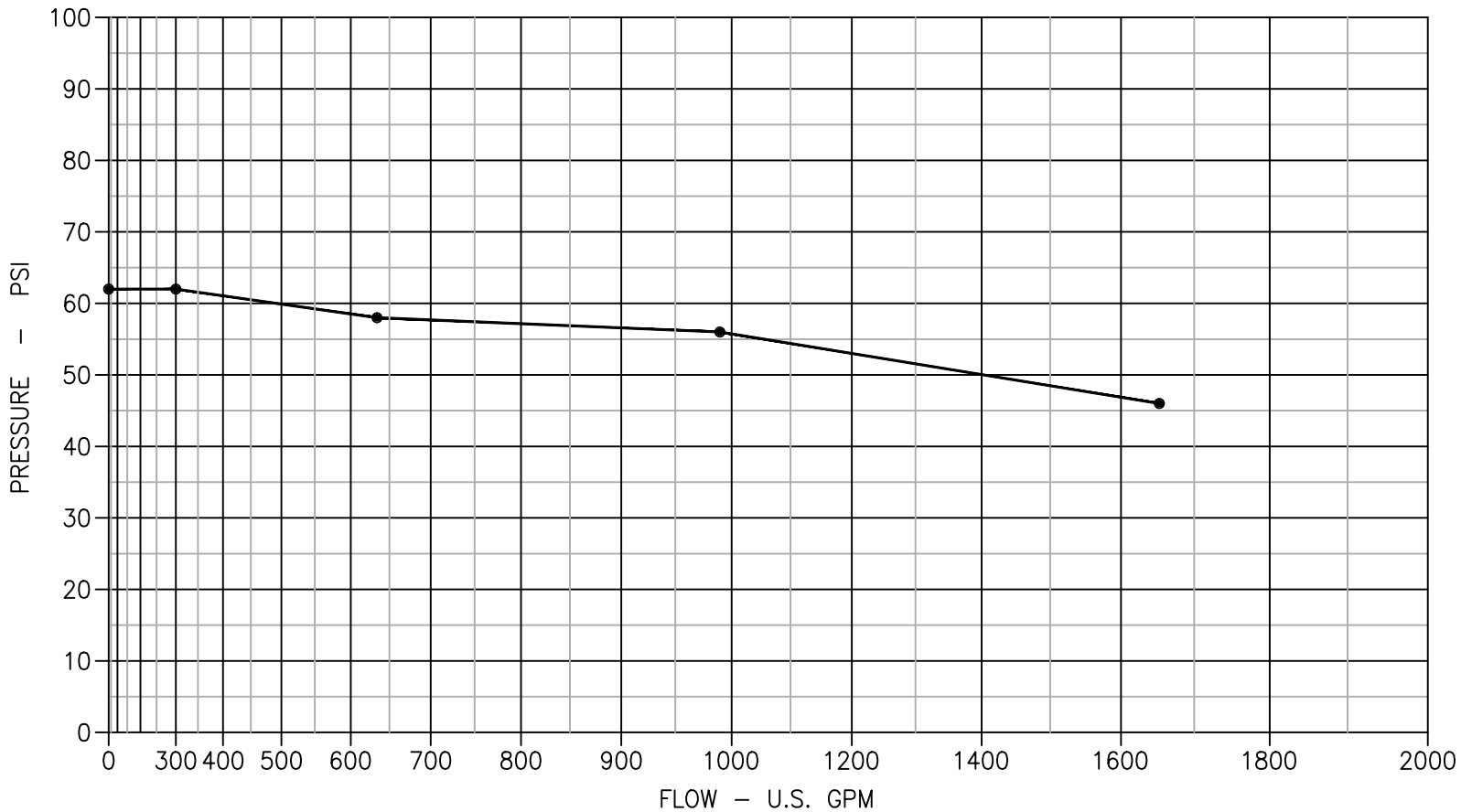
STATIC PRESSURE : 62 PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-1/8	0.97	62	64	299
2	1	1-3/4	0.90	58	56	666
3	1	2-1/2	0.90	56	34	984
4	2	2-1/2	0.90	46	24	1652



211 DOCK RD	BY : LEN K.
BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : APR 17, 2024

STATIC:	RESIDUAL:	FLOW:
<u>62</u> PSI	TEST#1 <u>62</u> PSI @ <u>299</u> GPM	
	TEST#2 <u>58</u> PSI @ <u>666</u> GPM	
	TEST#3 <u>56</u> PSI @ <u>984</u> GPM	
	TEST#3 <u>46</u> PSI @ <u>1652</u> GPM	





APPENDIX B

SANITARY SERVICING CALCULATIONS

211 Dock Road, Barrie Sanitary Flow Calculations

Design Criteria

Flow per capita (Q): 225 L/cap/day
Peak Flow $Q_p = P * Q * M / 86,400 + I * A$
Peaking Factor (Harmon Formula) $M = 1 + (14 / (4 + (P / 1,000) ^ { 0.5 }))$ Where: $2 \leq "M" \leq 4$
Infiltration Allowance: 0.10 L/s/ha

Site Data

Description	Density	Units	Flow Rate
Single Family Detached	3.13 people/unit	5 units	225 L/cap/d

Calculate Population

Pop. Townhouse = 3.13 x 5
Pop. = 16 people

Calculate Average Daily Flows

ADF (L/s) = 225 x 16
ADF (L/s) = 3,521 L/day
ADF (L/s) = 0.04 L/s

Calculate Peaking Factor

M = $1 + \frac{14}{4 + \frac{16}{1,000}^{0.5}} + 0.1 * 0.12$

M = 4.41
Use Max Peaking Factor 4

Calculate Peak Flow

Qp = 0.04 x 4.00
= 0.16 L/s
Infiltration Allowance = 0.10 x 0.20 ha
= 0.02 L/s
Qp (Inc. Infiltration Allowance) = 0.18 L/s



APPENDIX C

STORMWATER MANAGEMENT CALCULATIONS

211 Dock Road, Barrie

Calculation of Runoff Coefficients

Runoff Coefficient	=	0.15	0.95	0.95	0.08	0.95		Weighted Runoff Coefficient
Surface Cover	=	Grass	Asphalt	Building	Forest	Conc.		
<u>Pre-Development</u>	Total Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)		
1	12565	0	0	0	12565	0		
Pre Total	12565	0	0	0	12565	0		
<u>Post-Development</u>	Total Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)		
1	3142	1164	506	1472	0	0		
2	9423	2656	0	0	6767	0		
Post Total	12565	3820	506	1472	6767	0		
<u>EXTERNAL</u>	Total Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)	Area (m ²)		
EXT-1	1578	880	698	0	0	0		
EXT-2	1225	765	0	460	0	0		

211 Dock Road, Barrie Pre-Development Peak Flows

City of Barrie
Storm Event (yrs) Coeff A Coeff B Coeff C Modified Rational Method
Q = CiCIA / 360

2	678.085	4.699	0.781
5	853.608	4.699	0.766
10	975.865	4.699	0.760
25	1146.275	4.922	0.757
50	1236.152	4.699	0.751
100	1426.408	5.273	0.759

Where:

Q - Flow Rate (m³/s)
C - Rational Method Runoff Coefficient
I - Storm Intensity (mm/hr)
A - Area (ha.)
Ci - Peaking Coefficient

Area Number	1	EXT-1
Area	1.26 ha	0.16 ha
Runoff Coefficient	0.08	0.50
Time of Concentration	10 min	10 min
Return Rate	2 year	2 year
Peaking Coefficient (Ci)	1.00	1.00
Rainfall Intensity	83.1 mm/hr	83.1 mm/hr
Pre-Development Peak Flow	0.02 m ³ /s	0.02 m ³ /s

Return Rate	5 year	5 year
Peaking Coefficient (Ci)	1.00	1.00
Rainfall Intensity	108.9 mm/hr	108.9 mm/hr
Pre-Development Peak Flow	0.03 m ³ /s	0.02 m ³ /s

Return Rate	10 year	10 year
Peaking Coefficient (Ci)	1.00	1.00
Rainfall Intensity	126.5 mm/hr	126.5 mm/hr
Pre-Development Peak Flow	0.04 m ³ /s	0.03 m ³ /s

Return Rate	25 year	25 year
Peaking Coefficient (Ci)	1.10	1.10
Rainfall Intensity	148.2 mm/hr	148.2 mm/hr
Pre-Development Peak Flow	0.05 m ³ /s	0.04 m ³ /s

Return Rate	50 year	50 year
Peaking Coefficient (Ci)	1.20	1.20
Rainfall Intensity	164.2 mm/hr	164.2 mm/hr
Pre-Development Peak Flow	0.06 m ³ /s	0.04 m ³ /s

Return Rate	100 year	100 year
Peaking Coefficient (Ci)	1.25	1.25
Rainfall Intensity	180.2 mm/hr	180.2 mm/hr
Pre-Development Peak Flow	0.06 m ³ /s	0.05 m ³ /s



211 Dock Road, Barrie Post-Development Peak Flows

Storm Event (yrs)	City of Barrie Coeff A	Coeff B	Coeff C	Modified Rational Method $Q = C_i C_i A / 360$
2	678.085	4.699	0.781	Where: Q - Flow Rate (m^3/s) C - Rational Method Runoff Coefficient I - Storm Intensity (mm/hr) A - Area (ha.) C _i - Peaking Coefficient
5	853.608	4.699	0.766	
10	975.865	4.699	0.760	
25	1146.275	4.922	0.757	
50	1236.152	4.699	0.751	
100	1426.408	5.273	0.759	
	Uncontrolled Area to Tynhead Road	Uncontrolled Area to Dock Road Culvert		
Area Number	2	1 + EXT-1		
Area	0.94 ha	0.47 ha		
Runoff Coefficient	0.10	0.60		
Time of Concentration	10 min	10 min		
Return Rate	2 year	2 year		
Peaking Coefficient (C _i)	1.00	1.00		
Rainfall Intensity	83.1 mm/hr	83.1 mm/hr		
Post-Development Peak Flow	0.02 m^3/s	0.07 m^3/s		
Return Rate	5 year	5 year		
Peaking Coefficient (C _i)	1.00	1.00		
Rainfall Intensity	108.9 mm/hr	108.9 mm/hr		
Post-Development Peak Flow	0.03 m^3/s	0.09 m^3/s		
Return Rate	10 year	10 year		
Peaking Coefficient (C _i)	1.00	1.00		
Rainfall Intensity	126.5 mm/hr	126.5 mm/hr		
Post-Development Peak Flow	0.03 m^3/s	0.10 m^3/s		
Return Rate	25 year	25 year		
Peaking Coefficient (C _i)	1.10	1.10		
Rainfall Intensity	148.2 mm/hr	148.2 mm/hr		
Post-Development Peak Flow	0.04 m^3/s	0.13 m^3/s		
Return Rate	50 year	50 year		
Peaking Coefficient (C _i)	1.20	1.20		
Rainfall Intensity	164.2 mm/hr	164.2 mm/hr		
Post-Development Peak Flow	0.05 m^3/s	0.16 m^3/s		
Return Rate	100 year	100 year		
Peaking Coefficient (C _i)	1.25	1.25		
Rainfall Intensity	180.2 mm/hr	180.2 mm/hr		
Post-Development Peak Flow	0.06 m^3/s	0.18 m^3/s		

211 Dock Road, Barrie Volume Control Sizing Calculations

As the site meets the definition of Major Development, find the required volume control storage as per LSRCA Guidelines Section 3.2.4. The control requirement volume is calculated over 25 mm of the total impervious area on the site:

$$\begin{aligned} \text{Storage Volume} &= 1,978 \times 0.025 \\ \text{Area Storage Volume Required} &= 49.4 \text{ m}^3 \end{aligned}$$

Since the groundwater table within the project site is considerably high, flexible treatment alternative include retaining runoff from a 12.5 mm storm event from all impervious surface:

$$\begin{aligned} \text{Storage Volume} &= 1978 \times 0.0125 \\ \text{Area Storage Volume Required} &= 24.7 \text{ m}^3 \end{aligned}$$

Additional flexible treatment alternative include retaining runoff from 5 mm from all impervious surfaces:

$$\begin{aligned} \text{Storage Volume} &= 1978 \times 0.005 \\ \text{Area Storage Volume Required} &= 9.9 \text{ m}^3 \end{aligned}$$

The groundwater table within the project site is considerably high. As such, implementation of Low Impact Development such as bioretention swale, soakaway pits, infiltration galleries, surface ponding, and SWM pond are not feasible to maintain minimum separation of 1.0 m between bottom of these features and groundwater table. However, filtration beds have been proposed to capture runoff from the building rooftop and sized to provide volume control of 6.4 m³.

$$\begin{aligned} \text{Therefore, find equivalent rainfall depth} &= \frac{\text{Volume provided for Filtraion bed}}{\text{Impervious Area Over Site}} \\ &= \frac{6.4 \text{ m}^3}{1978 \text{ m}^2} \quad (\text{As per filtration bed calculations}) \\ &= 3.2 \text{ mm} \end{aligned}$$

Therefore, volume control will be provided across the impervious area of any rainfall event 3 mm or less with the use of filtration bed.



211 Dock Road, Barrie Filtration bed Calculations

Using 5mm Storm Event Over half the rooftop and front yard area

$$\begin{aligned}\text{Front half of roof + Front Yard (A)} &= 1273 \text{ m}^2 \\ \text{Storm Event (D)} &= 5.0 \text{ mm} \\ \text{Required Volume (V)} &= A \times D \\ V &= 6.4 \text{ m}^3\end{aligned}$$

Required filtration Bottom Area

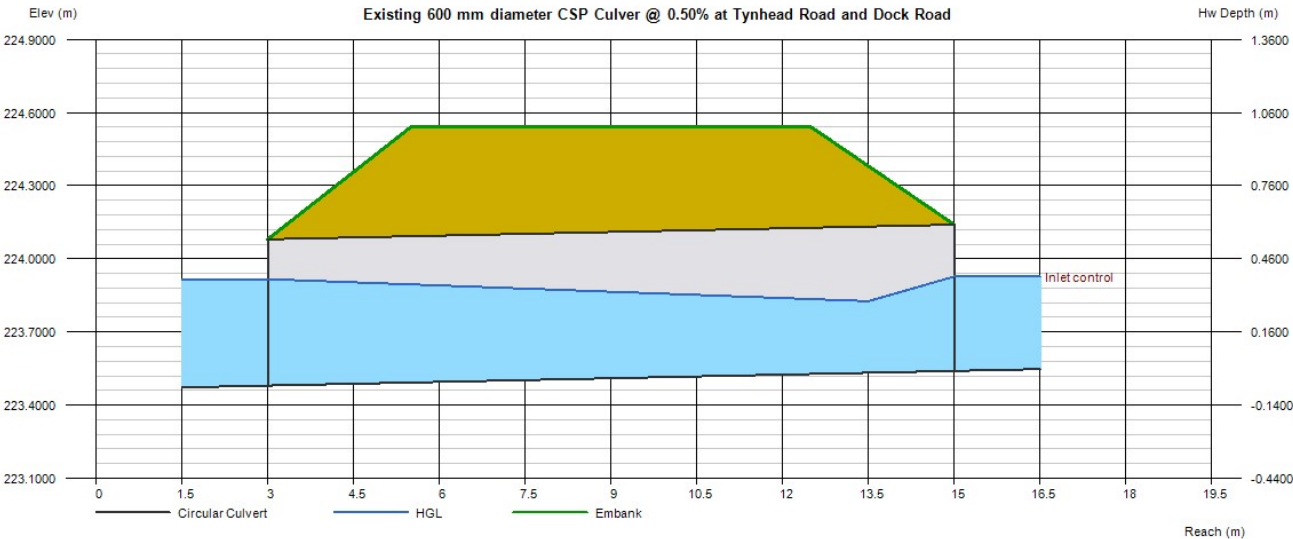
$$\begin{aligned}\text{Required Volume} &= \frac{6.4 \text{ m}^3}{5} \text{ total filtration bed} \\ &= 1.3 \text{ m}^3 \\ \text{Stone Reservoir Depth (d}_r\text{)} &= 0.40 \text{ m} \\ \text{Porosity (V}_r\text{)} &= 0.40 \text{ for clear stone} \\ \text{Footprint Surface Area (A}_f\text{)} &= \frac{V}{d_r \times V_r} \\ &= 8.0 \text{ m}^2\end{aligned}$$

Therefore, Five filtration bed with an equivalent dimension of 2.0 x 4.0 x 0.4 m per unit for the project will achieve Volume control target

Culvert Report

Existing 600 mm diameter CSP Culver @ 0.50% at Tynhead Road and Dock Road

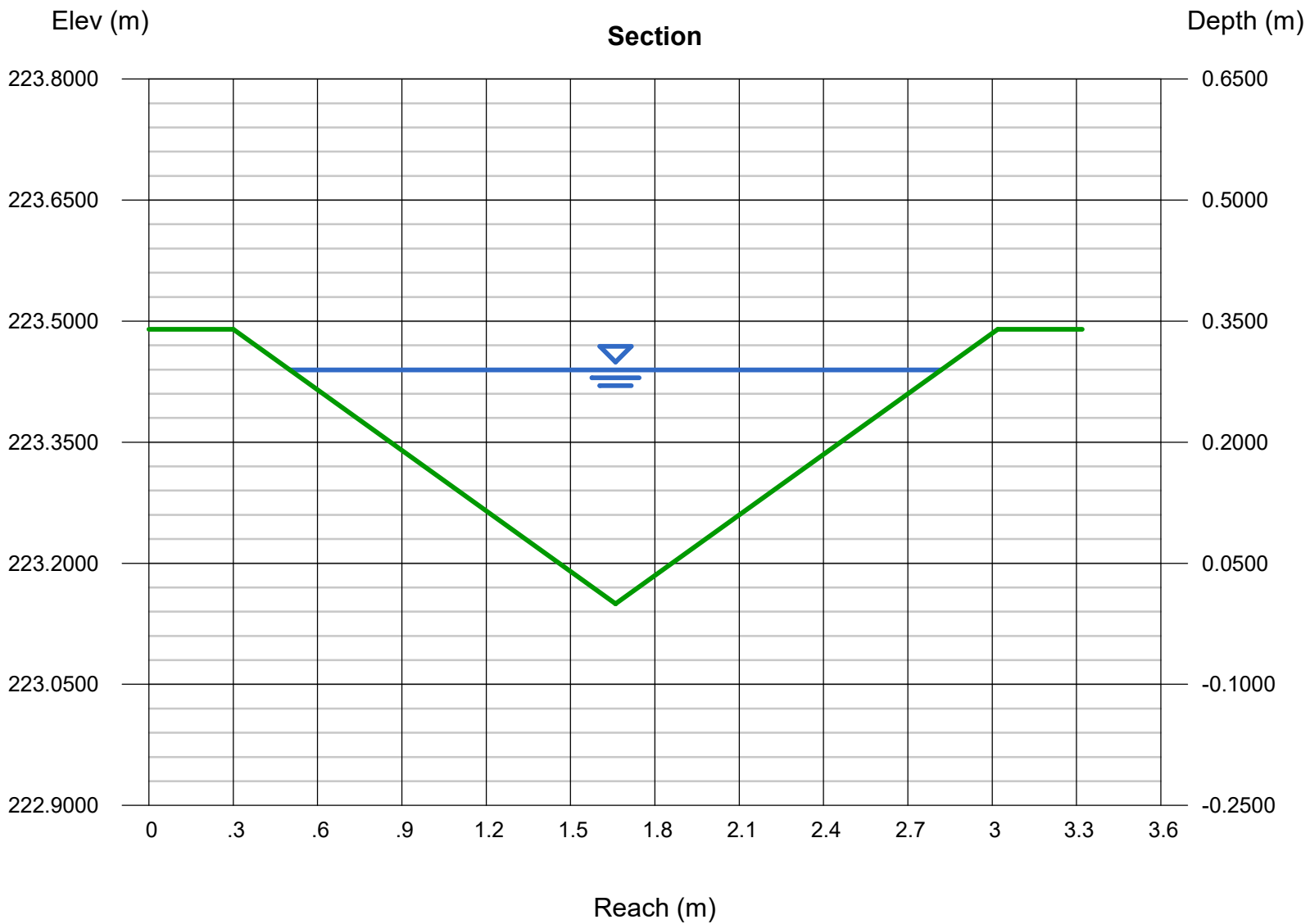
Invert Elev Dn (m)	= 223.4800	Calculations	
Pipe Length (m)	= 12.0000	Qmin (cms)	= 0.1800
Slope (%)	= 0.5000	Qmax (cms)	= 0.1800
Invert Elev Up (m)	= 223.5400	Tailwater Elev (m)	= (dc+D)/2
Rise (mm)	= 600.0		
Shape	= Circular	Highlighted	
Span (mm)	= 600.0	Qtotal (cms)	= 0.1800
No. Barrels	= 1	Qpipe (cms)	= 0.1800
n-Value	= 0.013	Qovertop (cms)	= 0.0000
Culvert Type	= Circular Corrugate Metal Pipe	Veloc Dn (m/s)	= 0.8166
Culvert Entrance	= Headwall	Veloc Up (m/s)	= 1.4361
Coeff. K,M,c,Y,k	= 0.0078, 2, 0.0379, 0.69, 0.5	HGL Dn (m)	= 223.9166
		HGL Up (m)	= 223.8132
		Hw Elev (m)	= 223.9273
		Hw/D (m)	= 0.6455
		Flow Regime	= Inlet Control
Embankment			
Top Elevation (m)	= 224.5400		
Top Width (m)	= 7.0000		
Crest Width (m)	= 7.0000		



Channel Report

Dock Rd Ditch Capacity - 100yr Storm (Downstream of Ex 600 mm Dia CSP Culvert)

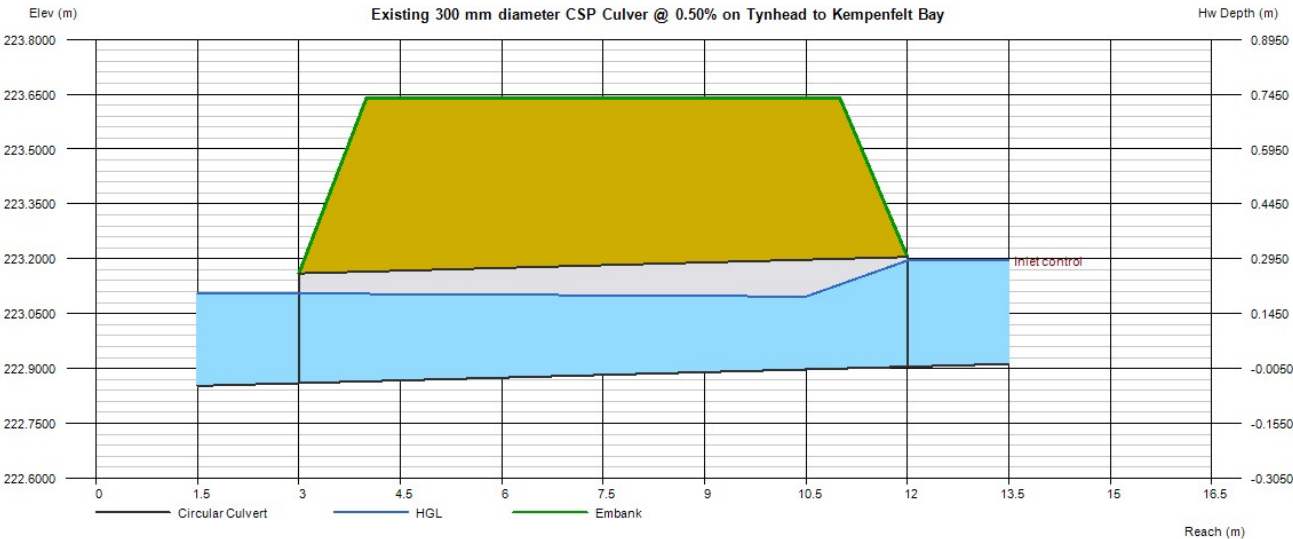
Triangular		Highlighted	
Side Slopes (z:1)	= 4.0000, 4.0000	Depth (m)	= 0.2896
Total Depth (m)	= 0.3400	Q (cms)	= 0.210
		Area (sqm)	= 0.3354
Invert Elev (m)	= 223.1500	Velocity (m/s)	= 0.6262
Slope (%)	= 0.5000	Wetted Perim (m)	= 2.3878
N-Value	= 0.030	Crit Depth, Yc (m)	= 0.2256
		Top Width (m)	= 2.3165
		EGL (m)	= 0.3096
Calculations			
Compute by:	Known Q		
Known Q (cms)	= 0.2100		



Culvert Report

Existing 300 mm diameter CSP Culver @ 0.50% on Tynhead to Kempenfelt Bay

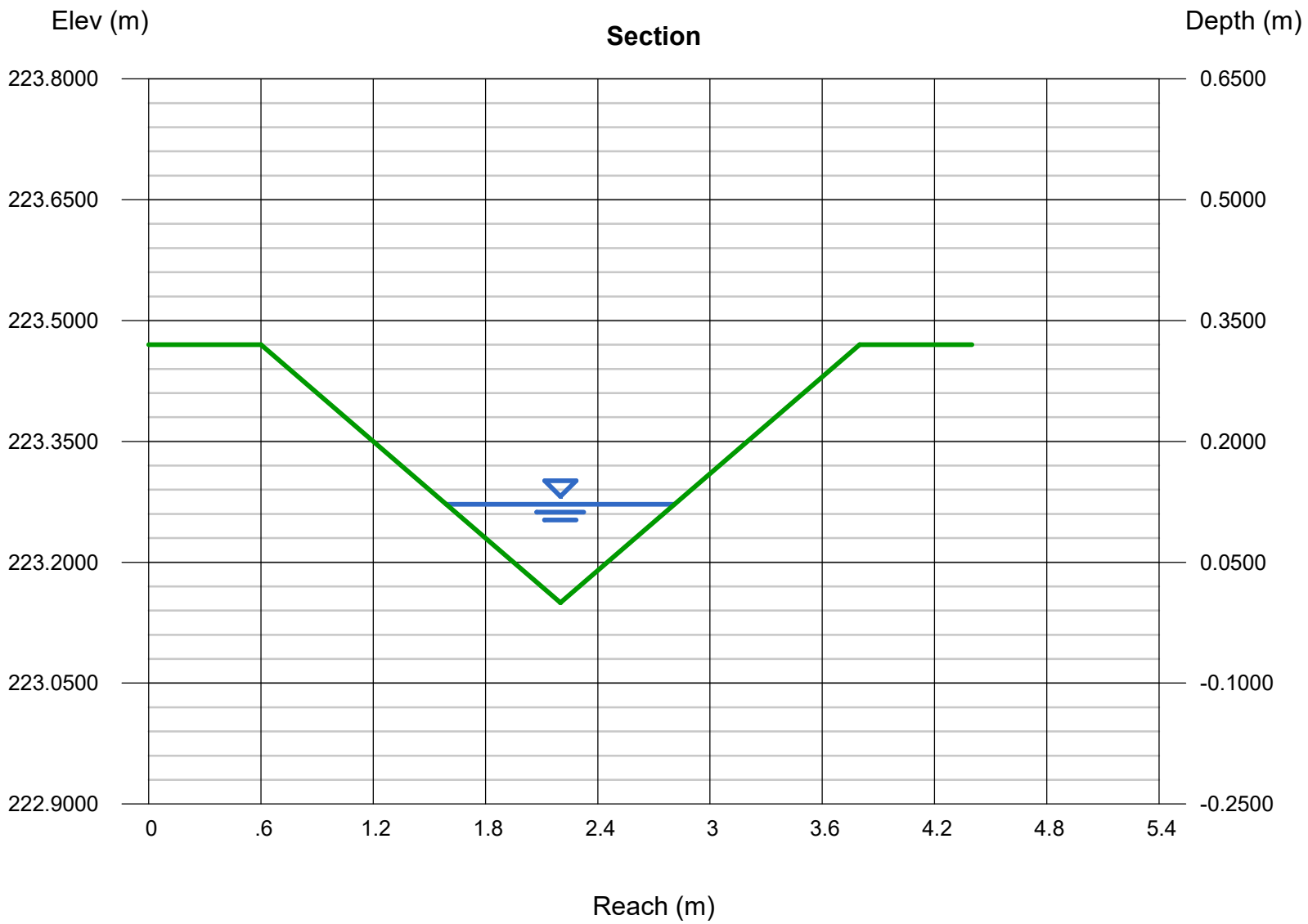
Invert Elev Dn (m)	= 222.8600	Calculations	
Pipe Length (m)	= 9.0000	Qmin (cms)	= 0.0600
Slope (%)	= 0.5000	Qmax (cms)	= 0.0600
Invert Elev Up (m)	= 222.9050	Tailwater Elev (m)	= (dc+D)/2
Rise (mm)	= 300.0		
Shape	= Circular	Highlighted	
Span (mm)	= 300.0	Qtotal (cms)	= 0.0600
No. Barrels	= 1	Qpipe (cms)	= 0.0600
n-Value	= 0.013	Qovertop (cms)	= 0.0000
Culvert Type	= Circular Corrugate Metal Pipe	Veloc Dn (m/s)	= 0.9704
Culvert Entrance	= Headwall	Veloc Up (m/s)	= 1.2693
Coeff. K,M,c,Y,k	= 0.0078, 2, 0.0379, 0.69, 0.5	HGL Dn (m)	= 223.1051
		HGL Up (m)	= 223.0953
Embankment		Hw Elev (m)	= 223.1951
Top Elevation (m)	= 223.6400	Hw/D (m)	= 0.9671
Top Width (m)	= 7.0000	Flow Regime	= Inlet Control
Crest Width (m)	= 7.0000		



Channel Report

Tynhead Road Ditch Capacity - 100 year Storm Event

Triangular		Highlighted	
Side Slopes (z:1)	= 5.0000, 5.0000	Depth (m)	= 0.1219
Total Depth (m)	= 0.3200	Q (cms)	= 0.060
		Area (sqm)	= 0.0743
Invert Elev (m)	= 223.1500	Velocity (m/s)	= 0.8073
Slope (%)	= 2.6000	Wetted Perim (m)	= 1.2433
N-Value	= 0.030	Crit Depth, Yc (m)	= 0.1250
		Top Width (m)	= 1.2192
		EGL (m)	= 0.1552
Calculations			
Compute by:	Known Q		
Known Q (cms)	= 0.0600		





APPENDIX D

PHOSPHORUS BUDGET CALCULATIONS

211 Dock Road, Barrie Phosphorus Budget

Lovers Creek	Forest	Hay-Pasture	High Intensity Residential	Wetland
Phosphorus Export (kg/ha/year)	0.06	0.07	1.32	0.05

Pre-Development Condition:

	Forest	Hay-Pasture	High Intensity Residential	Wetland
Area (ha)	0.66	0.00	0.00	0.00
Total P (kg)	0.04	0.00	0.00	0.00
Total Pre-Development P (kg)		0.04		

Post-Development Condition (Uncontrolled):

	Forest	Hay-Pasture	High Intensity Residential	Wetland
Area (ha):	0.00	0.00	0.66	0.00
Total P (kg) :	0.00	0.00	0.87	0.00
Total Uncontrolled Post-Development (kg):		0.87		

Post-Development Condition (Controlled):

<u>Untreated Area</u>	Forest	Hay-Pasture	High Intensity Residential	Wetland
Area (ha):	0.00	0.00	0.20	0.00
Total P (kg) :	0.00	0.00	0.26	0.00
<u>Without Treatment</u>				
Total Post Development (kg):		0.26		
<u>Area Draining to Vegetated Filter Strip</u>	Forest	Hay-Pasture	High Intensity Residential	Wetland
Area (ha):	0.00	0.00	0.33	0.00
Total P (kg) :	0.00	0.00	0.44	0.00
<u>Vegetated Filter Strip</u>				
Total P (kg):		0.44		
Vegetated Filter Strip Proficiency (%):		65		
P Removed (kg):		0.28		
P Remaining (kg):		0.15		
<u>Area Draining to Filtration Bed</u>	Forest	Hay-Pasture	High Intensity Residential	Wetland
Area (ha):	0.00	0.00	0.13	0.00
Total P (kg) :	0.00	0.00	0.17	0.00

Vegetated Filtration Bed

Total P (kg):		0.17
Vegetated Filter Strip Proficiency (%):		45
P Removed (kg):		0.08
P Remaining (kg):		0.09
Total Site P (kg):	=	0.26 + 0.15 + 0.09
	=	0.51

Phosphorous Offsetting Calculations:

As per the LSRCA's Phosphorous Offsetting Policy, dated May 2023, the required fee for the development is:

Total Post-development Phosphorus Remaining over Pre-development Conditions:

Total Post-development P (kg):	=	0.51	-	0.04
		0.47		
LSPOP Fee	=	\$35,770 x 2.5 x Weight (kg) + Administrative Fee		
LSPOP Fee	=	\$35,770 x 2.5 x 0.47		
Sub-Total LSPOP Fee: =		\$41,788		
LSPOP Administrative Fee (15%)	=	\$41,788	x	0.15
	=	\$6,268		
Total LSPOP Fee:	=	\$41,788	+	\$6,268
Total LSPOP Fee:	=	\$48,056		



APPENDIX E

HYDROGEOLOGICAL ASSESSMENT UPDATE, COMPLETED BY AZIMUTH ENVIRONMENTAL CONSULTING INC., DATE MAY 2024



Hydrogeological Assessment Update

211 Dock Road

Barrie, Ontario

Prepared for:
1000067364 Ontario Inc.

Prepared by:
Azimuth Environmental
Consulting, Inc.

Revised May 2024

AEC 16-202



Environmental Assessments & Approvals

May 21st, 2024

AEC 16-202

1000067364 Ontario Inc
P.O. Box 310
Aurora, ON
L4G 3H4

Attention: Mike Cross

Re: **Hydrogeological Assessment Update**
211 Dock Road, City of Barrie, Ontario

Dear Mr. Cross:

Azimuth Environmental Consulting, Inc. (Azimuth) is pleased to provide our Hydrogeological Assessment Update for the property located at 211 Dock Road within the City of Barrie (the "Site"). This evaluation focused on the existing soil and ground water regime underlying the Site and the potential for the proposed development to impact the existing conditions. The report has been updated to reflect a revised Site Plan and the inclusion of additional ground water data.

Should you have any questions or wish to discuss the report in greater detail, please do not hesitate to contact the undersigned.

Yours truly,
AZIMUTH ENVIRONMENTAL CONSULTING, INC.



Jenn Millington, M.A.Sc., P.Geo.
Senior Hydrogeologist



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1.0 INTRODUCTION

Azimuth Environmental Consulting, Inc. (“Azimuth”) has been retained by 1000067364 Ontario Inc. to conduct a Hydrogeological Assessment Update for the proposed residential development located at 211 Dock Road within the City of Barrie, Ontario (the “Site”)(Figure 1). The previous report titled Hydrogeological Evaluation, 211 Dock Road, Barrie, Ontario was issued in November of 2018.

The Site is approximately 1.25 hectares (ha) in size and is located on the north side of Dock Road, west of Tynhead Road, approximately 190 m east of Tyndale Road (Figure 2). The Site is currently composed of undeveloped forest, with one residential home currently under construction. There is a wetland feature located in the south east portion of the Site.

The proposed development of the Site includes five single lot residential homes off of Dock Road. The north portion of the Site will be dedicated to the City of Barrie. The purpose of this assessment is to characterize the existing hydrogeological conditions at the Site and the potential for the proposed development to impact the existing environmental conditions.

2.0 ENVIRONMENTAL SETTING

2.1 Soil

The soil map of Simcoe County (Soil Survey Report No. 29, Scale 1:63,360) shows the uppermost soil to be composed of a combination of Bondhead sandy loam – stony phase, and Sargent gravelly sandy loam. Bondhead sandy loam is classified within hydrologic soil group “AB” while Sargent gravelly sandy loam is classified within hydrologic soil group “A”. Group A soils represent material which have low runoff potential and high infiltration rates even when thoroughly wet. They consist of deep, well to excessively drained sand or gravel and have a high rate of water transmission. Group B soils represent material which has a moderate infiltration rate when thoroughly wet and consists of moderately deep to deep, fine to coarse textured soil.

2.2 Physiography

The Ontario Geologic Survey (Chapman and Putnam, 1984) describes the area as being located within the Simcoe Lowlands Physiographic region. The Simcoe Lowlands represent areas that were flooded by Lake Algonquin and are bordered by shore cliffs, beaches, and boulder terraces. The Barrie area represents a flat floored valley connecting the Nottawasaga basin and the Lake Simcoe basin.



2.3 Topography and Drainage

According to local topographic mapping, the Site is found at an elevation between 224 – 228 meters above sea level (masl). The Site displays a gradual slope to the north east toward Lake Simcoe, which is located approximately 115 m from the Site boundary. There is a wetland feature in the south east portion of the Site. There is a seasonal drainage feature which overlaps the northern tip of the Site in a west to east direction, discharging into a road side ditch along the western side of Tynhead Road. This ditch flows into a culvert crossing beneath Tynhead Road that flows through the Tynhead development and outlets directly into Lake Simcoe. Based on local topographic mapping, the Site is considered to be located within one catchment and all runoff is expected to flow north east toward the seasonal drainage feature or road side ditch along Tynhead Road.

2.4 Bedrock Geology

The Ontario Geologic Survey Earth Database shows that the uppermost bedrock unit at the subject property consists of limestone and shale of the Simcoe Group of the Verulam Formation (OGS, 2017). The Verulam Formation is Middle Ordovician in age. Bedrock is sufficiently deep (100m+) and does not influence the water balance assessment.

2.5 Quaternary Geology

The surficial material for the Site is variable, and is composed of three different materials (OGS, 2017). The south west corner of the Site is composed of sandy silt to silty sand textured till, and the eastern Site boundary is composed of fine-textured silt and clay with minor sand and gravel. There is a narrow strip of coarse textured glaciolacustrine deposits aligned north west to south east containing sand and gravel with minor silt and clay associated with a former beach ridge and near shore deposit.

2.6 Hydrogeology

The Ontario Ministry of the Environment, Conservation, and Parks (MECP) Water Well Records (Appendix B) were referenced for any recorded well information within the vicinity (~ 300 m) of the Site (GIN, 2018, Table 1). The development will be serviced with municipal water and sewer utilities; however, many of the existing homes surrounding the development utilize private well and septic systems. Well records can be used to gain subsurface information which can provide insight into the geological formations within the area.

The well records included within Table 1 were advanced primarily for domestic use, with three wells listed for test hole purposes, one well used for observation, one well was abandoned, and one well listed as not used. Well depths ranged between 7.3 – 103.3



mbgs, with corresponding water levels ranging between 0.0 – 7.3 mbgs. The overburden materials listed in the well records included in Table 1 vary significantly, and are composed of both sand and clay deposits. This is consistent with the information reviewed above, which indicates a highly variable Quaternary geology along the Lake Simcoe shoreline. None of the well records encountered bedrock, indicating it is found at a depth greater than 100 mbgs in the vicinity of the Site.

Table 1: MECP Water Well Database Summary

Well No.	Distance from the Site (m)	Direction from the Site	Elevation (m)	Date Drilled	Well Type	Well Depth (m)	Water Level (m)	Primary Use
5705815	20	W	224	1968-07-16	Overburden	7.3	3.7	Domestic
5718499	25	E	221	1982-09-21	Overburden	18.9	1.8	Domestic
5717012	45	E	221	1980-07-25	Overburden	79.6	3.1	Observation
7104787	45	SE	-	2008-03-11	Overburden	25.3	1.1	Test Hole
5727029	55	NW	-	1990-06-14	Overburden	27.4	1.2	Domestic
5721022	55	NW	-	1986-08-07	Overburden	35.1	-	Domestic
5725739	55	NW	-	1989-09-22	Overburden	10.4	0.6	Domestic
5734432	55	NW	-	1999-07-26	Overburden	11.6	7.3	Domestic
5730409	55	NW	-	1993-11-22	Overburden	31.1	1.8	Domestic
5701773	65	E	220	1966-09-01	Overburden	9.8	0.0	Domestic
5701770	65	E	221	1956-10-16	Overburden	44.5	-	Domestic
5701769	70	E	221	1956-07-13	Overburden	43.3	-	Domestic
7104786	70	SE	-	2008-03-11	Overburden	22.6	-	Not Used
7120047	70	SE	-	2008-12-01	Overburden	7.6	5.0	Test Hole
5718492	90	W	221	1982-09-16	Overburden	26.2	6.1	Domestic
5720118	150	SW	229	1985-07-29	Overburden	12.8	4.3	Domestic
5720227	150	SW	229	1985-09-30	Overburden	25.6	6.7	Domestic
5701771	155	SW	230	1963-07-12	Overburden	63.4	0.6	Domestic
5708974	200	W	229	1972-06-12	Overburden	21.0	4.6	Domestic
5720403	220	W	229	1985-12-11	Overburden	22.6	6.1	Domestic
5708973	230	NW	229	1972-06-10	Overburden	21.0	4.6	Domestic
5708971	235	NW	227	1972-06-15	Overburden	21.0	3.6	Domestic
5707696	265	W	232	1970-08-06	Overburden	19.8	0.9	Domestic
5710324	265	W	232	1973-07-14	Overburden	35.7	4.6	Domestic
5715730	270	NW	221	1978-10-79	Overburden	103.3	-	Test Hole
5716048	280	NW	222	1978-09-04	Overburden	34.1	1.2	Domestic
5709546	280	NW	227	1972-08-20	Overburden	15.9	0.6	Domestic
5737317	295	NW	226	2002-08-08	-	-	-	Abandoned

The Oak Ridges Moraine Groundwater Program (ORMGP, 2018) includes a water table layer which was created by contouring the static water levels from all wells where the well screen is less than 20 m deep. This layer is meant to represent an average water table since the values used in its creation were collected from all seasons over time. ORMGP (2018) suggests that the actual water table at any given time of the year may be up to 2-3m lower or higher than the values indicated on the water table layer. According to ORMGP (2018) the water table at the Site is found between 221 - 224 masl, which



represents 1 - 3 mbgs. Ground water flow is from south west to north east toward the Lake Simcoe shoreline. Maps from the ORMGP (2018) are included in Appendix C.

The Site is not considered a Significant Ground Water Recharge Area (SGRA) or a Highly Vulnerable Aquifer (HVA), and it is not located within a Wellhead Protection Area (WHPA) A, B, C, D, Q1, or Q2. A small portion of the eastern property boundary overlaps with the Intake Protection Zone 2 (IPZ-2) associated with the City of Barrie Water Treatment Plant (WTP) intake. The raw water intake is located approximately 10km south west of the mouth of Kempenfelt Bay, approximately 400 m from the south shore, in approximately 27 m of water. The IPZ-2 is delineated based on linear distance and travel time to the intake point.

3.0 MONITORING

3.1 Geotechnical Program

Peto MacCallum Ltd (PML) completed a geotechnical evaluation at the Site in September of 2017 which included advancing three (3) boreholes to depths of 5.0 to 6.4 mbgs. Each borehole was completed with a monitoring well (BH-1, BH-2, & BH-3). The geology of the site is given below (PML, 2017):

Topsoil: A 350 to 400 mm thick layer of topsoil was found at the surface of all boreholes

Sandy Silt: A 300 mm thick sandy silt layer was encountered and penetrated in Borehole 2 between 0.4 m and 0.7 m depth (223.2 – 222.9 masl). The unit was loose and was moist with moisture content of 8%.

Sand: A 2.2 and 0.4 m thick layer of sand was encountered in Boreholes 2 and 3 below the topsoil or sandy silt, extending to 2.9 m / 220.7 masl and 0.8 m / 224.3 masl respectively. The sand had variable silt and gravel content. Cobbles and boulders were noted in Borehole 3. The unit was dense to very dense in Borehole 2 and loose in Borehole 3. The sand was moist in Borehole 3 (moisture content of 4%) and wet in Borehole 2 (moisture content 8 to 17%).

Sand and Gravel: A sand and gravel deposit was encountered in Boreholes 1 and 2 below the topsoil and upper soil units extending to the depth of each borehole. The unit contained trace to some silt, and cobbles and boulders were noted. Borehole 1 met auger refusal at 5.0 mbgs and this is believed to be due to boulders. The material was dense to very dense, locally compact near the surface of Borehole 1. The deposit was moist to wet with depth and a moisture content between 2 to 15%.



Layered Clayey Silt/Silty Clay: A layered clayey silt/silty clay unit was encountered in Borehole 3, occurring from 0.8 m / 224.3 masl to 5.2 m / 218.9 masl. The unit was typically very stiff to hard with wet layers noted at depth.

Sandy Silt Till: A sandy silt till deposit was encountered in Borehole 3 below the clayey silt/silty clay unit at 5.2 m depth extending to the 6.4 m depth of the borehole. Cobbles and boulders were noted. The material was very dense and moist with a moisture content of 10%. The deposit also has wet sand layers.

The results of the geotechnical program (PML, 2017) are consistent with the surficial geology described in Section 2.5. The two boreholes located in the north east portion of the Site (BH-1 and BH-2) contain sand and gravel typical of a near shore environment (*i.e.*, Lake Simcoe to the north east). The borehole located in the south west of the Site (BH-3) contained a thin sand unit with trace gravel overlying clayey silt/silty clay overlying sandy silt till.

3.2 Azimuth (2018) Field Program

Azimuth conducted a scoped field program in July of 2018 to investigate the surficial soil conditions in the south east portion of the Site in the vicinity of the proposed residential homes. This program included using a hand auger to advance three holes (BH-4, BH-5, & BH-6) to depths between 1.0 and 2.8 mbgs. A standpipe was installed within each hole to enable ground water measurements.

The material encountered at BH-4 was composed of 0.35m of topsoil overlying brown clayey silt to 2.8mbgs. The material encountered at BH-5 and BH-6 was composed of 0.30 – 0.35m of topsoil overlying brown medium to fine grained sand. The test pit logs are included in Appendix D.

A cross-section is provided on Figure 3 which shows the subsurface material encountered at BH-1, BH-2, and BH-3. The south portion of the Site in the vicinity of BH-3 contained a thin sand layer overlying more fine-grained clayey silt/silty clay/sandy silt till. The overlying sand layer appears to become increasingly thin as you move north east toward Lake Simcoe. The material encountered within BH-4, BH-5, and BH-6 was variable, and did not show the same trend of increasing sand thickness from west to east toward lake. Excavation in the vicinity of Dock Road will therefore likely encounter surficial sand overlying clayey silt/silty clay however the thickness of the overlying sand unit will be variable.



3.3 Ground Water Elevations

Ground water measurements were collected within BH-1 – BH-3 in November of 2017 and April, May, and June of 2018, within BH-1 – BH-6 in July and August of 2018, and within BH-1, BH-2, & BH-4 – BH-6 in March and April of 2024. The complete database of manual measurements is included in Appendix E.

It is noted that ground water table will fluctuate seasonally, with the highest values typically recorded within the Spring (March to June). The reading taken on April 19th 2024, and corresponding water elevations, should be used for the Site's high ground water levels and used for reference in Site design. This ground water level data is provided on Figure 4.

The water level measured on April 19th 2024 ranged between 0.25 mbgs and -0.07 mbgs which represents 223.5 masl to 224.6 masl. The ground water flow direction was noted to be north east, toward the Lake Simcoe shoreline. Surface water ponding was noted at BH-2, BH-4, and BH-6.

3.4 Hydraulic Conductivity Testing

In order to understand the hydraulic characteristics of the underlying overburden, a transient slug test can be performed within monitoring wells to determine the average hydraulic conductivity of the screened interval. A slug test involves the instantaneous injection or withdrawal of a volume or slug of water or solid cylinder of known volume. This is accomplished by adding or displacing a known volume to/from a well and measuring water level response time to return to equilibrium.

Hydraulic conductivity testing was completed at the Site by Azimuth staff within the on-Site monitoring wells in November of 2017. Water level measurements were recorded both manually and with automatic dataloggers, which were programmed to record the pressure of water above the data logger every second. Data was analyzed using the Hvorslev Method (1951), which assumes a homogeneous, isotropic medium in which soil and water are incompressible. Hydraulic testing results are summarized in Table 2, and within Appendix F.

Table 2: Hydraulic Testing Results

Monitoring Well	Hydraulic Conductivity (m/s)	Soil Description
BH-1	4.1×10^{-6}	Sand & Gravel
BH-2	9.1×10^{-4}	Sand & Gravel
BH-3	1.1×10^{-5}	Clayey Silt/Silty Clay/Sandy Silt Till



The results indicate that the hydraulic conductivity of the deposits range between 9.1×10^{-4} to 4.1×10^{-6} m/s. The sand and gravel within the screened interval of BH-1 and BH-2 display hydraulic conductivities that are consistent with published values. The measured hydraulic conductivity for BH-3 is slightly higher than typical published values for sandy silt till. This discrepancy may be due to the presence of trace gravel, trace cobbles, trace boulders, and wet sand layers in the till producing an increase in water movement. The borehole log for BH-3 also noted wet layers within the bottom of the clayey silt/silty clay, which is included within the screened interval.

3.5 Water Quality Sample

A water quality sample was collected from BH-2 on April 19th 2024 to determine the onsite ground water quality in preparation for dewatering activities. The results are included in Appendix G and have been compared to both the City of Barrie Appendix B Parameter List (“Appendix B List”) and the Provincial Water Quality Objectives (PWQO).

The sample was analyzed for both filtered and unfiltered TSS and metals, as per the requirements of the City of Barrie. However the standard operating procedure is to filter metal parameters in the field. The following exceedances were noted:

PWQO Exceedances: total phosphorus, copper (unfiltered), iron (unfiltered), tungsten (unfiltered), zirconium (unfiltered), arsenic (unfiltered), lead (unfiltered), nickel (unfiltered), thallium (unfiltered), cadmium (unfiltered), cobalt (unfiltered), vanadium (unfiltered), and zinc (unfiltered)

Appendix B List Exceedances: oil & grease – animal/vegetable, total kjeldahl nitrogen (TKN), total phosphorus, aluminum (unfiltered), chromium (unfiltered), copper (unfiltered), iron (unfiltered), lead (unfiltered), nickel (unfiltered), zinc (unfiltered), and TSS

The sample contained an oil & grease (animal & vegetable) concentration of 1.8 mg/L which is above the Appendix B threshold of 0. The Site contains a mature forest and wetland with organic material at surface. This detection is therefore considered a natural occurrence due to the accumulation and decomposition of plant material.

It should be noted that the sample had an unfiltered TSS concentration of 34,900 NTU, which is considered very high. The majority of the elevated parameters noted above are therefore the result of excess metals or nutrients that are attached to the sediment grains in suspension. This is evident when comparing the filtered and unfiltered results for the noted metal exceedances above. The filtered results of aluminum, chromium, copper,



iron, lead, tungsten, zirconium, arsenic, thallium, cadmium, cobalt, vanadium, nickel, and zinc all met their respective PWQO and Appendix B limits. As per standard operation procedures, the phosphorus and TKN analyses were completed only on water that was unfiltered, and therefore contained high concentration of sediment particles. The increased phosphorus and TKN are therefore likely attributed to the excess sediment.

On-site filtration or settling of dewatering effluent prior to any discharge is therefore recommended as part of any dewatering program. It is recommended that the discharge water be tested using a portable turbidimeter at the onset of dewatering to confirm adequate sediment filtration.

4.0 WELL SURVEY

The Site is located within a residential area of the City of Barrie, Ontario. Although the Site will be serviced with water and sewer utilities, there are some adjacent parcels which still obtain potable water from private wells and utilize private septic systems.

A Baseline Residential Water Well Survey was completed by Azimuth in November of 2017. This survey included all parcels within 300 m of the Site boundary and included homes along Dock Road, Tynhead Road, Tyndale Road, Jean Street, Tollendale Mill Road, Plunkett Court, and Gray Lane. The survey included a review of available Ontario Ministry of the Environment, Conservation, and Parks (MECP) well records (Section 2.6), a door-to-door survey requesting home owner participation, and a home owner questionnaire if response was received.

Based on an interpretation of aerial imagery, there are approximately 60 parcels that may contain private wells within 300 m of the Site boundary. The area has historically been privately serviced, but municipal services (water and septic) have recently become available for existing homes. Most of these wells were decommissioned after municipal services were provided to the area.

A letter inviting residents to participate in the water well survey program was hand delivered to these surrounding residences on November 10th 2016. Parcels that were undeveloped (no permanent structure) were not targeted during the door-to-door survey.

Seven residences responded to the residential well survey. One resident indicated they had connected to municipal water and their well had been decommissioned. Four residents contacted Azimuth to follow up regarding the letter notifications however did not wish to provide well details or participate in the survey. One of the respondents that did not provide details did indicate they had a good functioning well and septic system.



The remaining two responding residents indicated that they had drilled wells, estimated to be 100 ft and 160 ft deep. The owner of the 160 ft drilled well indicated that the well head was not accessible for a water level or additional monitoring. The owner of the 100 ft drilled well indicated that he tests it regularly with the Simcoe County Health Unit and he has not had any issues with bacteria.

A road side survey was completed by Azimuth staff in October of 2018. All parcels within 50m of the six proposed building foundations were examined from the road way for the presence of a private well. Most homes to the south of Dock Road are recently constructed and therefore are not anticipated to have ever been privately serviced. For the remaining homes on the north side of Dock Road and along the east side of Tynhead Road, no private wells were visible. It should be noted that some well heads may be buried or obstructed by vegetation or structures. However, no obvious signs of a private well were noted within 50m of the proposed building footprints.

5.0 WATER BALANCE

In order to determine the potential changes to the natural ground water recharge conditions, a pre- and post-development water balance assessment has been completed using the Thornthwaite and Mather method (1957). This method evaluates evapotranspiration based on precipitation and temperature. Residual soil saturation is a function of topography and soil type. Monthly data are tabulated from daily average temperature and precipitation, and the water budget is a continuous calculation over the period of record.

Values were determined on a monthly basis, compiled from daily Environment Canada meteorological data station located in Barrie, Ontario between 1970 and 2021 (Station ID 6110557). The calculations are based on the average conditions during this period; the average precipitation was 907 mm, rainfall was 654 mm, evapotranspiration was 479 mm and the surplus was 428 mm.

5.1 Land Use

5.1.1 Pre-Development

The pre-development Site area was classified according to land use/vegetation type. Land within the pre-development area is provided in Table 3.



Table 3: Pre Development Area Classification

Land Use	Land Area (m ²)
Forest	8,839
Wetland	3,727
TOTAL	12,566

Land within the pre-development scenario is considered 30% impervious. It should be noted that the limits of the existing wetland are subject to change depending on the upcoming in-season delineation with the City of Barrie and LSRCA.

5.1.2 Post-Development

The land classification in the post-development scenario was classified based on the Site Plan (Appendix H). Land within the post-development area is provided in Table 4.

Table 4: Post Development Area Classification

Land Use	Land Area (m ²)
Forest	4,174
Wetland	2,865
Landscaped	3,268
Driveway	749
Structures	1,510
TOTAL	12,566

Land within the post-development scenario is considered 41% impervious.

5.2 Infiltration

Infiltration is generated one of two ways: (1) directly from rainfall impact on pervious surfaces; and (2) indirectly when runoff from impervious surfaces is diverted into adjacent naturalized areas.

Infiltration factors for the Site were estimated based on the underlying soil, local topography, and ground cover as per Table 2 of the Ministry of Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (1995).

The soil variable factor was determined by taking into account information obtained from the regional geologic mapping and the geotechnical program completed for the Site. This information confirms that the surficial material is variable, however is composed primarily of sand and gravel to depth in the north and south east portion of the Site, and is composed of about 1.2 m of sand with trace silt overlying clayey silt in the south east



portion of the Site. Since the surficial material is primarily composed of sandy deposit, a sandy loam classification was used in the water balance assessment.

The infiltration factors utilized in the water balance assessment are summarized in Table 5 below.

Table 5: Summary of Pervious Land Infiltration Factor

Scenario	Land Use	Infiltration Factor	Assumption
Pre-Development	Forest	0.90	Flat land (0.3), sandy loam soil (0.4), woodland (0.2)
	Wetland	0.00	Saturated conditions do not enable infiltration
Post-Development	Forest	0.90	Flat land (0.3), sandy loam soil (0.4), woodland (0.2)
	Wetland	0.00	Saturated conditions do not enable infiltration
	Landscaped	0.80	Flat land (0.3), sandy loam soil (0.4), grass (0.1)

5.2.1 Pre-Development Infiltration

Pre-development direct infiltration was determined by multiplying the annual average surplus amount, the area of each land use, and the infiltration factor for each land use. The pre-development annual infiltration is therefore 3,405 m³/year (Appendix I).

5.2.2 Post-Development

Post-development infiltration (without mitigation) was determined by multiplying the annual average surplus amount, the area of each land use, and the infiltration factor for each land use. The post-development annual direct infiltration is therefore 2,727 m³/year. There is therefore a decrease in infiltration of 678 m³/year from pre- to post-development without mitigation measures employed.

The surplus infiltration from the rooftop downspouts is determined by multiplying the annual precipitation (904 mm), by 50% as per the CVC LID Manual for HSG A & B soils, and by 90% to account for a 10% evapotranspiration factor. It is then assumed that only 75% of the rooftop downspouts will be directed to pervious grass. This contributes an additional 462 m³/year.



5.3 Water Balance Summary

Using the climate model data and calculations mentioned above, the water balance was completed for pre-development, post-development, and post-development with mitigation (Appendix I).

The pre-development infiltration volume is 3,405 m³/year. This assumes the Site is composed of primarily agricultural land with a wetland. The post-development without mitigation infiltration volume is 2,727 m³/year, which is a deficit of 678 m³/year. This assumes the Site contains five single lot residential homes and associated driveways. An additional 462 m³ of infiltration can be obtained by discharging downspouts to pervious surfaces. The post-development with mitigation volume is therefore 3,189 m³/year, which represents a 6% decrease from the pre-development volume. This change in pre- to post-development infiltration is not anticipated to significantly impact the Site.

6.0 DEWATERING ASSESSMENT

The proposed development will include the construction of 5 single detached homes. Each home will be individually serviced with water and sanitary services. The service connections will be off of Dock Road to the south. Due to the high ground water table at the Site and proximity to Lake Simcoe, dewatering may be required to maintain dry conditions during construction.

6.1 Drawdown Conditions

The City of Barrie's Lot Grading and Drainage Infrastructure Design Standard (2023) stipulates that the underside of the floor slab should be set 0.5m higher than the seasonal high ground water level. Temporary dewatering would therefore not be anticipated during construction of the detached home foundation. The basement floor slab elevation for the homes will be determined during detailed design. Although the seasonally high ground water is noted to be within 0.5m of the ground surface across the Site, the minimum separation will be created through the importation of fill across the development area and the use of a raised bungalow design.

Each of the homes will require connection to water and sanitary services, which will overlap with the underlying ground water table. Information obtained from the Water and Sanitary Servicing Plan (Appendix H) indicates that a 74.6 m sanitary line will be installed along Dock Road. This line will connect to the existing municipal sanitary network at the corner of Plunkett Court and Dock Road. Potable water will be obtained from an existing watermain along Dock Road. Each home will then have individual water and sanitary connections off of Dock Road.



The minimum depth of servicing will be 221.63 masl, which represents the north connection of the existing sanitary manhole SAH09132 at the corner of Dock Road and Plunkett Court (Appendix H).

The high ground water level in the vicinity of Dock Road is 224.75 masl (Figure 4). Construction dewatering will target 0.5m below the trench base to maintain dry working conditions. The maximum ground water lowering will therefore be 3.6 m for the current dewatering assessment.

Given the required drawdown is greater than 1.5 m, the use of shallow well points or eductor systems will likely be required. The exact dewatering methodology will depend on site-specific conditions and construction methods such that it will be determined by the dewatering contractor. Water generated from construction dewatering could be discharged into the road side ditch along the north side of Dock Road. This water would flow east, ultimately discharging into Lake Simcoe.

The following assumptions have been made with respect to variables and approach for the dewatering calculations:

- Each townhouse unit is designed so that the underside of the basement slab is at least 0.5m above the ground water table. Based on this information, dewatering for structure construction is not anticipated;
- Trench dewatering will likely be required to enable construction of the sanitary line along Dock Road, and the individual water and sanitary connection for each home;
- Construction ground water lowering will target a depth of 0.5 m below the base of the servicing trench;
- The high ground water level used for the Dock Road sanitary line is 224.75 masl. The high ground water level used for each of the individual sanitary and water lines range between 224.0 masl and 224.75 masl (Figure 4);
- Each of the individual water and sanitary lines are assumed to be up to 20m long. Each trench is assumed to be 3m wide;
- The required drawdown for each 20 m segment of individual sanitary/water line ranges between 1.6m - 2.9m;
- Two dewatering assessments were completed: one using the worst-case hydraulic conductivity for the sand and gravel unit measured within BH-2 (9.1×10^{-4} m/s) and one for the clayey silt/silty clay unit measured within BH-1 (4.0×10^{-6} m/s);

The actual drawdown will depend on construction timing and the seasonal water table elevation.



6.2 Approximate Dewatering Volumes

For trench dewatering, calculations for the dewatering rate / volume were completed using the steady state method from Powers, *et al.* (2007) for estimating radial flow to an excavation in an unconfined aquifer.

The following equation was used:

$$Q = \{[(\pi * K) * (H^2 - h^2)] / [\ln(R_o/r)] + 2 * [a * K * (H^2 - h^2) / 2R_o]\}$$

(Ref: Powers *et al.* (2007))

The full dewatering assessment can be found in Appendix J, while the details are also summarized in Table 6 below.

Based on the information provided in Appendix J, when using the hydraulic conductivity measured within the sand and gravel at BH-2 the anticipated total dewatering for the Dock Road sanitary line and five 20m individual connections is 4,797,100 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 7,195,800 L/day to account for any onsite variability.

Based on the information provided in Appendix J, when using the hydraulic conductivity measured within the clayey silt/silty clay/sandy silt till at BH-3 the anticipated total dewatering for the Dock Road sanitary line and five 20m individual connections is 49,800 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 74,700 L/day to account for any onsite variability.

Two estimates have been provided to cover the range of conditions that may be encountered during the specified construction. Based on the subsurface field programs completed, excavations in the vicinity of Dock Road will likely encounter surficial sand overlying clayey silt/silty clay. However, the thickness of the overlying sand unit will be variable. The actual dewatering rate will therefore likely fall somewhere in between the two estimates provided in Table 6. Additional work such as a test pit program could be completed after vegetation removal once the depth of infrastructure is confirmed. This program would add additional clarity to the understanding of the subsurface conditions and refine the expected dewatering estimate.

Any construction dewatering between 50,000 L/day and 400,000 L/day can be completed after registration under the Environmental Activity and Sector Registry (EASR). Any



active construction dewatering above 400,000 L/day requires a Permit To Take Water (PTTW).

Based on the current understanding of the Site and calculated values, without additional subsurface details, a PTTW should be obtained to ensure construction water can be properly managed under the full range of potential conditions. The magnitude of dewatering required will vary on the timing of construction as less dewatering would be needed in the summer drought conditions when the water table is highly variable. Peak ground water elevation typically occurs between mid April and the end of May. The daily dewatering rate may be reduced by limiting the length of excavation open at one time, however this may not be feasible for the proposed development.

Table 6: Summary of Dewatering Conditions

Variable	75m Dock Road Sanitary		Five 20m Service Connections	
	Low K	High K	Low K	High K
Effective Radius [r_e] (m)	25	25	7	7
Hydraulic Conductivity [K] (m/s)	4.0×10^{-6}	9.1×10^{-4}	4.0×10^{-6}	9.1×10^{-4}
Required Drawdown [$H-h$] (m)	3.6	3.6	1.6 – 2.9	1.6 – 2.9
Saturated Thickness Before Pumping [H] (m)	4.1	4.1	2.1 – 3.4	2.1 – 3.4
Depth of Water During Pumping [h] (m)	0.5	0.5	0.5	0.5
Length of excavation [a] (m)	75	75	20	20
Width of excavation [b] (m)	3	3	3	3
Radius of Influence [R] (m) ¹	47	352	17 - 25	151 - 267
Total Discharge [Q] (L/day)	37,600	1,809,000	49,800	2,988,100
Total Discharge [Q] (L/day) 1.5 X Safety Factor Applied	<u>56,400</u>	<u>2,713,500</u>	<u>74,700</u>	<u>4,482,300</u>

6.3 Well Impact Assessment

Based on the information provided in Table 6, the predicted zone of influence for the Dock Road sanitary line may range between 47m and 352m while the predicted zone of influence for the individual service connections range between 17m and 267m.

The zone of influence describes the distance between the point of greatest drawdown (dewatering trench) and the point where there is no drawdown. The drawdown within the outer reaches of the zone of influence is therefore much smaller than the maximum drawdown.

As noted in Section 4.0, a well survey and road side survey was completed by Azimuth. As part of the road side survey, all parcels within 50m of the six proposed building foundations were examined from the road way for the presence of a private well. Most



homes to the south of Dock Road are recently constructed and therefore are not anticipated to have ever been privately serviced. For the remaining homes on the north side of Dock Road and along the east side of Tynhead Road, no private wells were visible in 2018. It should be noted that some well heads may be buried or obstructed by vegetation or structures. However, no obvious signs of a private well were noted within 50m of the proposed building footprints.

Additional private supply wells are located within the maximum zone of influence noted in Table 6. The potential for impact will depend on the subsurface conditions encountered during construction, the depth of the individual wells, and the depth of available water within the water column. Any well impact that does occur would be temporary in nature during the construction phase of development. To reduce the potential for impact, construction should be completed in stages and during dry summer months when the water level is not at its highest to reduce the required drawdown.

7.0 SUMMARY AND CONCLUSIONS

Azimuth Environmental Consulting, Inc. has been retained by 1000067364 Ontario Inc. to conduct a Hydrogeological Assessment Update for the proposed residential development located at 211 Dock Road within the City of Barrie, Ontario. The Site is approximately 1.25 ha in size and is located on the north side of Dock Road, west of Tynhead Road, south east of Tyndale Park. The Site is currently composed of undeveloped forest, with one residential home currently under construction. There is a wetland feature located in the south east portion of the Site.

The proposed development of the Site includes five single lot residential homes off of Dock Road. The north portion of the Site will be dedicated to the City of Barrie. The purpose of this assessment is to characterize the existing hydrogeological conditions at the Site and the potential for the proposed development to impact the existing environmental conditions.

The Site is found at an elevation between 224 – 228 masl and slopes to the north east toward Lake Simcoe. There is a wetland in the south east portion of the Site. There is a seasonal drainage feature which overlaps the northern tip of the Site in a west to east direction, discharging into a road side ditch along the western side of Tynhead Road. This ditch flows into a culvert crossing beneath Tynhead Road that flows through the Tynhead development and outlets directly into Lake Simcoe.

A cross-section is provided on Figure 3 which shows the subsurface material encountered at BH-1, BH-2, and BH-3. The south portion of the Site in the vicinity of BH-3 contained a thin sand layer overlying more fine-grained clayey silt/silty clay/sandy silt



till. The overlying sand layer appears to become increasingly thin as you move north east toward Lake Simcoe. The material encountered within BH-4, BH-5, and BH-6 was variable, and did not show the same trend of increasing sand thickness from west to east toward lake. Excavation in the vicinity of Dock Road will therefore likely encounter surficial sand overlying clayey silt/silty clay however the thickness of the overlying sand unit will be variable.

The reading taken on April 19th 2024, and corresponding water elevations, should be used for the Site's high ground water levels and used for reference in Site design. The water level measured on April 19th 2024 ranged between 0.25 mbgs and -0.07 mbgs which represents 223.5 masl to 224.6 masl. The ground water flow direction was noted to be north east, toward the Lake Simcoe shoreline.

A water quality sample was collected from BH-2 on April 19th 2024. The results indicate minor exceedances of both the PWQO and City of Barrie Appendix B parameter list. However, the use of on-site filtration or settling of dewatering effluent prior to discharge is recommended and would likely reduce many of the identified parameters. The detection of oil & grease (animal & vegetable) is considered a natural occurrence due to the accumulation and decomposition of plant material within the mature forest and wetland conditions.

A well survey was conducted for all parcels within 300 m of the Site boundary in November 2017 and included homes along Dock Road, Tynhead Road, Tyndale Road, Jean Street, Tollendale Mill Road, Plunkett Court, and Gray Lane. Seven residences responded to the residential well survey. One resident indicated they had connected to municipal water and their well had been decommissioned. Four residences contacted Azimuth to follow up regarding the letter notifications however did not wish to provide well details or participate in the survey. One of the respondents that did not provide details did indicate they had a good functioning well and septic system. The remaining two responding residents indicated that they had drilled wells, estimated to be 100 ft and 160 ft deep. A road side survey was completed by Azimuth staff in October of 2018. All parcels within 50m of the six proposed building foundations were examined from the road way for the presence of a private well. Most homes to the south of Dock Road are recently constructed and therefore are not anticipated to have ever been privately serviced. For the remaining homes on the north side of Dock Road and along the east side of Tynhead Road, no private wells were visible. It should be noted that some well heads may be buried or obstructed by vegetation or structures. However, no obvious signs of a private well were noted within 50m of the proposed building footprints.



A pre- and post-development water balance assessment was completed to assess any impacts to the infiltration rate at the Site. The pre-development infiltration volume is 3,405 m³/year. This assumes the Site is composed of primarily agricultural land with a wetland. The post-development without mitigation infiltration volume is 2,727 m³/year, which is a deficit of 678 m³/year. This assumes the Site contains five single lot residential homes and associated driveways. An additional 462 m³ of infiltration can be obtained by discharging downspouts to pervious surfaces. The post-development with mitigation volume is therefore 3,189 m³/year, which represents a 6% decrease from the pre-development volume. This change in pre- to post-development infiltration is not anticipated to significantly impact the Site.

The proposed development will include the construction of 5 single detached homes. Each home will be individually serviced with municipal water and sanitary services. The service connections will be off of Dock Road to the south. Due to the high ground water table at the Site and proximity to Lake Simcoe, dewatering may be required to maintain dry conditions during construction.

Two dewatering assessments were completed: one using the worst-case hydraulic conductivity for the sand and gravel unit measured within BH-2 (9.1×10^{-4} m/s) and one for the clayey silt/silty clay unit measured within BH-1 (4.0×10^{-6} m/s). When using the high hydraulic conductivity value, the total dewatering is calculated at 4,797,100 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 7,195,800 L/day to account for any onsite variability. When using the low hydraulic conductivity value, the total dewatering is calculated at 49,800 L/day. A 1.5x safety factor can then be applied to the above total volume for a conservative estimate of 74,700 L/day to account for any onsite variability.

Based on the subsurface field programs completed, excavations in the vicinity of Dock Road will likely encounter surficial sand overlying clayey silt/silty clay. However, the thickness of the overlying sand unit will be variable. The actual dewatering rate will therefore likely fall somewhere in between the two estimates provided in Table 6.

Based on the current understanding of the Site and calculated values, without additional subsurface details, a PTTW should be obtained to ensure construction water can be properly managed under the full range of potential conditions. The magnitude of dewatering required will vary on the timing of construction as less dewatering would be needed in the summer drought conditions when the water table is highly variable. The daily dewatering rate may be reduced by limiting the length of excavation open at one time, however this may not be feasible for the proposed development.



Private supply wells are located within the maximum zone of influence noted in Table 6. The potential for impact will depend on the subsurface conditions encountered during construction, the depth of the individual wells, and the depth of available water within the water column. Any well impact that does occur would be temporary in nature during the construction phase of development. To reduce the potential for impact, construction should be completed in stages and during dry summer months when the water level is not at its highest to reduce the drawdown required.

8.0 REFERENCES

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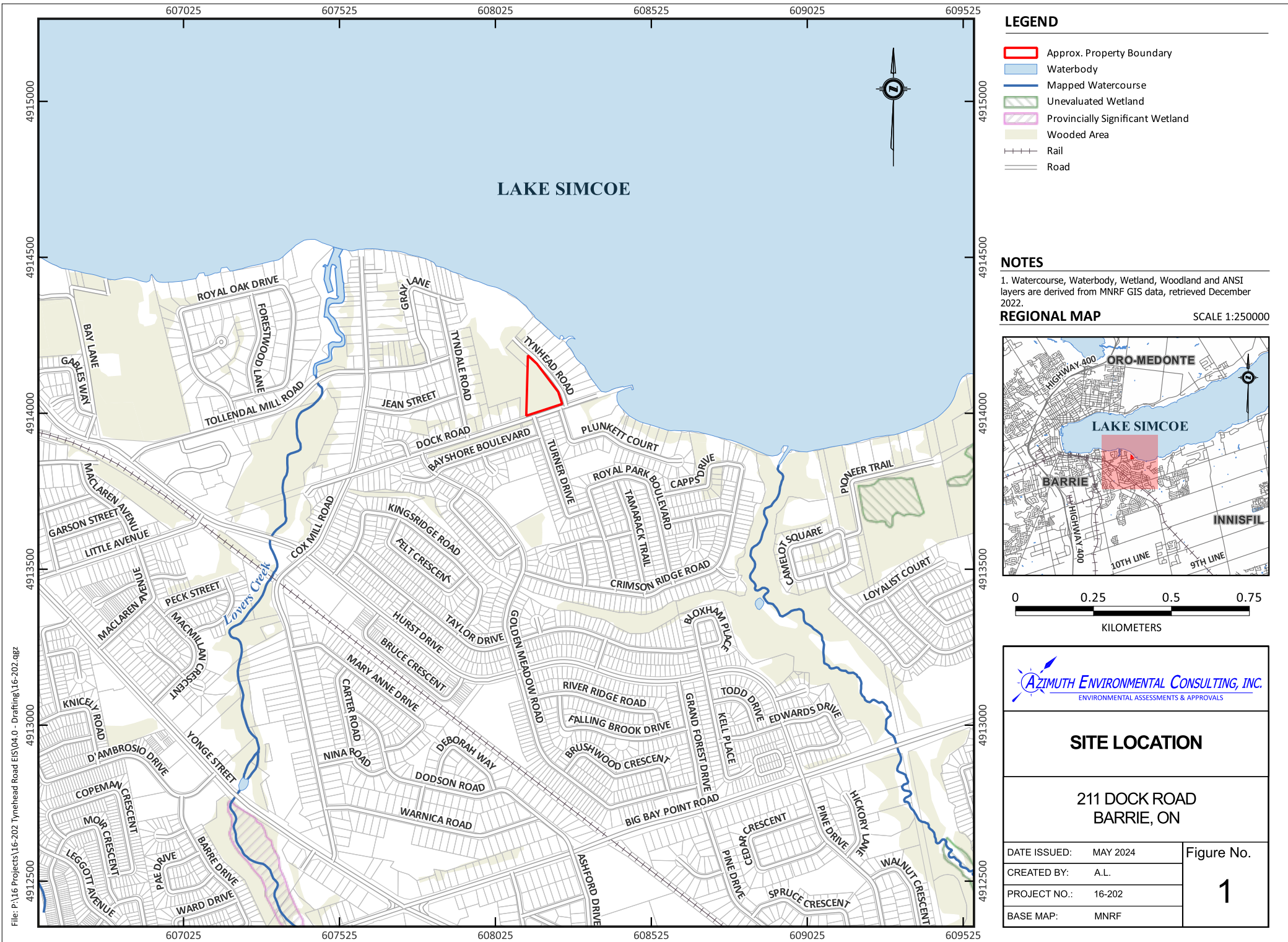
APPENDICES

- Appendix A: Figures**
 - Appendix B: MECP Well Records**
 - Appendix C: ORMGP Mapping**
 - Appendix D: Azimuth (2018) Field Program**
 - Appendix E: Ground Water Data**
 - Appendix F: Hydraulic Conductivity Results**
 - Appendix G: Water Quality Results**
 - Appendix H: Development Drawings**
 - Appendix I: Water Balance**
 - Appendix J: Dewatering Assessment**
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APPENDIX A

Figures



Plotted by: ALU on May 10, 2024 at 3:52pm
File: \\azimuth\shared\Projects\16-202 Simcoe\16-202 Site Layout 2.dwg Layout: SITE LAYOUT PlotScale: 1



LEGEND:

- APPROX. PROPERTY BOUNDARY
- 0.5m CONTOURS (OMAFRA LAKE SIMCOE DTM, 2022)
- WETLAND
- MONITORING WELL

LOCATION PLAN

The location plan is a simplified map showing the site's location relative to Lake Simcoe. The site is outlined in red. Surrounding roads include Gray Lane, Tynhead Road, Dock Road, Turner Drive, and Plunkett Court. A north arrow and a scale bar (0 to 50.0) are included. Below the scale bar, it reads 'HORIZONTAL SCALE 1:1000'.

ENVIRONMENTAL ASSESSMENTS & APPROVALS

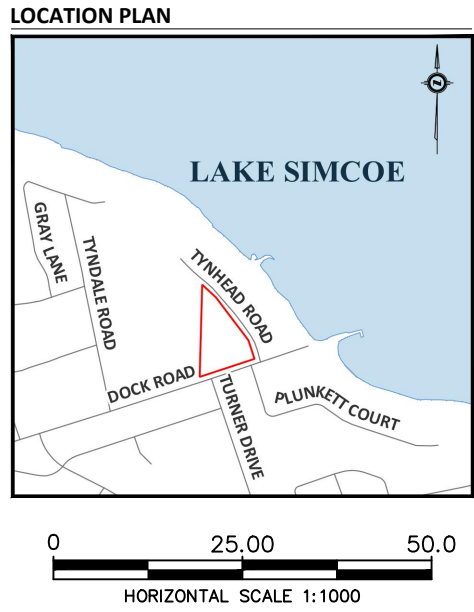
SITE LAYOUT

211 DOCK ROAD
BARRIE, ON

DATE ISSUED:	MAY 2024	Figure No. 2
CREATED BY:	A.L.	
PROJECT NO.:	16-202	
REFERENCE:	SIMCOE COUNTY	

LAKE
SIMCOE

- LEGEND:
- APPROX. PROPERTY BOUNDARY
 - 100.00 0.25m GROUND WATER CONTOURS
 - INFERRED DIRECTION OF GROUND WATER FLOW
 - MONITORING WELL AND GROUND WATER LEVEL



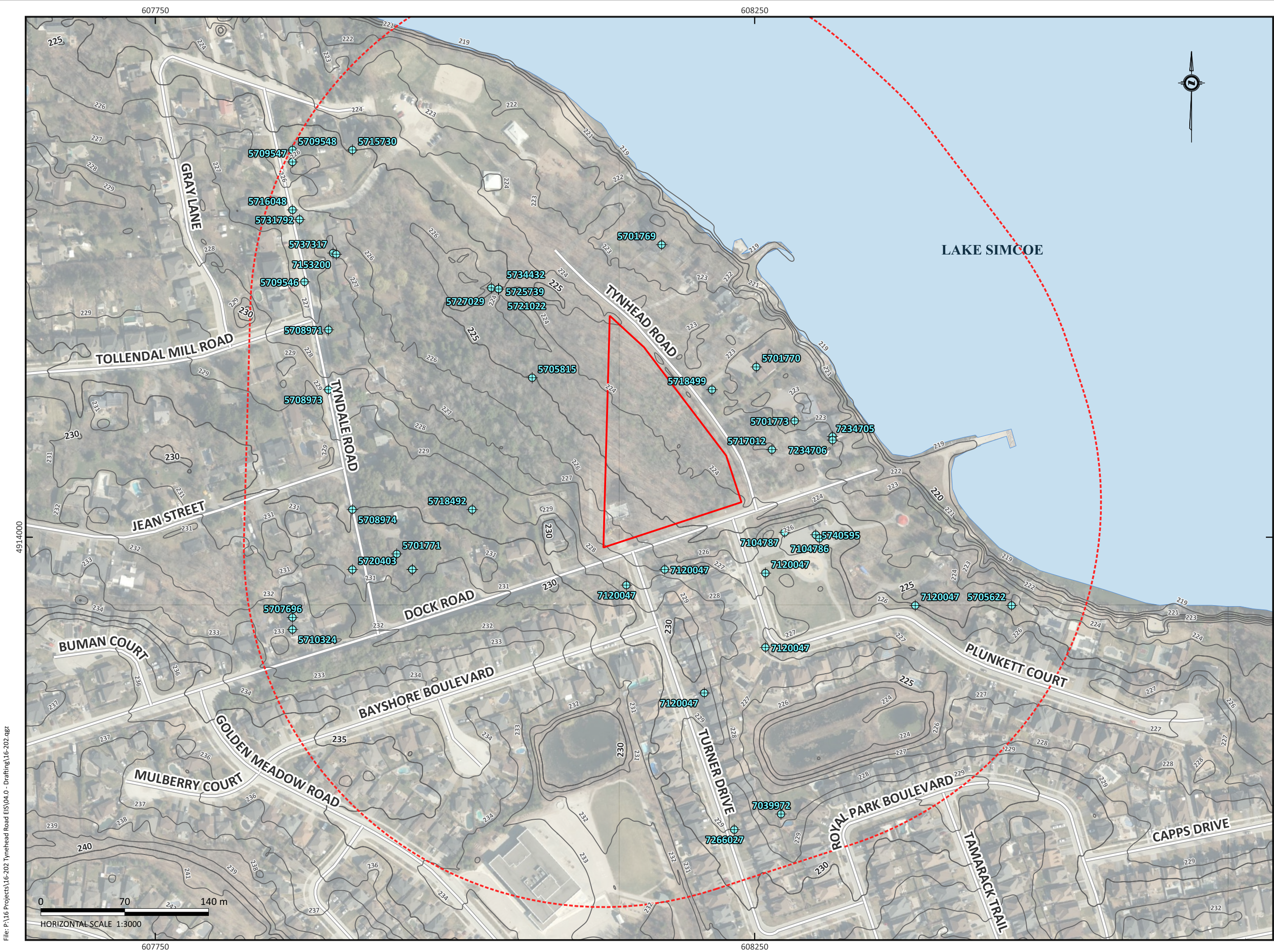
AZIMUTH ENVIRONMENTAL CONSULTING, INC.
ENVIRONMENTAL ASSESSMENTS & APPROVALS

GROUND WATER FLOW

211 DOCK ROAD
BARRIE, ON

DATE ISSUED:	MAY 2024	Figure No. 4
CREATED BY:	A.L.	
PROJECT NO.:	16-202	
REFERENCE:	SIMCOE COUNTY	

Printed by: ALU on May 3, 2024 at 3:43pm
File: E:\16 projects\16-202 Tynhead road\ah\04.0 - draft\16-202 Site Layout.dwg Layout: GW Plotstyle: 1



LEGEND

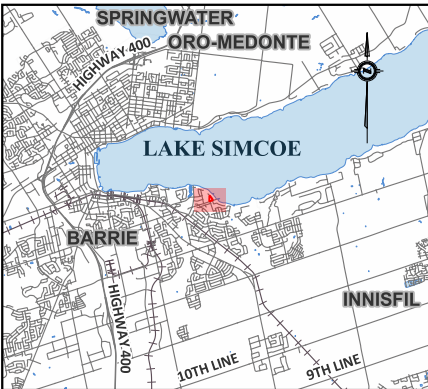
- Approx. Property Boundary
- 300m Buffer
- Waterbody
- Road

1m Contours (OMAFRA Lake Simcoe DTM 2022)

- Major Contour - 5m Intervals
- Minor Contour - 1m Intervals
- MECP Water Well Location

LOCATION MAP

SCALE 1:250000



PRIVATE WELL USERS

211 DOCK ROAD
BARRIE, ON

DATE ISSUED: MAY 2024
CREATED BY: A.L.
PROJECT NO.: 16-202
BASE MAP: SIMCOE COUNTY

Figure No.

5



APPENDIX B

MECP Well Records



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5705815

External identity : ca.on.waterWell.5705815

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 7.32m

Elevation : 224.03m

Water level : 3.66m

Water yield : 9.09lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	4.57	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
4.57	7.32	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5718499

External identity : ca.on.waterWell.5718499

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 18.90m

Elevation : 220.98m

Water level : 1.83m

Water yield : 36.37lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 17.0688 to 19.20m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	3.35	Clay	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
3.35	14.02	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
14.02	15.85	Clay	CLAY SAND SILTY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
15.85	18.90	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5717012

External identity : ca.on.waterWell.5717012

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 79.55m

Elevation : 220.98m

Water level : 3.05m

Water use : Not Used

Well status : Observation Wells

Well type : Unknown

Screen components : From 60.96 to 62.79m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.96	Gravel Sand Gravel	GRAVEL SAND BOULDERS	[24,44]% [26,53]% [24,44]%	[3E-4,3E-2]m.s-1 [2E-7,6E-3]m.s-1 [3E-4,3E-2]m.s-1
3.96	15.85	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
15.85	17.68	Clay Unknown material	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
17.68	18.90	Clay Sand Unknown material	CLAY SANDY LAYERED	[34,57]% [26,53]%	[1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
18.90	20.42	Clay Unknown material	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
20.42	38.71	Clay Unknown material	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
38.71	51.82	Clay Unknown material	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
51.82	64.62	Sand Clay Unknown material	FINE SAND CLAY LAYERED	[26,53]% [34,57]%	[2E-7,6E-3]m.s-1 [1E-11,4.7E-9]m.s-1
64.62	69.19	Clay Unknown material	CLAY HARD PACKED	[34,57]%	[1E-11,4.7E-9]m.s-1



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7104787

External identity : ca.on.waterWell.7104787

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 19.51m

Elevation : NaNm

Water level : 1.14m

Water use : Test Hole

Well status : Test Hole

Well type : Unknown

Well casings : From 0.00 to 19.51m.

Sealing components : From 0.00 to 18.29m.

Screen components : From 19.5072 to 22.56m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	0.91	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
0.91	2.44	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
2.44	9.75	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
9.75	10.06	Silt	SILT	[34,61]%	[1E-9,2E-5]m.s-1
10.06	23.77	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
23.77	25.30	Silt	SILT CLAY	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5727029

External identity : ca.on.waterWell.5727029

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 27.43m

Elevation : NaNm

Water level : 1.22m

Water yield : 45.46lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 4.57 to 6.10m.

Screen components : From 26.2128 to 27.43m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	12.19	Sand	SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
12.19	18.29	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
18.29	25.30	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
25.30	27.43	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5721022

External identity : ca.on.waterWell.5721022

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 35.05m

Elevation : NaNm

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 34.1376 to 35.05m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	Gravel Sand Unconsolidated material	GRAVEL SAND MUCK	[24,44]% [26,53]%	[3E-4,3E-2]m.s-1 [2E-7,6E-3]m.s-1
1.52	27.43	Silt Clay Sand	SILT CLAY SAND	[34,61]% [34,57]% [26,53]%	[1E-9,2E-5]m.s-1 [1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
27.43	33.53	Silt	SILT	[34,61]%	[1E-9,2E-5]m.s-1
33.53	35.05	Sand Silt	SAND SILT	[26,53]% [34,61]%	[2E-7,6E-3]m.s-1 [1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5725739

External identity : ca.on.waterWell.5725739

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 10.36m

Elevation : NaNm

Water level : 0.61m

Water yield : 45.46lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 8.5344 to 10.36m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	8.53	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
8.53	10.36	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material	WATER-BEARING		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5734432

External identity : ca.on.waterWell.5734432

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 11.58m

Elevation : NaNm

Water level : 7.32m

Water yield : 150.02lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 0.00 to 2.44m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Soil	TOPSOIL		
0.30	6.10	Clay	CLAY SANDY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
6.10	7.01	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
7.01	11.58	Silt	SILT	[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5730409

External identity : ca.on.waterWell.5730409

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 31.09m

Elevation : NaNm

Water level : 1.83m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 0.00 to 1.83m; From 1.83 to 3.05m.

Screen components : From 30.1752 to 31.09m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.83	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
1.83	29.57	Silt	SILT CLAY SAND	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
29.57	31.09	Sand	COARSE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701773

External identity : ca.on.waterWell.5701773

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 9.75m

Elevation : 220.07m

Water level : 0.00m

Water yield : 9.09lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.05	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.05	6.71	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
6.71	9.75	Sand	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701770

External identity : ca.on.waterWell.5701770

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 44.50m

Elevation : 220.68m

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	5.49	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
5.49	8.23	Limestone	LIMESTONE	[7,56]%	[1E-9,6E-6]m.s-1
8.23	19.81	Clay	CLAY QUICKSAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
19.81	25.91	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
25.91	30.78	Unconsolidated material	MUCK CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Clay			
30.78	44.50	Sand	QUICKSAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701769

External identity : ca.on.waterWell.5701769

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 43.28m

Elevation : 220.98m

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	Soil	TOPSOIL		
1.22	10.97	Anthropogenic material	FILL		
10.97	14.02	Unconsolidated material Gravel	MUCK GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
14.02	23.47	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
23.47	26.21	Diamicton	HARDPAN		
26.21	28.65	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
28.65	32.92	Unconsolidated material Clay	MUCK CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
32.92	34.75	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1
34.75	39.01	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
39.01	43.28	Sand	QUICKSAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7104786

External identity : ca.on.waterWell.7104786

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 22.56m

Elevation : NaNm

Water use : Not Used

Well type : Unknown

Well casings : From 0.00 to 19.51m.

Sealing components : From 19.51 to 22.56m; From 0.00 to 19.51m.

Screen components : From 19.5072 to 22.56m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Soil	TOPSOIL		
0.61	1.52	Clay	CLAY SILTY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
1.52	2.44	Sand	SAND SILTY	[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
2.44	3.96	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.96	10.67	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
10.67	11.58	Sand	FINE SAND SILT	[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1
11.58	22.56	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.7120047

External identity : ca.on.waterWell.7120047

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 7.60m

Elevation : NaNm

Water level : 5.00m

Water use : Test Hole

Well status : Test Hole

Well type : Unknown

Well casings : From 0.00 to 4.60m.

Sealing components : From 0.00 to 0.00m.

Screen components : From 4.6 to 7.60m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.50	Silt	SILT CLAY SAND	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
1.50	7.60	Silt	SILT CLAY SILT	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5718492

External identity : ca.on.waterWell.5718492

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 26.21m

Elevation : 220.98m

Water level : 6.10m

Water yield : 45.46lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 24.384 to 26.21m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Anthropogenic material	FILL		
0.61	4.27	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.27	23.16	Clay	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
23.16	23.77	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
23.77	26.21	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5720118

External identity : ca.on.waterWell.5720118

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 12.80m

Elevation : 228.60m

Water level : 4.27m

Water yield : 18.18lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	3.35	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
3.35	10.36	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
10.36	12.80	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5720227

External identity : ca.on.waterWell.5720227

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 25.60m

Elevation : 228.60m

Water level : 6.71m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 24.6888 to 25.60m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	Clay	CLAY BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	SAND	[24,44]%	[3E-4,3E-2]m.s-1
		Sand		[26,53]%	[2E-7,6E-3]m.s-1
1.52	24.69	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
24.69	25.60	Sand	SAND SILT	[26,53]%	[2E-7,6E-3]m.s-1
		Silt		[34,61]%	[1E-9,2E-5]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5701771

External identity : ca.on.waterWell.5701771

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 63.40m

Elevation : 230.12m

Water level : 0.61m

Water yield : 31.82lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 62.1792 to 63.09m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Anthropogenic material	FILL		
0.30	10.67	Sand	MEDIUM SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	GRAVEL CLAY	[24,44]%	[3E-4,3E-2]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
10.67	56.69	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
56.69	61.57	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
61.57	62.18	Sand	FINE SAND	[26,53]%	[2E-7,6E-3]m.s-1
62.18	63.40	Sand	COARSE SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5708974

External identity : ca.on.waterWell.5708974

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 21.03m

Elevation : 228.60m

Water level : 4.57m

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 20.1168 to 21.03m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Sand	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
		Anthropogenic material			
0.30	0.61	Soil	TOPSOIL		
0.61	2.44	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
2.44	14.94	Sand	SAND BOULDERS	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	CLAY	[24,44]%	[3E-4,3E-2]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
14.94	17.68	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
17.68	21.03	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5720403

External identity : ca.on.waterWell.5720403

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 22.56m

Elevation : 228.60m

Water level : 6.10m

Water yield : 36.37lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 21.6408 to 22.56m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	7.01	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	WOOD	[24,44]%	[3E-4,3E-2]m.s-1
		Organic material	FRAGMENTS		
7.01	20.73	Clay	CLAY STONES	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
20.73	22.56	Sand	SAND CLEAN	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5708973

External identity : ca.on.waterWell.5708973

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 21.03m

Elevation : 228.60m

Water level : 4.57m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 20.1168 to 21.03m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Anthropogenic material	FILL		
0.61	0.91	Soil	TOPSOIL		
0.91	9.14	Sand	SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel	BOULDERS	[24,44]%	[3E-4,3E-2]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
9.14	14.33	Gravel	GRAVEL CLAY	[24,44]%	[3E-4,3E-2]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
14.33	14.94	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
14.94	17.98	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
17.98	21.03	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5708971

External identity : ca.on.waterWell.5708971

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 21.03m

Elevation : 227.08m

Water level : 3.66m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 20.1168 to 21.03m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.30	Sand	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
		Anthropogenic material			
0.30	0.61	Soil	TOPSOIL		
0.61	2.44	Sand	SAND BOULDERS	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
2.44	4.88	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
4.88	18.29	Sand	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
		Clay	BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
18.29	21.03	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5707696

External identity : ca.on.waterWell.5707696

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 19.81m

Elevation : 231.65m

Water level : 0.91m

Water yield : 4.55lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Anthropogenic material Gravel	FILL GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1
0.61	15.24	Clay Gravel Gravel	CLAY GRAVEL BOULDERS	[34,57]%	[1E-11,4.7E-9]m.s-1
				[24,44]%	[3E-4,3E-2]m.s-1
				[24,44]%	[3E-4,3E-2]m.s-1
15.24	19.81	Sand Gravel	MEDIUM SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
				[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5710324

External identity : ca.on.waterWell.5710324

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 35.66m

Elevation : 231.65m

Water level : 4.57m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Screen components : From 35.052 to 35.97m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.52	Sand	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
		Anthropogenic material			
1.52	1.83	Unconsolidated material	MUCK		
1.83	4.88	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
4.88	35.05	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
35.05	35.66	Sand	SAND GRAVEL	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5715730

External identity : ca.on.waterWell.5715730

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 103.33m

Elevation : 220.98m

Water use : Not Used

Well status : Test Hole

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	2.13	Clay	CLAY GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	BOULDERS	[24,44]%	[3E-4,3E-2]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
2.13	17.68	Clay	CLAY GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1
		Gravel	HARD	[24,44]%	[3E-4,3E-2]m.s-1
		Unknown material			
17.68	24.38	Clay	CLAY SOFT	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
24.38	28.35	Silt	SILT CLAY PACKED	[34,61]%	[1E-9,2E-5]m.s-1
		Clay		[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
28.35	38.71	Clay	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
38.71	47.55	Silt	SILT SAND	[34,61]%	[1E-9,2E-5]m.s-1
		Sand	PACKED	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material			
47.55	51.82	Clay	CLAY HARD	[34,57]%	[1E-11,4.7E-9]m.s-1
		Unknown material			
51.82	63.09	Sand	SAND SILT	[26,53]%	[2E-7,6E-3]m.s-1
		Silt	GRAVEL	[34,61]%	[1E-9,2E-5]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
63.09	99.97	Clay	CLAY GRAVEL	[34,57]%	[1E-11,4.7E-9]m.s-1



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5716048

External identity : ca.on.waterWell.5716048

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 34.14m

Elevation : 222.50m

Water level : 1.22m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	1.22	Clay Sand	CLAY SAND	[34,57]% [26,53]%	[1E-11,4.7E-9]m.s-1 [2E-7,6E-3]m.s-1
1.22	17.07	Clay Unknown material	CLAY STONEY	[34,57]%	[1E-11,4.7E-9]m.s-1
17.07	30.18	Clay Gravel Unknown material	CLAY GRAVEL LAYERED	[34,57]% [24,44]%	[1E-11,4.7E-9]m.s-1 [3E-4,3E-2]m.s-1
30.18	32.92	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
32.92	34.14	Gravel	GRAVEL	[24,44]%	[3E-4,3E-2]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5709546

External identity : ca.on.waterWell.5709546

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 15.85m

Elevation : 227.08m

Water level : 0.61m

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	0.61	Sand Anthropogenic material	SAND FILL	[26,53]%	[2E-7,6E-3]m.s-1
0.61	1.22	Soil	TOPSOIL		
1.22	3.35	Sand Clay	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
				[34,57]%	[1E-11,4.7E-9]m.s-1
3.35	6.40	Clay Sand	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
				[26,53]%	[2E-7,6E-3]m.s-1
6.40	15.85	Sand Clay	SAND CLAY	[26,53]%	[2E-7,6E-3]m.s-1
				[34,57]%	[1E-11,4.7E-9]m.s-1

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



Groundwater Information Network

Réseau d'Information sur les Eaux Souterraines

Water Well

Identity : ca.on.waterWell.5731792

External identity : ca.on.waterWell.5731792

Source : Ontario Ministry of Environment

Online resource : <http://www.ene.gov.on.ca/environment/en/subject/wells/index.htm>

Length : 42.67m

Elevation : NaNm

Water yield : 22.73lpm

Water use : Domestic

Well status : Water Supply

Well type : Unknown

Sealing components : From 0.00 to 41.76m.

Screen components : From 41.7576 to 42.67m.

Well Log

Depth from (m)	Depth to (m)	GIN Lithology	Original Lithology	Porosity*	Hydraulic Conductivity*
0.00	31.39	Clay	CLAY SAND	[34,57]%	[1E-11,4.7E-9]m.s-1
		Sand	STONES	[26,53]%	[2E-7,6E-3]m.s-1
		Gravel		[24,44]%	[3E-4,3E-2]m.s-1
31.39	32.61	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material	WATER-BEARING		
32.61	39.62	Clay	CLAY	[34,57]%	[1E-11,4.7E-9]m.s-1
39.62	42.67	Sand	SAND	[26,53]%	[2E-7,6E-3]m.s-1
		Unknown material	WATER-BEARING		

*Note: Porosity and hydraulic conductivity values are NOT measured but are derived from tables showing statistical averages for lithologies



APPENDIX C

ORMGP Mapping

Depth To Water Table (mbgs) - 211 Dock Road

Legend

- CAMC Boundary
- Oak Ridges Moraine Boundary
- Well
- VFlow YC Area - 100m - Strahler (
- Depth to Water Table (m)
- High : 512.956
- Low : 1.1e-005



114.7 0 57.33 114.7 Metres

1: 2,257



© Conservation Authorities Moraine Coalition, 2018
Map Compiled by the Conservation Authorities Moraine Coalition
101 Exchange Avenue, Vaughan, Ontario, M3N 1S4

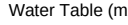
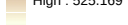
This map is for information purposes only and the Conservation
Authorities Moraine Coalition takes no responsibility for, nor guarantees,
the accuracy of all the information contained within the map.

**AZIMUTH ENVIRONMENTAL
CONSULTING, INC.**
Environmental Assessments & Approvals

SOURCE: CAMC, 2018; MNR, 2018;
PROJECTION: WGS_1984_Web_Mercator_Au
xiliarv Sphere
DATE PRINTED: February 7, 2018

Water Table Elevation (masl) - 211 Dock Road

Legend

-  CAMC Boundary
-  Oak Ridges Moraine Boundary
-  Well
-  VFlow YC Area - 100m - Strahler (
-  Water Table (mASL)
High : 525.169
-  Low : 3.71631





APPENDIX D

Azimuth (2018) Field Program



TEST PIT / BOREHOLE LOGS

TEST PIT LOGS

Date: July 9, 2018

Weather: Sunny, 28°C.

Location: 211 Dock Road, City of Barrie

Attendance: Colin Ross - Azimuth Environmental Consulting, Inc.

Method of Examination: Hand augured test holes examining soil brought up at each location.

LEGEND:

SOIL TEXTURE

Boulders		>200 mm
Cobbles		60 – 200 mm
Gravel	Coarse	20 – 60 mm
	Medium	6 – 20 mm
	Fine	2 – 6 mm
Sand	Coarse	0.6 – 2 mm
	Medium	0.2 – 0.6 mm
	Fine	0.06 – 0.02 mm
Silt		0.02 – 0.006 mm
Clay		<0.002 mm

Fine sand: smallest particle visible to the naked eye
Silt: particles not visible to the eye / slightly plastic
Clay sticks to skin / plastic

SOIL COMPOSITION

“trace”	<10%
“some”	10 – 20%
adjective (e.g. sandy)	20 – 35%
“and”	35 – 50%
noun (e.g. sand)	>50%



MOISTURE CONDITION – COHESIONLESS SOILS

“dry”	absence of moisture, dusty
“moist”	damp but no visible water
“wet”	damp and contains noticeable water
“saturated”	soil is completely wetted to excess and may be dripping

COMPACTNESS CONDITION – COARSE SOILS

	‘N’ Value	
“very loose”	<4	can be excavated by hand
“loose”	4 - 10	can be excavated with a spade
“compact”	10 - 30	requires a sharp spade
“dense”	30 - 50	requires a pick for excavation
“very dense”	>50	difficult to excavate with pick

CONSISTANCY CONDITION – COHESIVE SOILS

	‘N’ value	
“very soft”	< 2	Exudes between fingers when squeezed
“soft”	2-4	Moulded by light finger pressure
“firm”	4-8	Moulded by strong finger pressure
“stiff”	8-15	Can be indented by thumb
“hard”	>30	



Test Hole #4 (BH-4)

Easting: 608227 m (NAD 83 Zone 17)

Northing: 4914038 m

Test Hole Purpose: To determine site soils and install monitoring well for ground water depth measurements.

Test Pit Description

0.00 - 0.35 m Top Soil

Dark brown sand with trace silt and organics, rootlets, moist, loose.

0.35 – 2.8 m Clayey Silt

Brown clayey silt, dry, stiff, becoming hard with depth, poorly sorted.

Becomes gray at ~1.0 m and increasingly hard with depth.

Excavation halted at 2.8 m due to depth limits of hand auger.

Monitoring Well Details

2 inch diameter PVC well construction with 1.5 m screen

Total Depth: 2.8 mbgs

Stickup: 0.84 m

Water Level: 0.79 mbgs

Test Hole #5 (BH-5)

Easting: 608182 m (NAD 83 Zone 17)

Northing: 4914019 m

Test Pit Purpose: To determine site soils and install monitoring well for ground water depth measurements.

Test Pit Description

0.00 - 0.35 m Top Soil

Dark brown sand with trace silt and organics, rootlets, moist, loose.

0.35 – 1.20 m Sand

Brown, medium to fine grained sand, trace silt, some stones at depth, loose, poorly sorted.

Excavation halted at 1.2 m due to borehole cave, could not extend any deeper.



Monitoring Well Details

2 inch diameter PVC well construction with 0.65 m screen

Total Depth: 1.2 mbgs

Stickup: 0.96 m

Water Level: 0.88 mbgs

Test Hole #6 (BH-6)

Easting: 608206 m (NAD 83 Zone 17)

Northing: 4914030 m

Test Pit Purpose: To determine site soils and install monitoring well for ground water depth measurements.

Test Pit Description

0.00 - 0.30 m Top Soil

Dark brown sand with trace silt and organics, rootlets, moist, loose.

0.30 – 1.00 m Sand

Brown, medium to fine grained sand, trace silt, some stones at depth, loose, poorly sorted.

Excavation halted at 1.0 m due to borehole cave, could not extend any deeper.

Monitoring Well Details

2 inch diameter PVC well construction with 0.8 m screen

Total Depth: 1.0 mbgs

Stickup: 0.84 m

Water Level: 0.42 mbgs



APPENDIX E

Ground Water Data

16-202 211 Dock Road Water Level Database

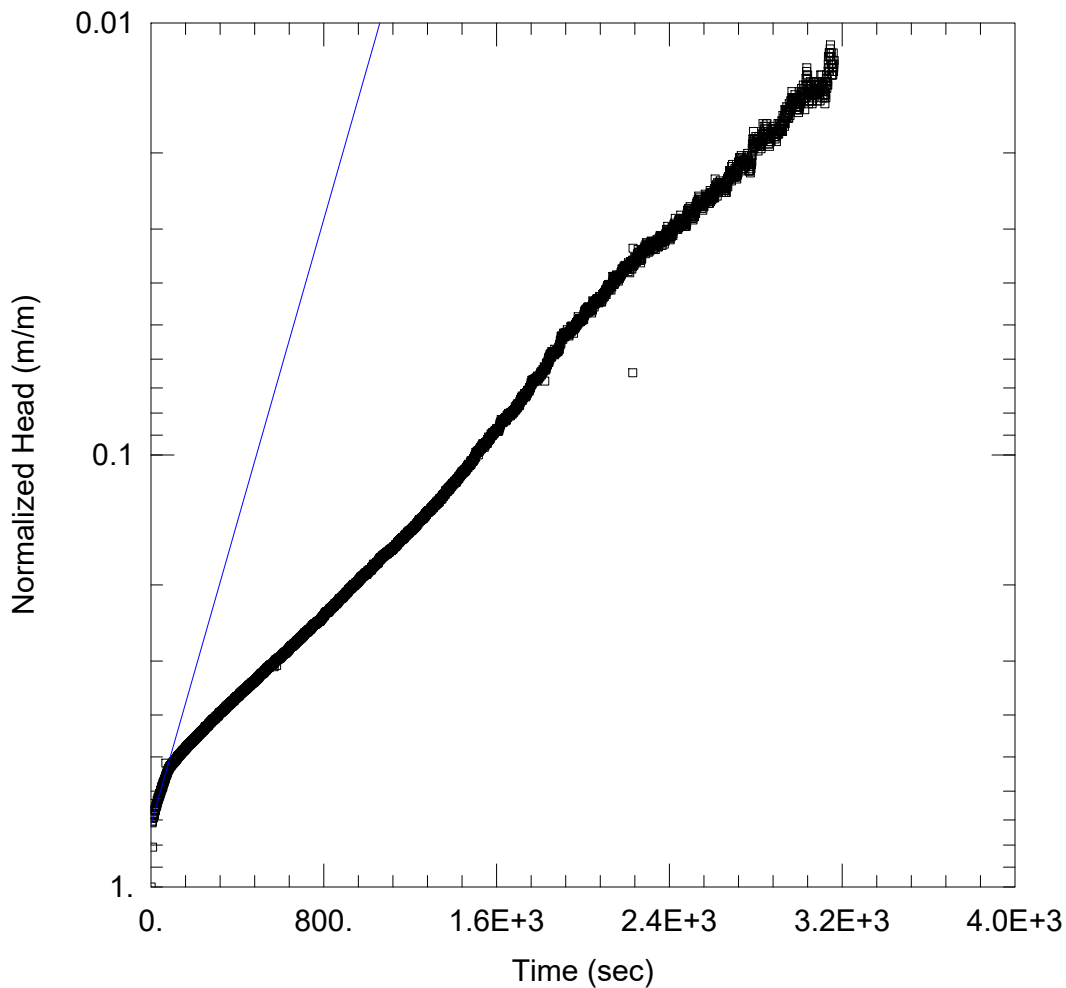
Well ID	Depth (mbgs)	Stick Up (m)	Ground Elevation¹	Ground Water Level																			
				2017-10-11		2017-11-28		2018-04-23		2018-05-16		2018-06-12		2018-07-03		2018-07-10		2018-08-20		2024-03-08		2024-04-19	
				mbgs	masl	mbgs	masl	mbgs	mbgs	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl	mbgs	masl
BH 1	5.0	0.77	223.77	2.80	221.00	2.40	221.40	0.28	223.50	1.23	222.54	1.56	222.20	2.15	221.62	2.17	221.6	2.62	221.15	1.43	222.34	0.25	223.5
BH 2	5.9	0.85	223.62	0.70	222.90	0.11	223.50	-0.09	223.70	0.05	223.60	0.11	223.50	0.31	223.31	0.35	223.27	0.08	223.54	-0.02	223.64	-0.07	223.7
BH 3	6.0		225.07	0.10	225.00	0.72	224.40	0.46	224.60	0.65	224.40	0.77	224.30	0.89	224.18	0.90	224.17	1.51	223.56	NA	NA	NA	NA
BH 4	2.8	1.02	224													0.79	223.21	0.45	223.55	0.46	223.54	-0.01	224.0
BH 5	1.2	1.08	224.75													0.88	223.87	0.31	224.44	0.31	224.44	0.16	224.6
BH 6	1.0	0.97	224.5													0.42	224.08	0.10	224.40	0.09	224.41	0.11	224.4

from grading plan



APPENDIX F

Hydraulic Conductivity Results



WELL TEST ANALYSIS

Data Set: M:\16 Projects\16-202 Tynehead Road EIS\03.0 - Data\03.2 - Field\slug tests\BH1.aqt
 Date: 09/25/18 Time: 11:56:14

PROJECT INFORMATION

Company: Azimuth Environmental
 Project: 16-202
 Location: 211 Dock Road
 Test Well: BH1
 Test Date: November 27 2017

AQUIFER DATA

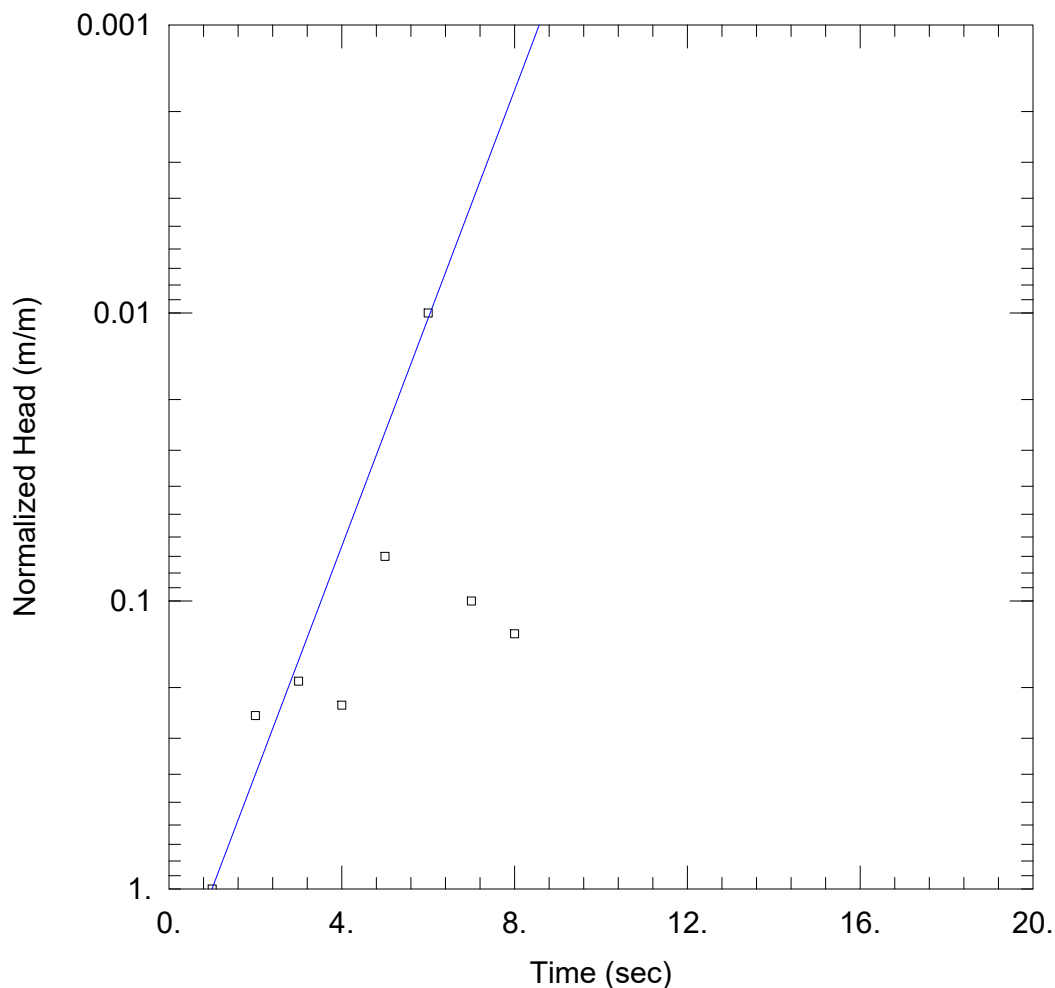
Saturated Thickness: 2.6 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH1)

Initial Displacement: -0.4092 m Static Water Column Height: 2.6 m
 Total Well Penetration Depth: 5. m Screen Length: 1.5 m
 Casing Radius: 0.025 m Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 4.02E-6$ m/sec $y_0 = -0.293$ m



WELL TEST ANALYSIS

Data Set: M:\16 Projects\16-202 Tynehead Road EIS\03.0 - Data\03.2 - Field\slug tests\BH2.aqt
 Date: 09/25/18 Time: 11:56:57

PROJECT INFORMATION

Company: Azimuth Environmental
 Project: 16-202
 Location: 211 Dock Road
 Test Well: BH2
 Test Date: November 27 2017

AQUIFER DATA

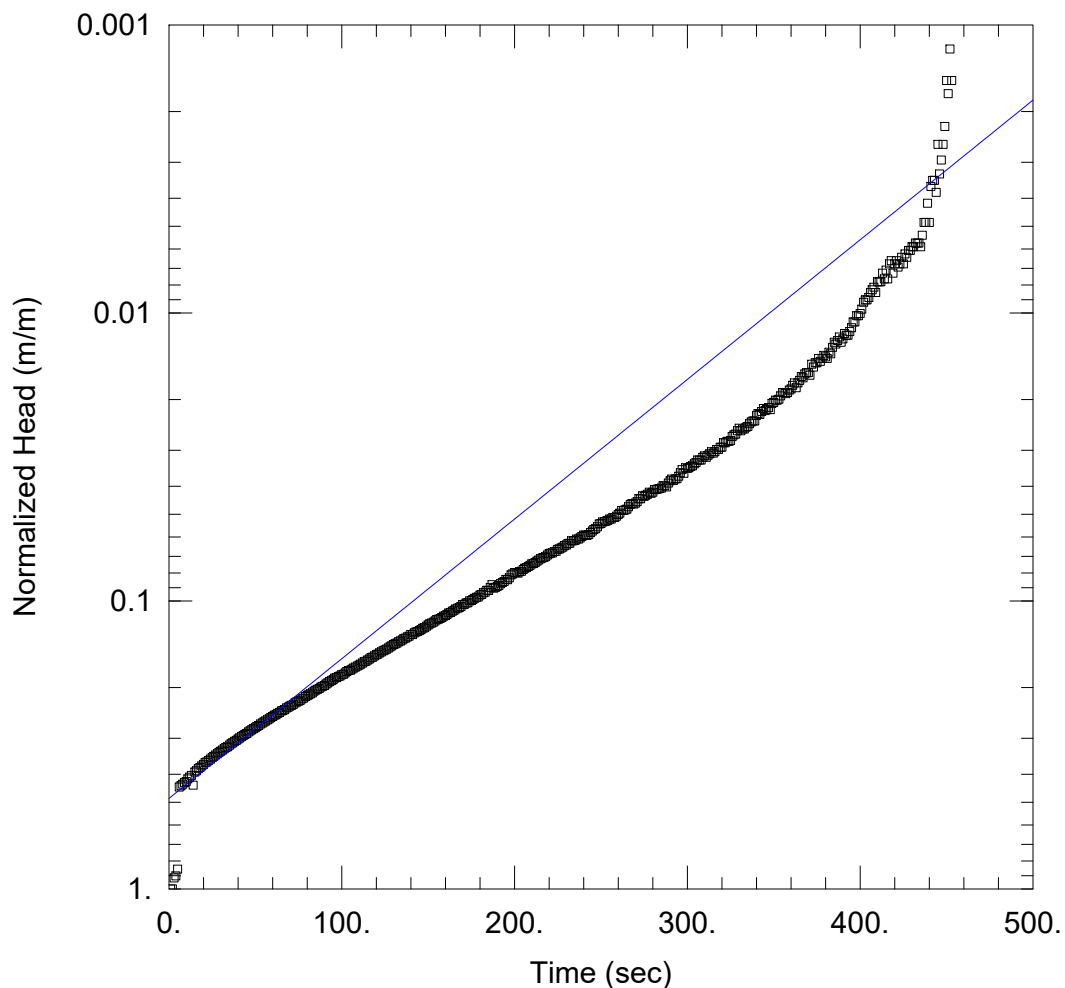
Saturated Thickness: 5.18 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH2)

Initial Displacement: -1. m Static Water Column Height: 5.18 m
 Total Well Penetration Depth: 5.18 m Screen Length: 1.5 m
 Casing Radius: 0.025 m Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
 $K = 0.0009093$ m/sec $y_0 = -2.477$ m



WELL TEST ANALYSIS

Data Set: M:\16 Projects\16-202 Tynehead Road EIS\03.0 - Data\03.2 - Field\slug tests\BH3.aqt
 Date: 09/25/18 Time: 11:57:33

PROJECT INFORMATION

Company: Azimuth Environmental
 Project: 16-202
 Location: 211 Dock Road
 Test Well: BH3
 Test Date: November 27 2017

AQUIFER DATA

Saturated Thickness: 5.8 m Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (BH3)

Initial Displacement: -0.5771 m Static Water Column Height: 5.8 m
 Total Well Penetration Depth: 5.9 m Screen Length: 1.5 m
 Casing Radius: 0.025 m Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev
 $K = 1.114E-5$ m/sec $y_0 = -0.2798$ m



APPENDIX G

Water Quality Results

C.O.C.: G114928

REPORT No: 24-010875 - Rev. 1

Report To:

Azimuth Environmental
642 Welham Rd
Barrie, ON L4N9A1

CADUCEON Environmental Laboratories

112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Jenn Millington

DATE RECEIVED: 2024-Apr-19
DATE REPORTED: 2024-May-03
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 16-202
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	1	OTTAWA	PCURIEL	2024-Apr-24	A-IC-01	SM 4110B
BOD5 (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-24	BOD-001	SM 5210B
COD (Liquid)	1	KINGSTON	EHINCH	2024-Apr-24	COD-001	SM 5220D
Cond/pH/Alk Auto (Liquid)	1	OTTAWA	SBOUDREAU	2024-Apr-24	COND-02/PH-02/A LK-02	SM 2510B/4500H/ 2320B
Cyanide Total (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-23	CN-001	SM 4500-CN-E
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Apr-25	D-ICPMS-01	EPA 6020
ICP/MS (Liquid)	1	OTTAWA	TPRICE	2024-Apr-25	D-ICPMS-01	EPA 200.8
ICP/OES Total (Liquid)	1	OTTAWA	APRUDYVUS	2024-Apr-25	D-ICP-01	SM 3120B
ICP/OES (Liquid)	1	OTTAWA	NHOGAN	2024-Apr-24	D-ICP-01	SM 3120B
Mercury (Liquid)	2	OTTAWA	TBENNETT	2024-Apr-24	D-HG-02	SM 3112B
ICPMS Precious Metals (Total)	1	OTTAWA	TPRICE	2024-Apr-30	D-ICPMS-01	EPA 6020
ICPMS Precious Metals (Liquid)	1	OTTAWA	TPRICE	2024-Apr-30	D-ICPMS-01	EPA 200.8
Ammonia (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-23	NH3-001	SM 4500NH3
OC Pesticides (Liquid)	1	KINGSTON	CSUMMERHAYS	2024-Apr-23	PESTCL-001	EPA 8081
Oil & Grease (Liquid)	1	KINGSTON	MLANE	2024-Apr-23	O&G-001	SM 5520
PHC F1 (Liquid)	1	RICHMOND_HILL	JEVANS	2024-Apr-24	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	1	KINGSTON	STHOMPSON	2024-Apr-25	PHC-W-001	MECP E3421
Phenols (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-25	PHEN-01	MECP E3179
Sulphide (Liquid)	1	KINGSTON	EHINCH	2024-Apr-23	H2S-001	SM 4500-S2
SVOC - Semi-Volatiles (Liquid)	1	KINGSTON	EASIEDU	2024-Apr-25	NAB-W-001	EPA 8270D
TP & TKN (Liquid)	1	KINGSTON	KDIBBITS	2024-Apr-25	TPTKN-001	MECP E3516.2
TSS (Liquid)	2	KINGSTON	DCASSIDY	2024-Apr-23	TSS-001	SM 2540D
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	FLENA	2024-Apr-24	C-VOC-02	EPA 8260


Christine Burke

Laboratory Manager

CADUCEON Environmental Laboratories Certificate of Analysis

Final Report

REPORT No: 24-010875 - Rev. 1

µg/g = micrograms per gram (parts per million) and is equal to mg/Kg

F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)

F2 C10-C16 hydrocarbons in µg/g, (F2-naph if requested)

F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)

F4 C34-C50 hydrocarbons in µg/g

This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.

Any deviations from the method are noted and reported for any particular sample.

nC6 and nC10 response factor is within 30% of response factor for toluene:

nC10, nC16 and nC34 response factors within 10% of each other:

C50 response factors within 70% of nC10+nC16+nC34 average:

Linearity is within 15%:

All results expressed on a dry weight basis.

Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

R.L. = Reporting Limit

NC = Not Calculated

Test methods may be modified from specified reference method unless indicated by an *

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.

If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in application to the CWS PHC

QC will be made available upon request.


Christine Burke

Laboratory Manager

The analytical results reported herein refer to the samples as received and relate only to the items tested. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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Final Report
REPORT No: 24-010875 - Rev. 1

					Client I.D.	
					MW-102	MW-102F
					Sample I.D.	24-010875-1
					Date Collected	2024-Apr-19
Parameter	Units	R.L.	Limits		-	-
pH @25°C	pH units	-	8.5	PWQO	8.19	
Fluoride	mg/L	0.1			<0.1	
Chloride	mg/L	0.5			12.1	
Sulphate	mg/L	1			11	
BOD5	mg/L	3			5	
Total Suspended Solids	mg/L	3			34900	3
Phosphorus (Total)	µg/L	10	10	INTERIM	388000	
Total Kjeldahl Nitrogen	mg/L	0.1			180	
Ammonia (N)-Total (NH3+NH4)	mg/L	0.05			0.23	
Sulphide	mg/L	0.01			<8.00	
Cyanide (Total)	mg/L	0.005			<0.005	
Phenolics	µg/L	1	1	PWQO	<1	
COD	mg/L	5			100	
Aluminum	µg/L	10	75	INTERIM		20
Barium	µg/L	1				63
Bismuth	µg/L	20				<20
Boron	µg/L	5	200	INTERIM		34
Iron	µg/L	5	300	PWQO		137
Manganese	µg/L	1				16
Tin	µg/L	50				<50
Tungsten	µg/L	10				<10


Christine Burke
Laboratory Manager

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Final Report
REPORT No: 24-010875 - Rev. 1

					Client I.D.	MW-102	MW-102F
					Sample I.D.	24-010875-1	24-010875-2
					Date Collected	2024-Apr-19	2024-Apr-19
Parameter	Units	R.L.	Limits			-	-
Zinc	µg/L	5	30	PWQO			<5
Zirconium	µg/L	3					<3
Hardness (as CaCO ₃)	mg/L as CaCO ₃	-				4000	
Aluminum (Total)	µg/L	10				57100	
Barium (Total)	µg/L	1				1220	
Bismuth (Total)	µg/L	20				<20	
Boron (Total)	µg/L	5	200	INTERIM		102	
Calcium (Total)	µg/L	20				1520000	
Iron (Total)	µg/L	5	300	PWQO		101000	
Magnesium (Total)	µg/L	20				116000	
Manganese (Total)	µg/L	1				3710	
Tin (Total)	µg/L	50				<50	
Tungsten (Total)	µg/L	10	30	INTERIM		50	
Zinc (Total)	µg/L	5	20, 30	INTERIM, PWQO		282	
Zirconium (Total)	µg/L	3	4	INTERIM		27	
Antimony	µg/L	0.1	20, 5	INTERIM, PWQO			<0.1
Arsenic	µg/L	0.1	5, 0.0	INTERIM, PWQO			0.8
Beryllium	µg/L	0.1	0.0, 11	INTERIM, PWQO			<0.1
Cadmium	µg/L	0.015	0.1, 0.2	INTERIM, PWQO			<0.030
Chromium	µg/L	1.0					<1.0
Cobalt	µg/L	0.1					0.1


Christine Burke
Laboratory Manager

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Final Report
REPORT No: 24-010875 - Rev. 1

Parameter	Units	R.L.	Limits	Client I.D.	MW-102	MW-102F
				Sample I.D.	24-010875-1	24-010875-2
				Date Collected	2024-Apr-19	2024-Apr-19
					-	-
Copper	µg/L	0.1	5	INTERIM		0.6
Lead	µg/L	0.02	1, 5	INTERIM, PWQO		<0.09
Molybdenum	µg/L	0.1	40	INTERIM		0.6
Nickel	µg/L	0.2	25	PWQO		0.4
Selenium	µg/L	1.00	100	PWQO		<1.00
Silver	µg/L	0.1	0.1	PWQO		<0.1
Thallium	µg/L	0.05	0.3, 0.3	INTERIM, PWQO		<0.05
Uranium	µg/L	0.05	5	INTERIM		0.10
Vanadium	µg/L	0.1	6	INTERIM		<0.4
Gold	mg/L	0.0007				<0.0007
Platinum	mg/L	0.00004				<0.00004
Rhodium	mg/L	0.00002				<0.00002
Antimony (Total)	µg/L	0.5	20	INTERIM	<0.5	
Arsenic (Total)	µg/L	0.5	5, 5	INTERIM, PWQO	9.6	
Beryllium (Total)	µg/L	0.5	11	PWQO	2.2	
Cadmium (Total)	µg/L	0.080	0.1, 0.2	INTERIM, PWQO	0.560	
Chromium (Total)	µg/L	5			86	
Cobalt (Total)	µg/L	0.5	0.9	INTERIM	46.8	
Copper (Total)	µg/L	0.5	5	INTERIM	218	
Lead (Total)	µg/L	0.10	1, 5	INTERIM, PWQO	61.6	
Molybdenum (Total)	µg/L	0.5	40	INTERIM	0.8	


Christine Burke
Laboratory Manager

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Final Report

REPORT No: 24-010875 - Rev. 1

					Client I.D.	
					MW-102	MW-102F
					Sample I.D.	
					24-010875-1	24-010875-2
					Date Collected	
					2024-Apr-19	2024-Apr-19
Parameter	Units	R.L.	Limits		-	-
Nickel (Total)	µg/L	1.0	25	PWQO	89.0	
Selenium (Total)	µg/L	5	100	PWQO	<5	
Silver (Total)	µg/L	0.5	0.1	PWQO	<0.5	
Thallium (Total)	µg/L	0.30	0.3, 0.3	INTERIM, PWQO	1.00	
Uranium (Total)	µg/L	0.30	5	INTERIM	3.90	
Vanadium (Total)	µg/L	0.5	6	INTERIM	118	
Gold (Total)	mg/L	0.0007			<0.0007	
Platinum (Total)	mg/L	0.00004			<0.00004	
Rhodium (Total)	mg/L	0.00002			<0.00002	
Mercury	µg/L	0.02	0.2	PWQO	<0.02	<0.02


Christine Burke

Laboratory Manager

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Final Report
REPORT No: 24-010875 - Rev. 1

					Client I.D.
					MW-102
					Sample I.D.
					24-010875-1
					Date Collected
					2024-Apr-19
Parameter	Units	R.L.	Limits		-
Benzene	µg/L	0.5	100	INTERIM	<0.5
Bromodichloromethane	µg/L	2	200	INTERIM	<2
Bromoform	µg/L	5	60	INTERIM	<5
Bromomethane	µg/L	0.5	0.9	INTERIM	<0.5
Chlorobenzene	µg/L	0.5	15	PWQO	<0.5
Chloromethane (Methyl Chloride)	µg/L	2	700	INTERIM	<2
Dichlorobenzene,1,2-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	4	PWQO	<0.5
Dichloroethane,1,1-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethane,1,2-	µg/L	0.5	100	INTERIM	<0.5
Dichloroethylene,1,1-	µg/L	0.5	40	INTERIM	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethylene,1,2-cis+trans-	µg/L	0.7			<0.7
Dichloroethylene,1,2-trans-	µg/L	0.5	200	INTERIM	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.7	INTERIM	<0.5
Ethylbenzene	µg/L	0.5	8	INTERIM	<0.5
Dichloromethane (Methylene Chloride)	µg/L	5	100	INTERIM	<5
Methyl tert-Butyl Ether (MTBE)	µg/L	2	200	INTERIM	<2
Styrene	µg/L	0.5	4	INTERIM	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5	20	INTERIM	<0.5


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Final Report
REPORT No: 24-010875 - Rev. 1

					Client I.D.
					MW-102
					Sample I.D.
					24-010875-1
					Date Collected
					2024-Apr-19
Parameter	Units	R.L.	Limits		
Tetrachloroethane,1,1,2,2-	µg/L	0.5	70	INTERIM	<0.5
Tetrachloroethylene	µg/L	0.5	50	INTERIM	<0.5
Toluene	µg/L	0.5	0.8, 0.8	INTERIM, PWQO	<0.5
Trichlorobenzene,1,2,4-	µg/L	0.5	0.5	PWQO	<0.5
Trichloroethane,1,1,1,-	µg/L	0.5	10	INTERIM	<0.5
Trichloroethane,1,1,2,-	µg/L	0.5	800	INTERIM	<0.5
Trichloroethylene	µg/L	0.5	20	INTERIM	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5			<5
Trimethylbenzene,1,3,5-	µg/L	0.1	3	INTERIM	<0.1
Vinyl Chloride	µg/L	0.2	600	INTERIM	<0.2
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	µg/L	1.1			<1.1
Xylene, o-	µg/L	0.5	40	INTERIM	<0.5
PHC F1 (C6-C10)	µg/L	25			<25
PHC F2 (>C10-C16)	µg/L	50			<50
PHC F3 (>C16-C34)	µg/L	400			<400
PHC F4 (>C34-C50)	µg/L	400			<400
Oil and Grease (Mineral)	mg/L	1.0			<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0			1.8


Christine Burke
Laboratory Manager

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Final Report
REPORT No: 24-010875 - Rev. 1

					Client I.D.
					MW-102
					Sample I.D.
					24-010875-1
					Date Collected
					2024-Apr-19
Parameter	Units	R.L.	Limits		
Acenaphthene	µg/L	0.05			<0.05
Acenaphthylene	µg/L	0.05			<0.05
Anthracene	µg/L	0.05	0.0008	PWQO	<0.05
Benzo[a]anthracene	µg/L	0.05	0.0004	INTERIM	<0.05
Benzo(a)pyrene	µg/L	0.01			<0.01
Benzo(b)fluoranthene	µg/L	0.05			<0.05
Benzo(b+k)fluoranthene	µg/L	0.1			<0.1
Benzo(g,h,i)perylene	µg/L	0.05	0.00002	INTERIM	<0.05
Benzo(k)fluoranthene	µg/L	0.05			<0.05
Chrysene	µg/L	0.05	0.0001	INTERIM	<0.05
Dibenzo(a,h)anthracene	µg/L	0.05	0.002	INTERIM	<0.05
Fluoranthene	µg/L	0.05	0.0008	INTERIM	<0.05
Fluorene	µg/L	0.05	0.2	INTERIM	<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05			<0.05
Methylnaphthalene,1-	µg/L	0.05	2	INTERIM	<0.05
Methylnaphthalene,2-(1-)	µg/L	1			<1
Methylnaphthalene,2-	µg/L	0.05	2	INTERIM	<0.05
Naphthalene	µg/L	0.05	7	INTERIM	<0.05
Phenanthrene	µg/L	0.05	0.03	INTERIM	<0.05
Pyrene	µg/L	0.05			<0.05
Total PAH	µg/L	0.1			<0.1


Christine Burke
Laboratory Manager

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Final Report

REPORT No: 24-010875 - Rev. 1

					Client I.D.	MW-102
					Sample I.D.	24-010875-1
					Date Collected	2024-Apr-19
Parameter	Units	R.L.	Limits			-
Hexachlorobenzene	µg/L	0.01				<0.01

Revised report to include dissolved metals to match the total list

: PWQO Limits
 INTERIM: Interim PWQO
 PWQO: PWQO



Christine Burke
 Laboratory Manager

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Summary of Exceedances		
Interim PWQO		
MW-102	Found Value	Limit
Phosphorus (Total)	388000	10
Tungsten (Total)	50	30
Zinc (Total)	282	20
Zirconium (Total)	27	4
Arsenic (Total)	9.6	5
Cadmium (Total)	0.560	0.1
Cobalt (Total)	46.8	0.9
Copper (Total)	218	5
Lead (Total)	61.6	1
Thallium (Total)	1.00	0.3
Vanadium (Total)	118	6
Benzo[a]anthracene	<0.05	0.0004
Benzo(g,h,i)perylene	<0.05	0.00002
Chrysene	<0.05	0.0001
Dibenzo(a,h)anthracene	<0.05	0.002
Fluoranthene	<0.05	0.0008
Phenanthrene	<0.05	0.03
PWQO		
MW-102	Found Value	Limit
Iron (Total)	101000	300
Zinc (Total)	282	30
Arsenic (Total)	9.6	5
Cadmium (Total)	0.560	0.2
Lead (Total)	61.6	5
Nickel (Total)	89.0	25
Silver (Total)	<0.5	0.1
Thallium (Total)	1.00	0.3
Anthracene	<0.05	0.0008

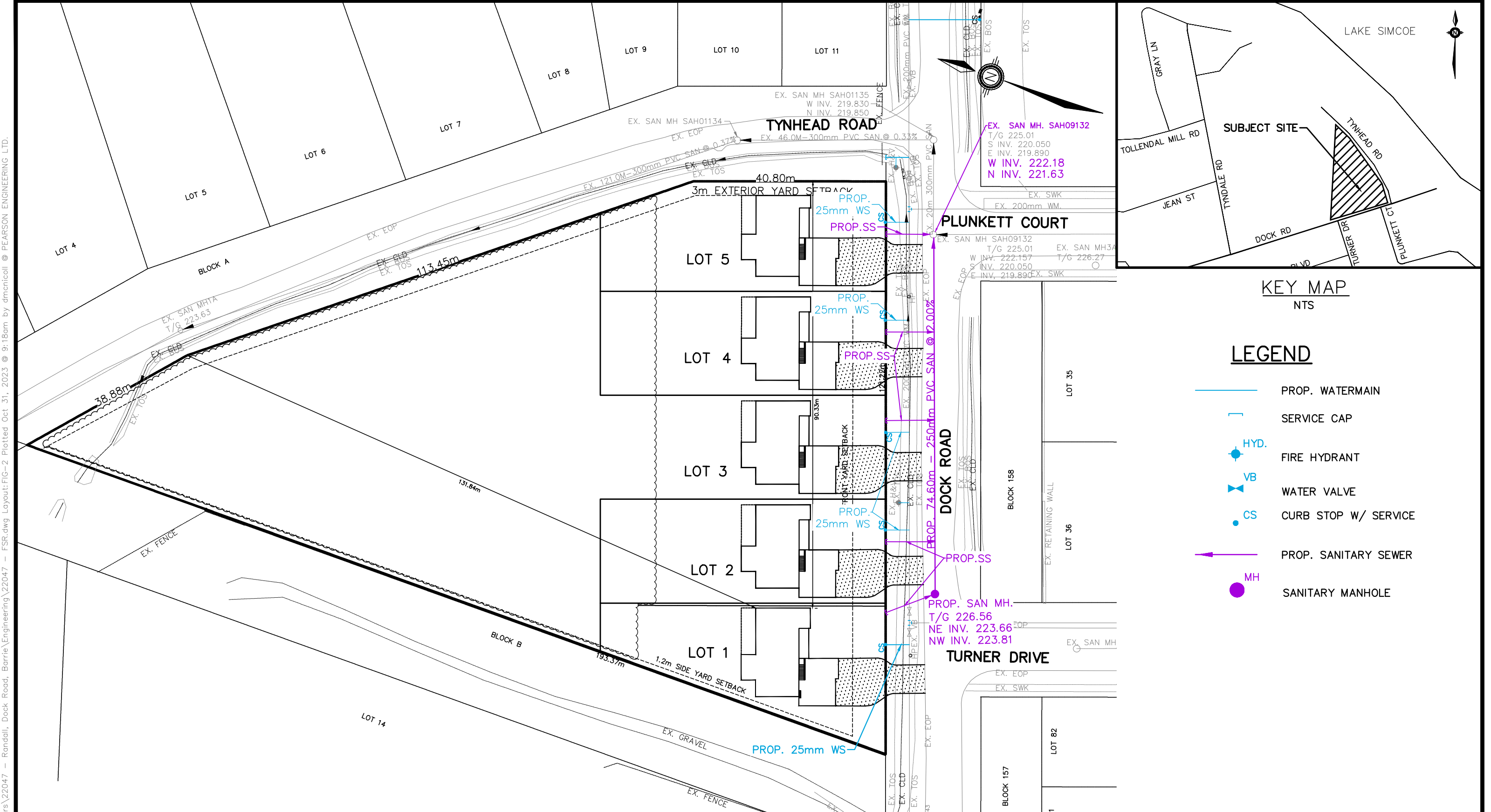

 Christine Burke
 Laboratory Manager



APPENDIX H

Drawings

P:\Autodesk Vault\Working Folders\22047 - Randall, Dock Road, Barrie\Engineering\22047 - FSR.dwg Layout:FIG-2 Plotted Oct 31, 2023 @ 9:18am by dmonicoli @ PEARSON ENGINEERING LTD.





**PEARSON
ENGINEERING**
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC	HORIZ SCALE	1: 750	PROJECT #	22047
DRAWN BY	WT	VERT SCALE	N/A	DRAWING #	FIG-2
CHECKED BY	MWD	DATE	OCTOBER 2023	REVISION #	0

1000067324 ONTARIO INC. 211 DOCK ROAD CITY OF BARRIE			
WATER AND SANITARY SERVICING PLAN			
NO.	REVISION NOTE	DATE	BY

KEY MAP
NTS

LEGEND

- PROP. WATERMAIN
- SERVICE CAP
- HYD. FIRE HYDRANT
- VB WATER VALVE
- CS CURB STOP W/ SERVICE
- PROP. SANITARY SEWER
- MH SANITARY MANHOLE



APPENDIX I

Water Balance

Table A: Pre-Development

Catchment Designation	Forest	Wetland	Total
Area (m ²)	8,839	3,727	12,566
Pervious Area (m ²)	8,839	0	8,839
Impervious Area (m ²)	0	3,727	3,727
Infiltration Factors			
Topography Infiltration Factor	0.3	0	
Soil Infiltration Factor	0.4	0	
Land Cover Infiltration Factor	0.2	0	
Infiltration Factor	0.9	0	
Run-Off Coefficient	0.1	1	
Run-Off From Impervious Surfaces	0.8	0.8	
Inputs (Per Unit Area)			
Precipitation (mm/yr)	907	907	907
Rainfall (mm/yr)	654	654	654
Run-On (mm/yr)	0	0	0
Other Inputs (mm/yr)	0	0	0
Total Inputs (mm/yr)	907	907	907
Outputs (Per Unit Area)			
Precipitation Surplus (mm/yr)	428	726	516
Net Surplus (mm/yr)	428	726	516
Evapotranspiration (mm/yr)	479	181	391
Infiltration (mm/yr)	385	0	271
Surplus Infiltration (mm/yr)	0	0	0
Total Infiltration (mm/yr)	385	0	271
Run-Off Pervious Areas (mm/yr)	43	0	30
Run-Off Impervious Areas (mm/yr)	0	726	215
Total Run-Off (mm/yr)	43	726	245
Total Outputs (mm/yr)	907	907	907
Difference (Inputs - Outputs)	0	0	0
Inputs (Volumes)			
Precipitation (m ³ /yr)	8,017	3,380	11,397
Run-On (m ³ /yr)	0	0	0
Other Inputs (m ³ /yr)	0	0	0
Total Inputs (m³/yr)	8,017	3,380	11,397
Outputs (Volumes)			
Precipitation Surplus (m ³ /yr)	3,783	2,704	6,487
Net Surplus (m ³ /yr)	3,783	2,704	6,487
Evapotranspiration (m ³ /yr)	4,234	676	4,910
Infiltration (m ³ /yr)	3,405	0	3,405
Surplus Infiltration (m ³ /yr)	0	0	0
Total Infiltration (m³/yr)	3,405	0	3,405
Run-Off Pervious Areas (m ³ /yr)	378	0	378
Run-Off Impervious Areas (m ³ /yr)	0	2,704	2,704
Total Run-Off (m ³ /yr)	378	2,704	3,082
Total Outputs (m³/yr)	8,017	3,380	11,397
Difference (Inputs - Outputs)	0	0	0

Table B: Post-Development (no mit)

Catchment Designation	Forest	Landscaped Grass	Driveway	Wetland	Structure	Total
Area (m ²)	4,174	3,268	749	2,865	1,510	12,566
Pervious Area (m ²)	4,174	3,268	0	0	0	7,442
Impervious Area (m ²)	0	0	749	2,865	1,510	5,124
Infiltration Factors						
Topography Infiltration Factor	0.3	0.3	0	0	0	
Soil Infiltration Factor	0.4	0.4	0	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	0	
Infiltration Factor	0.9	0.8	0	0	0	
Run-Off Coefficient	0.1	0.2	1	1	1	
Run-Off From Impervious Surfaces	0.8	0.8	0.8	0.8	0.8	
Inputs (Per Unit Area)						
Precipitation (mm/yr)	907	907	907	907	907	907
Rainfall (mm/yr)	654	654	654	654	654	654
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0
Total Inputs (mm/yr)	907	907	907	907	907	907
Outputs (Per Unit Area)						
Precipitation Surplus (mm/yr)	428	428	726	726	726	549
Net Surplus (mm/yr)	428	428	726	726	726	549
Evapotranspiration (mm/yr)	479	479	181	181	181	358
Infiltration (mm/yr)	385	342	0	0	0	217
Surplus Infiltration (mm/yr)	0	0	0	0	0	0
Total Infiltration (mm/yr)	385	342	0	0	0	217
Run-Off Pervious Areas (mm/yr)	43	86	0	0	0	36
Run-Off Impervious Areas (mm/yr)	0	0	726	726	726	296
Total Run-Off (mm/yr)	43	86	726	726	726	332
Total Outputs (mm/yr)	907	907	907	907	907	907
Difference (Inputs - Outputs)	0	0	0	0	0	0
Inputs (Volumes)						
Precipitation (m ³ /yr)	3,786	2,964	679	2,598	1,370	11,397
Run-On (m ³ /yr)	0	0	0	0	0	0
Other Inputs (m ³ /yr)	0	0	0	0	0	0
Total Inputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Outputs (Volumes)						
Precipitation Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Net Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Evapotranspiration (m ³ /yr)	1,999	1,565	136	520	274	4,494
Infiltration (m ³ /yr)	1,608	1,119	0	0	0	2,727
Surplus Infiltration (m ³ /yr)	0	0	0	0	0	0
Total Infiltration (m³/yr)	1,608	1,119	0	0	0	2,727
Run-Off Pervious Areas (m ³ /yr)	179	280	0	0	0	458
Run-Off Impervious Areas (m ³ /yr)	0	0	543	2,079	1,096	3,718
Total Run-Off (m ³ /yr)	179	280	543	2,079	1,096	4,176
Total Outputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Difference (Inputs - Outputs)	0	0	0	0	0	0

Table C: Post-Development (with mitigation)

Catchment Designation	Forest	Landscaped Grass	Driveway	Wetland	Structure	Total
Area (m ²)	4,174	3,268	749	2,865	1,510	12,566
Pervious Area (m ²)	4,174	3,268	0	0	0	7,442
Impervious Area (m ²)	0	0	749	2,865	1,510	5,124
Infiltration Factors						
Topography Infiltration Factor	0.3	0.3	0	0	0	
Soil Infiltration Factor	0.4	0.4	0	0	0	
Land Cover Infiltration Factor	0.2	0.1	0	0	0	
Infiltration Factor	0.9	0.8	0	0	0	
Run-Off Coefficient	0.1	0.2	1	1	1	
Run-Off From Impervious Surfaces	0.8	0.8	0.8	0.8	0.8	
Inputs (Per Unit Area)						
Precipitation (mm/yr)	907	907	907	907	907	907
Rainfall (mm/yr)	654	654	654	654	654	654
Run-On (mm/yr)	0	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0	0
Total Inputs (mm/yr)	907	907	907	907	907	907
Outputs (Per Unit Area)						
Precipitation Surplus (mm/yr)	428	428	726	726	726	549
Net Surplus (mm/yr)	428	428	726	726	726	549
Evapotranspiration (mm/yr)	479	479	181	181	181	358
Infiltration (mm/yr)	385	342	0	0	0	217
Surplus Infiltration (mm/yr)	0	0	0	0	306	37
Total Infiltration (mm/yr)	385	342	0	0	306	254
Run-Off Pervious Areas (mm/yr)	43	86	0	0	0	36
Run-Off Impervious Areas (mm/yr)	0	0	726	726	419	259
Total Run-Off (mm/yr)	43	86	726	726	419	296
Total Outputs (mm/yr)	907	907	907	907	907	907
Difference (Inputs - Outputs)	0	0	0	0	0	0
Inputs (Volumes)						
Precipitation (m ³ /yr)	3,786	2,964	679	2,598	1,370	11,397
Run-On (m ³ /yr)	0	0	0	0	0	0
Other Inputs (m ³ /yr)	0	0	0	0	0	0
Total Inputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Outputs (Volumes)						
Precipitation Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Net Surplus (m ³ /yr)	1,786	1,399	543	2,079	1,096	6,903
Evapotranspiration (m ³ /yr)	1,999	1,565	136	520	274	4,494
Infiltration (m ³ /yr)	1,608	1,119	0	0	0	2,727
Surplus Infiltration (m ³ /yr)	0	0	0	0	462	462
Total Infiltration (m³/yr)	1,608	1,119	0	0	462	3,189
Run-Off Pervious Areas (m ³ /yr)	179	280	0	0	0	458
Run-Off Impervious Areas (m ³ /yr)	0	0	543	2,079	633	3,256
Total Run-Off (m ³ /yr)	179	280	543	2,079	633	3,714
Total Outputs (m³/yr)	3,786	2,964	679	2,598	1,370	11,397
Difference (Inputs - Outputs)	0	0	0	0	0	0

Table D: Water Balance Summary Table

Parameter	Site						
	Pre-Development	Post-Development	Change (Pre to Post)		Post-Development with Mitigation	Change (Pre to Post with Mitigation)	
Inputs (Volume)							
Precipitation (m³/yr)	11,397	11,397	0	0%	11,397	0	0%
Run-On (m³/yr)	0	0	0	NA	0	0	NA
Other Inputs (m³/yr)	0	0	0	NA	0	0	NA
Total Inputs (m³/yr)	11,397	11,397	0	0%	11,397	0	0%
Outputs (Volume)							
Precipitation Surplus (m³/yr)	6,487	6,903	416	6%	6,903	416	6%
Net Surplus (m³/yr)	6,487	6,903	416	6%	6,903	416	6%
Evapotranspiration (m³/yr)	4,910	4,494	-416	-8%	4,494	-416	-8%
Infiltration (m³/yr)	3,405	2,727	-678	-20%	2,727	-678	-20%
Rooftop Infiltration (m³/yr)	0	0	0	NA	462	462	NA
Total Infiltration (m³/yr)	3,405	2,727	-678	-20%	3,189	-216	-6%
Run-Off Pervious Areas (m³/yr)	378	458	80	21%	458	80	21%
Run-Off Impervious Areas (m³/yr)	2,704	3,718	1,014	37%	3,256	552	20%
Total Run-Off (m³/yr)	3,082	4,176	1,094	35%	3,714	632	20%
Total Outputs (m³/yr)	11,397	11,397	0	0%	11,397	0	0%



APPENDIX J

Dewatering Assessment

16-202 Dock Road - Low K Scenario

Type	ID	Length (m)	Width (m)	Effectivve Radius ¹ (m)	Hydraulic Conductivity (m/s)	Hydraulic Conductivity (m/day)	Initial Depth of Water (static head) prior to dewatering (m)	H ²	Depth of Water in the well while pumping (m)	h ²	H-h (m)	H ² -h ²	Radius of Influence ² (m)	Discharge Into Ends ³ (m ³ /day)	Plane Discharge ⁴ (m ³ /day)	Total Discharge (m ³ /day)	Total Discharge (L/day)	Total Discharge x 1.5 Safety Factor (L/day)
		a	b	re	k	k	H		h				Ro	Q	Q	Q	Q	Q
Dock Road Sanitary	NA	75	3	25	4.00E-06	3.46E-01	4.12	17	0.5	0.5	3.62	16	47	28	9.2	37.6	37,600	56,400
Lot 1	NA	20	3	7	4.00E-06	3.46E-01	2.09	4	0.5	0.5	1.59	4	17	5	1.6	6.6	6,600	9,900
Lot 2	NA	20	3	7	4.00E-06	3.46E-01	2.39	6	0.5	0.5	1.89	5	19	6	1.9	8.0	8,000	12,000
Lot 3	NA	20	3	7	4.00E-06	3.46E-01	2.91	8	0.5	0.5	2.41	8	22	8	2.5	10.4	10,400	15,600
Lot 4	NA	20	3	7	4.00E-06	3.46E-01	3.21	10	0.5	0.5	2.71	10	24	9	2.9	12.0	12,000	18,000
Lot 5	NA	20	3	7	4.00E-06	3.46E-01	3.37	11	0.5	0.5	2.87	11	25	10	3.1	12.8	12,800	19,200
Total Dewatering																	87,400	131,100

Notes

¹ $r_e = (a+b) / \pi$ - assuming $a/b > 1.5$, or $r_e = \sqrt{ab} / \pi$ (Powers et. al., 2007)

² $R_o = r_e + 3000 * (H-h) * \sqrt{k}$ - Sichardts Formula, (Cashman and Preene, 2001)

³ $Q = [(\pi * K) * (H^2 - h^2)] / [\ln(R_o/r)]$ (Powers et al., 2007)

⁴ $Q = 2 * [a * K * (H^2 - h^2)] / (2R_o)$ (Powers et al., 2007)

* H & h are relative to base of active ground water levels

16-202 Dock Road - High K Scenario

Type	ID	Length (m)	Width (m)	Effectivve Radius ¹ (m)	Hydraulic Conductivity (m/s)	Hydraulic Conductivity (m/day)	Initial Depth of Water (static head) prior to dewatering (m)	H ²	Depth of Water in the well while pumping (m)	h ²	H-h (m)	H ² -h ²	Radius of Influence ² (m)	Discharge Into Ends ³ (m ³ /day)	Plane Discharge ⁴ (m ³ /day)	Total Discharge (m ³ /day)	Total Discharge (L/day)	Total Discharge x 1.5 Safety Factor (L/day)
		a	b	re	k	k	H		h				Ro	Q	Q	Q	Q	Q
Dock Road Sanitary	NA	75	3	25	9.10E-04	7.86E+01	4.12	17	0.5	0.5	3.62	16	352	1533	275.6	1809.0	1,809,000	2,713,500
Lot 1	NA	20	3	7	9.10E-04	7.86E+01	2.09	4	0.5	0.5	1.59	4	151	315	40.2	355.7	355,700	533,600
Lot 2	NA	20	3	7	9.10E-04	7.86E+01	2.39	6	0.5	0.5	1.89	5	178	403	46.0	449.3	449,300	674,000
Lot 3	NA	20	3	7	9.10E-04	7.86E+01	2.91	8	0.5	0.5	2.41	8	225	572	55.5	628.0	628,000	942,000
Lot 4	NA	20	3	7	9.10E-04	7.86E+01	3.21	10	0.5	0.5	2.71	10	253	685	61.1	745.8	745,800	1,118,700
Lot 5	NA	20	3	7	9.10E-04	7.86E+01	3.37	11	0.5	0.5	2.87	11	267	745	63.9	809.3	809,300	1,214,000
Total Dewatering																	4,797,100	7,195,800

Notes

¹ $r_e = (a+b) / \pi$ - assuming $a/b > 1.5$, or $r_e = \sqrt{ab} / \pi$ (Powers et. al., 2007)

² $R_o = r_e + 3000 * (H-h) * \sqrt{k}$ - Sichardts Formula, (Cashman and Preene, 2001)

³ $Q = [(\pi * K) * (H^2 - h^2)] / [\ln(R_o/r)]$ (Powers et al., 2007)

⁴ $Q = 2 * [\pi * K * (H^2 - h^2) / (2R_o)]$ (Powers et al., 2007)

* H & h are relative to base of active ground water levels



APPENDIX F

LETTERS TO UTILITIES



PEARSON
ENGINEERING LTD.

October 10, 2023

File:22047

Attention: Tony D'Onofrio

Alectra Utilities
55 Patterson Road,
Barrie, ON
L4N 3V9

Dear Tony,

**Re: Proposed Residential Development
211 Dock Road, Barrie
Request for Confirmation – Alectra Servicing**

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 211 Burton Avenue in Barrie. The development proposes five (5) single detached homes. The subject property is currently a vacant lot with one of the dwellings under construction on the retained lot. The 4 other dwellings will be constructed on the severed lots.

We request that, if available, you provide us your existing servicing and plan in this area, and we would appreciate any comments you could provide on the serviceability of the proposed development.

We thank you in advance for your assistance and co-operation in providing the background data. If you have any questions regarding the enclosed or require any additional information, please feel free to give me a call at (705) 719-4785.

Regards,

PEARSON ENGINEERING LTD.

April Cleaves, B.A. Tech., C.E.T.
Project Manager



PEARSON
ENGINEERING LTD.

October 10, 2023

File:22047

Attention: Lorraine Cibirka

Ms. Lorraine Cibirka
Access Network Design
2nd Floor, 136 Bayfield Street
Barrie, Ontario
L4M 3B1

Dear Lorraine,

**Re: Proposed Residential Development
211 Dock Road, Barrie
Request for Confirmation – Bell Servicing**

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 211 Burton Avenue in Barrie. The development proposes five (5) single detached homes. The subject property is currently a vacant lot with one of the dwellings under construction on the retained lot. The 4 other dwellings will be constructed on the severed lots.

We request that, if available, you provide us your existing servicing and plan in this area, and we would appreciate any comments you could provide on the serviceability of the proposed development.

We thank you in advance for your assistance and co-operation in providing the background data. If you have any questions regarding the enclosed or require any additional information, please feel free to give me a call at (705) 719-4785.

Regards,

PEARSON ENGINEERING LTD.

April Cleaves, B.A. Tech., C.E.T.
Project Manager



PEARSON
ENGINEERING LTD.

October 10, 2023

File:22047

Attention: David Smith

Enbridge Gas
10 Churchhill Drive
Barrie, Ontario
L4N 8Z5

Dear David,

**Re: Proposed Residential Development
211 Dock Road, Barrie
Request for Confirmation – Enbridge Servicing**

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 211 Burton Avenue in Barrie. The development proposes five (5) single detached homes. The subject property is currently a vacant lot with one of the dwellings under construction on the retained lot. The 4 other dwellings will be constructed on the severed lots.

We request that, if available, you provide us your existing servicing and plan in this area, and we would appreciate any comments you could provide on the serviceability of the proposed development.

We thank you in advance for your assistance and co-operation in providing the background data. If you have any questions regarding the enclosed or require any additional information, please feel free to give me a call at (705) 719-4785.

Regards,

PEARSON ENGINEERING LTD.

April Cleaves, B.A. Tech., C.E.T.
Project Manager



PEARSON
ENGINEERING LTD.

October 10, 2023

File:22047

Attention: Xinyi Wang

Xinyi Wang
Rogers Cable
1 Sperling Drive
Barrie, Ontario
L4M 6B8

Dear Xinyi,

**Re: Proposed Residential Development
211 Dock Road, Barrie
Request for Confirmation – Rogers Servicing**

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 211 Burton Avenue in Barrie. The development proposes five (5) single detached homes. The subject property is currently a vacant lot with one of the dwellings under construction on the retained lot. The 4 other dwellings will be constructed on the severed lots.

We request that, if available, you provide us your existing servicing and plan in this area and we would appreciate any comments you could provide on the serviceability of the proposed development.

We thank you in advance for your assistance and co-operation in providing the background data. If you have any questions regarding the enclosed or require any additional information, please feel free to give me a call at (705) 719-4785.

Regards,

PEARSON ENGINEERING LTD.

April Cleaves, B.A. Tech., C.E.T.
Project Manager