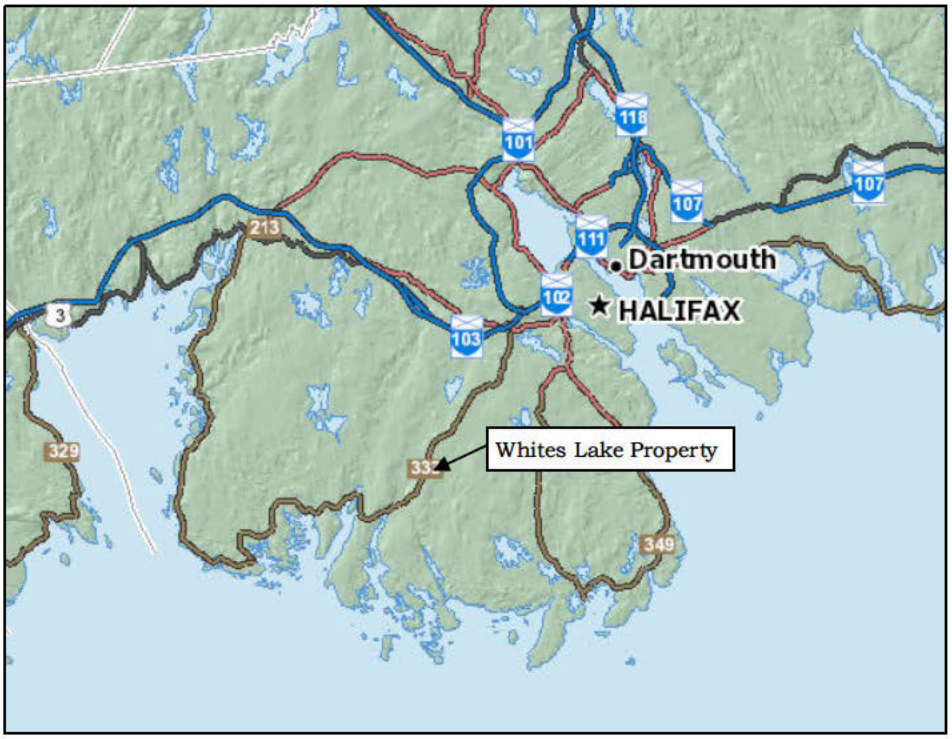
Whites Lake Property

Prospect Road, Whites Lake, Halifax County, Nova Scotia

Level I Groundwater Resources Assessment



Revision #1

prepared for:

Mr. Tom Lavers

W.G. Shaw & Associates Ltd.
Consulting Geoscientists
February 27, 2025

W.G. Shaw & Associates Ltd.

Consulting Geoscientists

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Antigonish , Nova Scotia
Canada B2G 2L3
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Mr. Tom Lavers
Prospect Road
White's Lake, Nova Scotia
Canada

February 27, 2025

Re : Whites Lake Property, HRM, Nova Scotia
Level I Groundwater Assessment

Dear Mr. Lavers,

Please find enclosed our revised technical report on a Level I Groundwater Assessment for the Whites Lake Property, HRM, Nova Scotia.

Sincerely,

[redacted]

William G. Shaw, *Pigeon.*
President

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1.0 Introduction

1.1 General Description of the Project

W.G. Shaw & Associates Ltd. (WGSL) was retained by Mr. Tom Lavers to conduct a Level I Groundwater Assessment for a proposed residential development (the Property), located at Whites Lake, Halifax County, Nova Scotia (Figures #1, #2 and #3).

The Property is a northeast-trending, roughly rectangular-shaped parcel of land that is approximately 500 metres long by 240 metres wide with a total area of 11.6 hectares (PID #0038 1715)(Figure #6 and Appendix A).

Future plans are to subdivide the Property into twelve (12) individual residential lots including one single-family dwelling with its own private water supply well (one well per lot).

1.2 Scope of Work and Methodology

In order to fulfill the requirements, we followed the Nova Scotia Environment's Guide to Groundwater Assessments for Subdivisions Serviced by Private Wells, Level I. These included the review, compilation and interpretation of the following sources of information and data:

- Geologic Reports and Maps: surficial sediments and bedrock geology
- Topographic Maps:
- Air Photos
- Water Wells Records: Nova Scotia Well Logs Database and Ground-water Atlas, well construction records, pump tests records and water quality records.
- Historical Pump Tests: wells and aquifers
- Nova Scotia Pump Test Database
- Watershed Maps: primary, secondary, tertiary
- Climate Data: annual precipitation patterns
- Nova Scotia Groundwater Toolkit

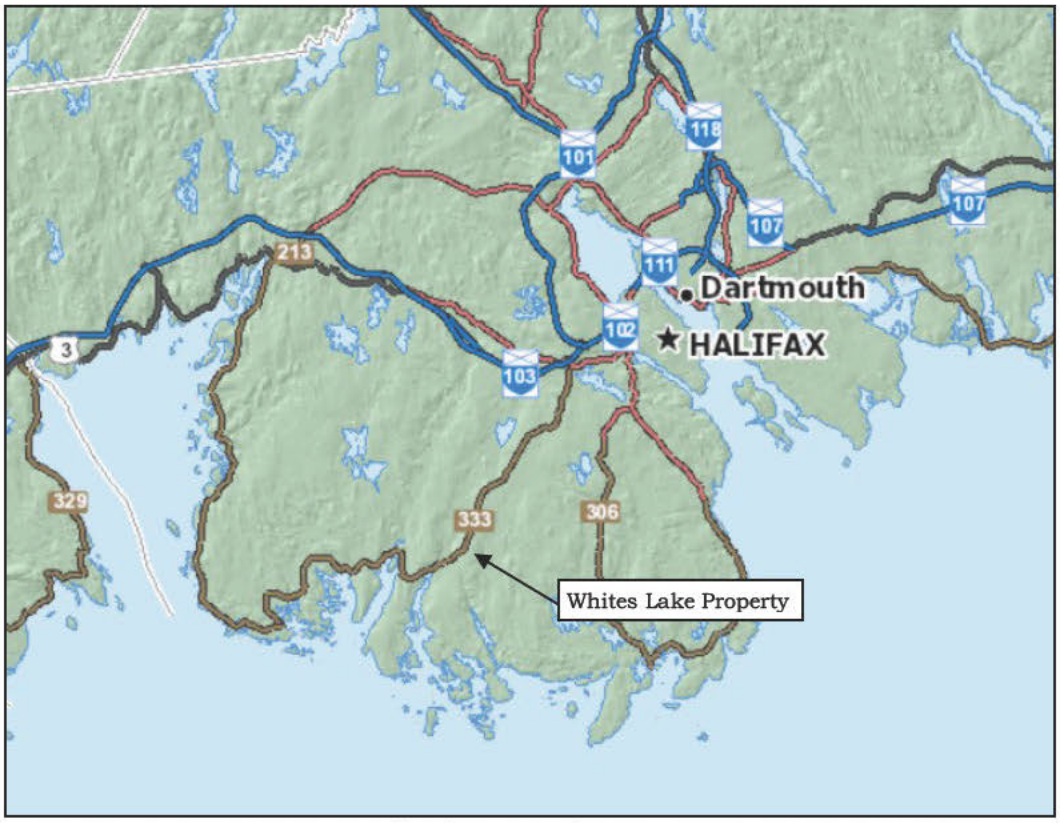


Figure #1 Location of Whites Lake Property on Regional Map

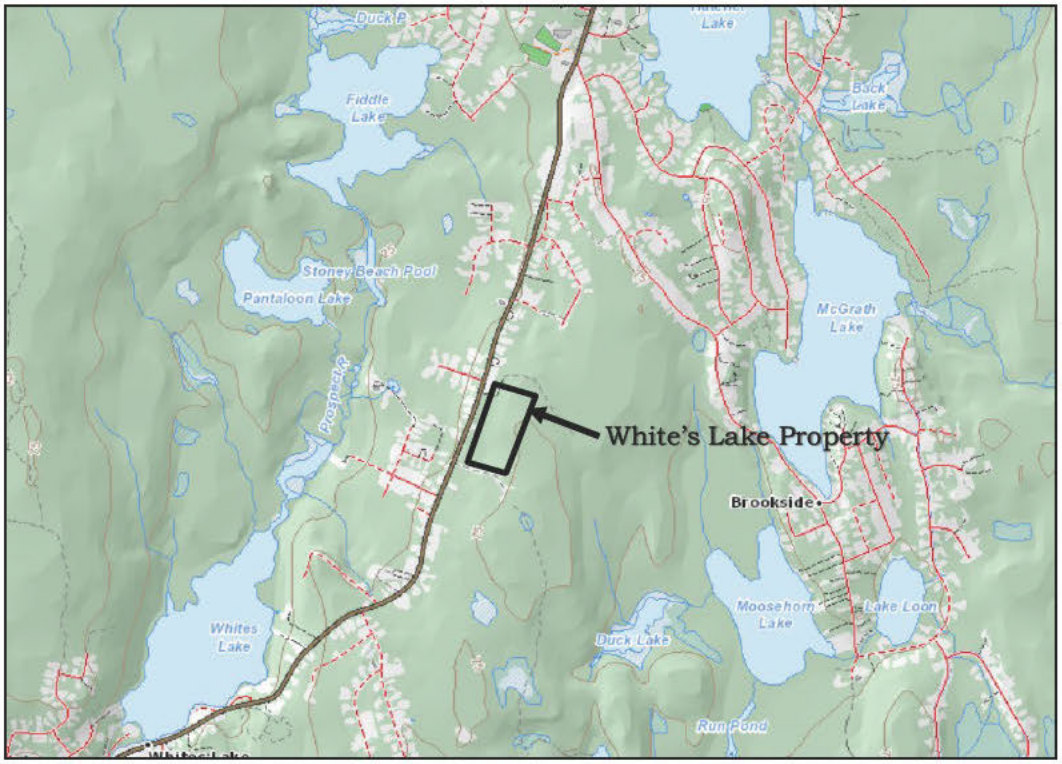


Figure #2 Location of White's Lake Property on Topographic Map

2.0 Natural Landscape and Climate

2.1 Natural Landscape and Topography

The Property is located within the Pennant Granite Barrens Natural Landscape of Nova Scotia. This landscape is characterized by low undulating terrain dominated by a mosaic of boreal and coastal coniferous forests with interspersed barrens.

The Property lies within a parcel of land that slopes gently toward the west from a maximum elevation of 80 metres on the east side to 60 metres on the west side (Figures #2 and #6).

2.2 Climate and Precipitation

Climate normals for the Property are derived from the Environment Canada (EC), climate monitoring station located at St. Margaret's Bay which is located approximately 22 kilometres to the northwest. The results indicate the area receives total annual precipitation of from 1,300 to 1,400 millimetres of normal which 85% occurs as rain. The average total annual precipitation for the 1981 to 2010 period was 1,380 millimetres (1.38 metres).

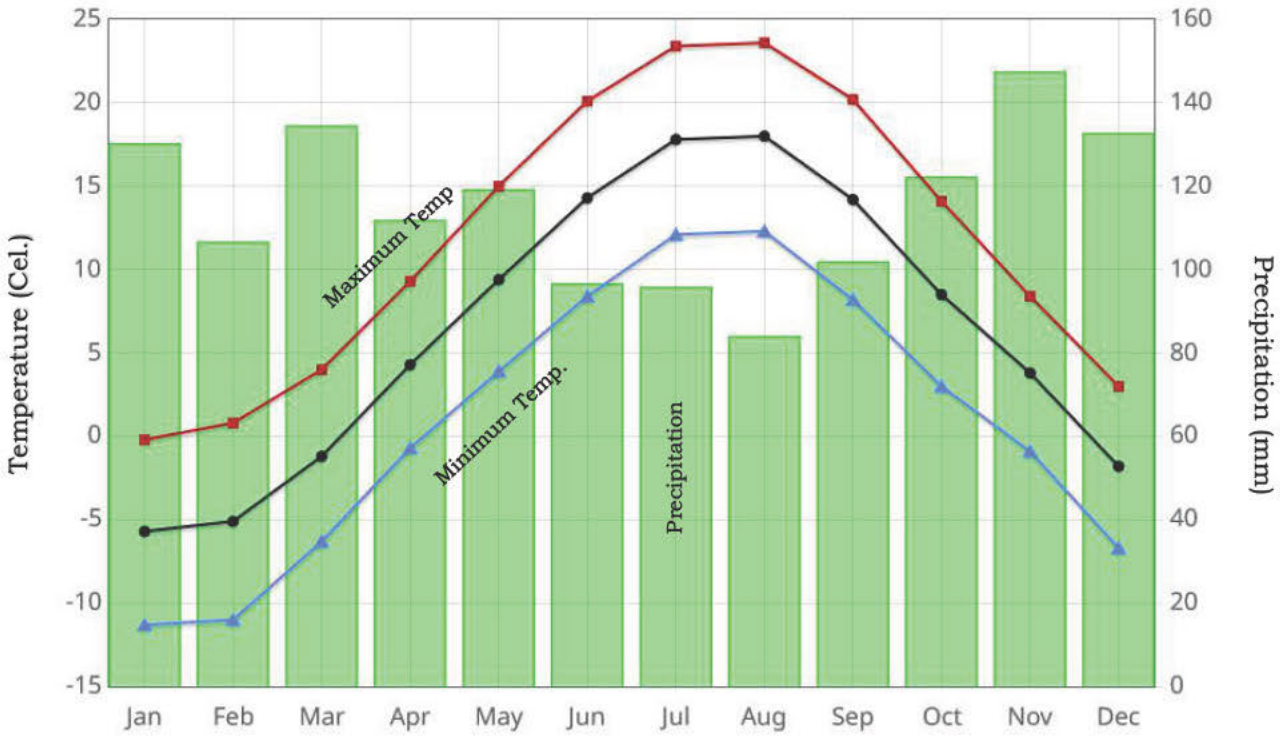


Figure #3 Climate Normals for the St. Margaret's Bay Climate Station from 1981 to 2010

2.3 Surface Water Features

The Property lies within the Sackville River Primary Watershed and within the Prospect River Secondary Watershed (Figures #5 and #6). There are no watercourses on the Property. Surface water runoff is by overland flow toward the west in the direction of the Prospect River which is located 600 metres west of the Property (Figures #4 and #5).

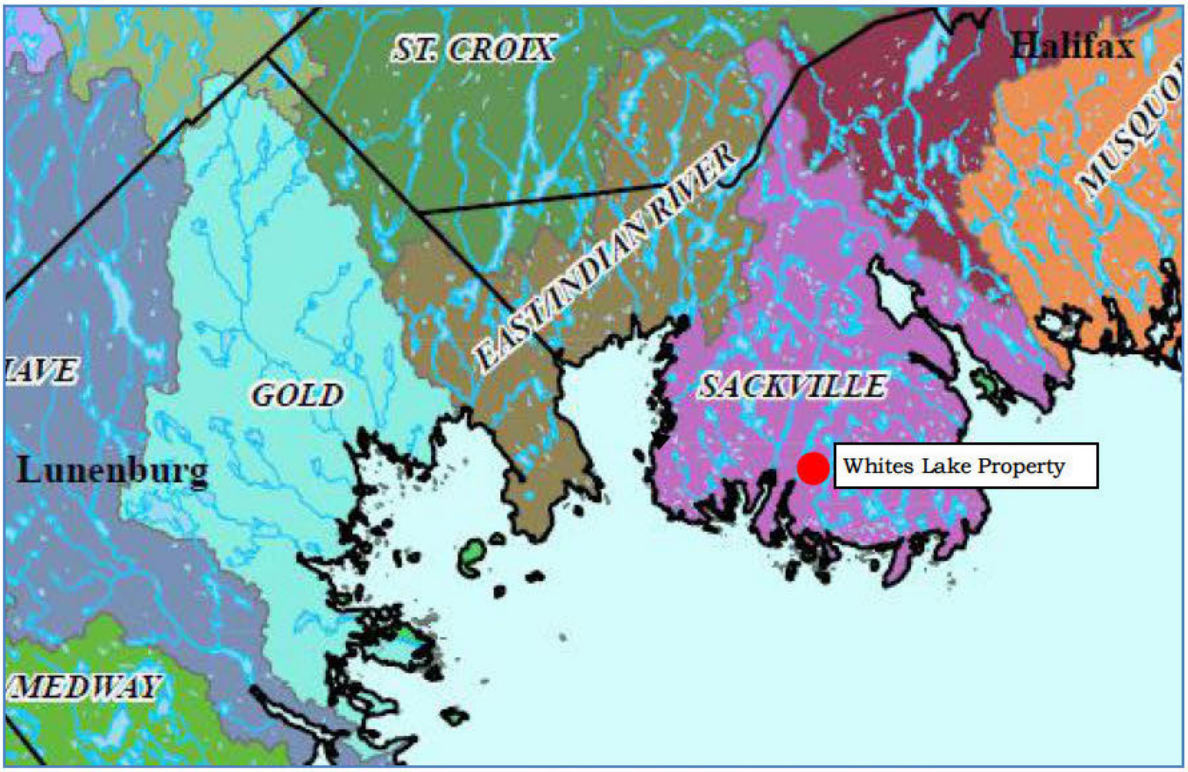


Figure #4 Primary Watersheds of Nova Scotia

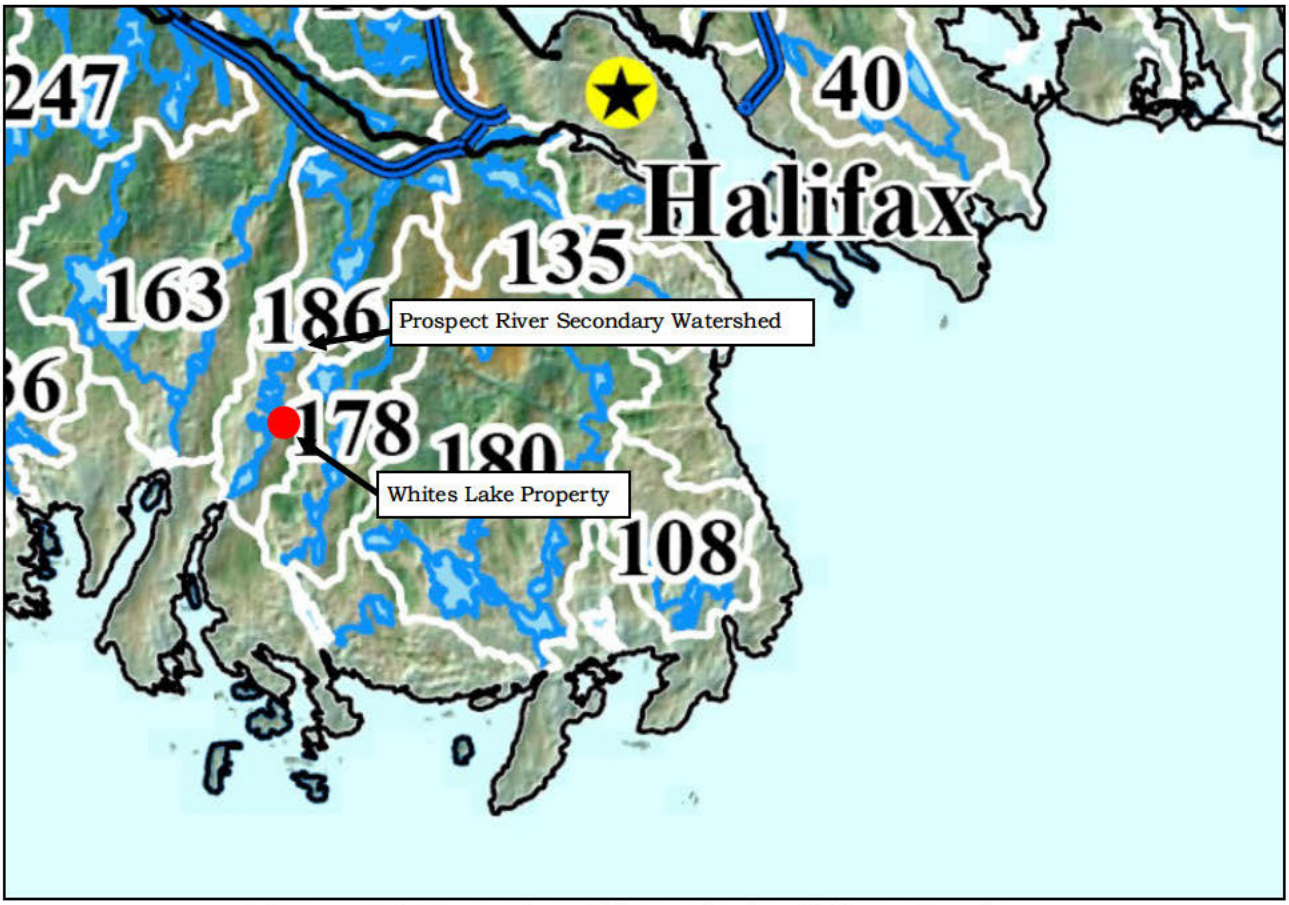


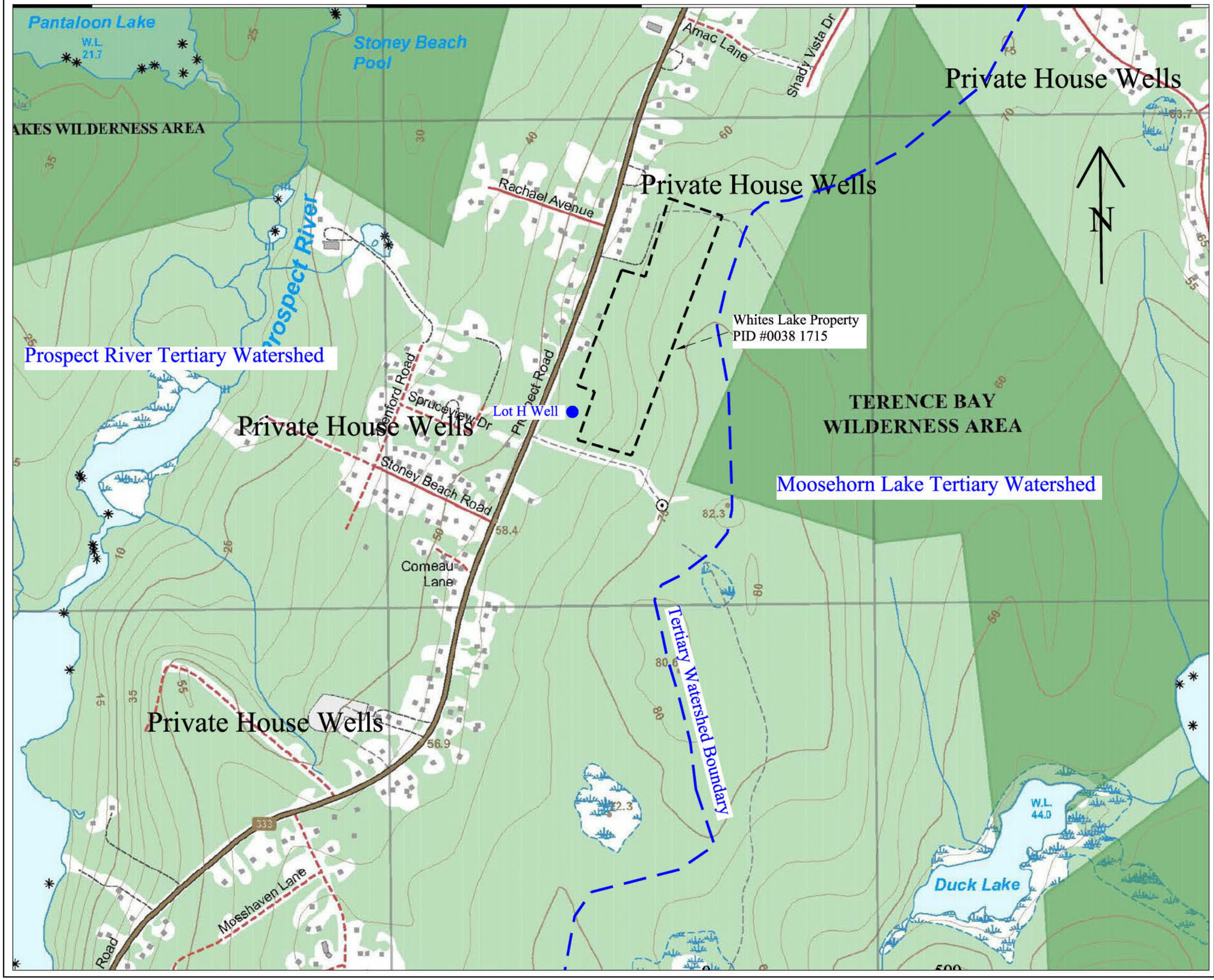
Figure #5 Secondary Watersheds of Nova Scotia

2.4 Wetlands

In Nova Scotia, a wetland is a term that includes the land areas that are commonly referred to as a marsh, swamp, fen or bog that either periodically or permanently has a water table at, near or above the land's surface or that is saturated with water. These land areas sustain aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation and biological activities adapted to wet conditions.[1]

A search of the Nova Scotia Ecological Land Classification mapping indicates there are no significant wetlands within the Property or within 1 kilometre of the Property.

[1] NS *Environment Act* as amended in 2006



Explanation

- Residential Building (private well)

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Whites Lake Property

Whites Lake, Nova Scotia

Figure #6

February, 2025

3.0 Anticipated Demand and Supply of Potable Water

3.1 Anticipated Demand

Considering proposed plans for the Property consist of the construction of up to 12 residential units with an average number of 3.0 people for each unit the following provides a summary of the anticipated water use per day.

Number of Residential Units	=	12	units
Number of People Per Unit	=	3.0	
Total Number of People Served	=	36	people
Water Use Per Person Per Day	=	240	litres
Total Maximum Water Use Per Day	=	8,640	litres/day

Therefore, at full build-out, the total maximum daily water use is expected to be in the range of 8,000 to 10,000 litres.

3.2 Anticipated Supply

Future plans are to subdivide the Property into twelve (12) individual residential lots each containing one single-family dwelling with its own private water supply well (one well per lot).

4.0 Summary of Hydrogeology

4.1 Surficial Sediments

The Property is covered by a layer of surficial sediments that consist of yellowish-grey coloured, gravely silt and clay (glacial till) which, according to local drilled well records are from 1 to 8 to metres thick.

4.2 Bedrock Hydrogeology

The Property is underlain by bedrock that consists of orangish-grey coloured granite where all of the porosity, permeability and storage of groundwater is within fractures in the bedrock (Illustration #1).

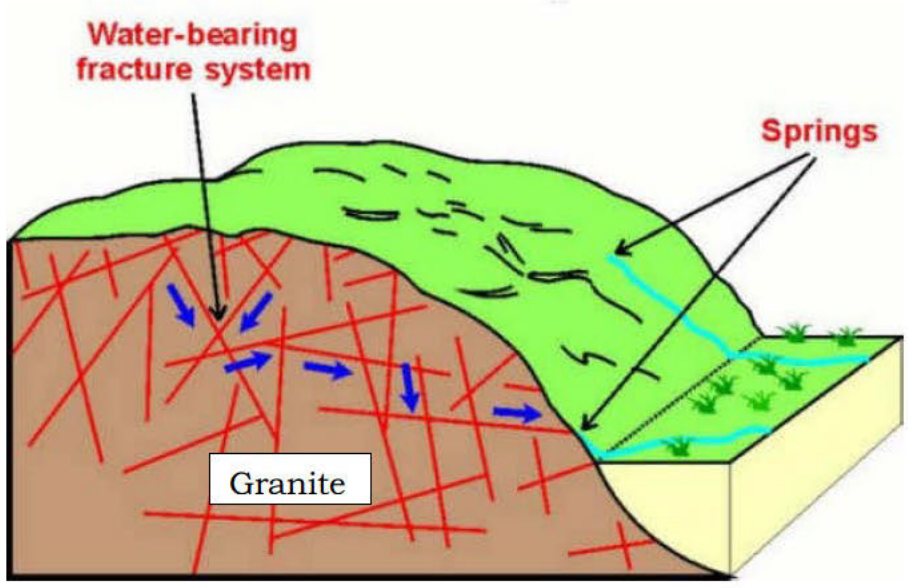


Illustration #1 Schematic Illustration of a Fractured Rock Aquifer System

Permeability of a fractured rock aquifer is dependent on the following factors:

- the number of fracture sets
- the orientation of the fracture sets
- the density of the fracture surfaces (spacing)
- the aperture of the fractures (distance between walls of fractures), and
- the degree of interconnection of the fracture sets.

Fractured rock aquifers generally have a much lower capacity to transmit water than sand & gravel aquifers or sandstone aquifers. This lower capacity results from both a smaller amount of open space (porosity) and heterogeneities of the fracture patterns that are always present in the aquifer as compared to the primary permeability found in sand & gravel and sandstone aquifers. As a result, many fractured rock aquifers are limited in the amount of water they can reliably produce in the long term and should be assessed in a cautious manner.

4.3 Regional Groundwater Flow

Based on topography and hydrogeology, regional groundwater flow direction is anticipated to be a subdued replica of the topographic surface which is toward the west.

Recharge to the granite, bedrock aquifer is from rainfall and snow melt infiltration both locally and areas hydraulically upgradient of the site on the east side of the Property.

5.0 Water Supply Wells and Water Quantity

5.1 Water Supply Wells in the Area

There are no water supply wells on the Property. In June of 2023, a water well was drilled adjacent to southwest corner of the Property as shown on Figure #6. The following is a summary of the well construction characteristics of this well.

5.1.1 Lot H Well

Total Depth	=	50.3	metres (165 feet)
Casing (152 mm; 6")	=	6.1	metres (20 feet)
Screens	=	none	metres
Bentonite Grout	=	6.1	metres
Static Water Level	=	4.5	metres BTC
Top of Bedrock	=	2.0	metres (6 feet)
Producing Aquifer	=	Bedrock	(Granite)
Estimated Yield (driller's estimate)	=	50	litres per minute

A review of topographic maps and air photos indicates there are approximately 80 residential properties within 500 metres of the Property boundaries, all of which have private house wells (Figure #6).

Research of the NSE Groundwater Atlas and NSE Drilled Well Database indicates NSE has records for 29 of these drilled wells (Table #1 and Figure #6). The NSE Drilled Well Database indicates these drilled wells have total depths of from 22.8 to 99.0 metres with driller's estimates of yields of from 2 to 114 with an average (mean) of 38 litres per minute[2].

[2] Driller's estimates of well yield are made by the drilling contractor after completion of well construction and are always greater than the sustainable yield of the well.

Table #1

Whites Lake Property

Drilled Well Records in NSE Database

NSE Well Number	NSE Well Address	Community	Date Drilled yr-mo-day	Total Depth metres	Casing Depth metres	Top of Bedrock metres	Static Water Level metres	Well Yield litres/minute
21,138	2588 Prospect Road	Whites Lake	2002-12-17	91.4	12.2	9.7	6.1	2
30,693	2660 Prospect Road	Whites Lake	2003-09-04	42.6	6.1	2.4	3.0	36
31,138	2540 Prospect Road	Whites Lake	2003-03-15	50.2	5.6	3.7		64
42,781	22 Rachael Avenue	Whites Lake	2004-06-11	42.6	7.0	4.3		68
51,152	32 Deepwood	Whites Lake	2005-03-15	99.0	6.1	3.7	6.1	2
51,173	31 Rachael Avenue	Whites Lake	2005-03-15	38.1	6.1	2.1	6.1	68
51,174	90 Rachael Avenue	Whites Lake	2005-03-15	38.1	8.5	6.1	6.1	68
51,336	Rachael Drive	Whites Lake	2005-05-16	42.6	10.1	5.5	3.0	65
61,182	Rachael Drive	Whites Lake	2006-03-15	44.2	12.2	9.1	6.1	45
80,297	2719 Prospect Road	Whites Lake	2008-07-23	42.6	6.1	1.2		27
100,616	26 Denford Road	Whites Lake	2010-06-23	42.6	7.3	3.4		20
150,001	32 A MacLane,		2015-01-12	56.3	9.1	5.5	3.0	14
180,109	2672 Prospect Road	Whites Lake	2018-04-16	48.7	12.2	1.8	3.0	36
180,945	2540 Prospect Road	Hatchet Lake	2018-12-04	80.7			1.5	23
200,530	2933 Prospect Road	Whites Lake	2020-10-29	44.2				68
831,163	Stoney Beach Road	Whites Lake	1983-08-26	42.6	6.1	0.3		5
841,088	Prospect Road	Whites Lake	1984-06-16	38.1	15.2	12.2	7.6	9
841,090	Prospect Bay	Whites Lake	1984-06-15	22.8	6.7		4.6	23
871,401	Stoney Beach Road	Whites Lake	1987-06-08	31.4	7.3	5.8	4.6	91
872,727	SITE 16 A	Whites Lake	1987-11-09	44.2	6.7			18
890,096		Whites Lake	1989-04-05	42.6	6.1	3.7		14
910,004		Whites Lake	1991-02-06	63.0	7.6	3.4	1.8	11
912,371	Sandstone Drive	Whites Lake	1991-07-02	32.0	6.7	1.8	6.1	36
930,478	Stoney Beach Road	Whites Lake	1993-05-31	30.5	6.1	2.7		18
940,765	Stoney Beach Road	Whites Lake	1994-04-28	32.0	8.5	0.9	2.4	68
951,022	Stoney Beach Road	Whites Lake	1995-06-13	31.4	7.3	5.5	3.7	45
960,372	2890 Prospect Road	Whites Lake	1996-05-30	54.8	7.0	5.8	4.9	10
970,138	2890 Prospect Road	Whites Lake	1997-05-12	75.2	6.1	4.6	4.6	114
970,776	2379 Prospect Road	Whites Lake	1997-09-30	42.6	6.1			18
Lot H Well	2740 Prospect Road	Whites Lake	2023-06-15	50.3	6.1	2.0	4.5	50
Minumum				22.8	5.6	0.3	1.5	2
Maximum				99.0	15.2	12.2	7.6	114
Average (Mean)				47.9	7.8	4.3	4.4	38

Notes 1) Blank cells indicate there is no data in the NSE Database.

2) Wells without civic addresses may not be within 500 metres of the Property.

5.2 Well Yields

A rough estimate of the anticipated yield of water wells to be constructed on the Property can be made using two methods: 1) using the Nova Scotia Department of Environment's Toolkit for Groundwater Assessments, and 2) comparing these results to driller's estimates of yields for the 33 well records within 500 metres of the Property that are in the NSE database.

Method #1

For Method #1, it is assumed the future test wells will be constructed to total depths of 70 metres, the pumps will be installed to depths of 60 metres and the deepest static water level will be 10 metres below grade. Using the transmissivity estimate for granite in the NSE Toolkit and applying the Farvolden formula for generating a calculated estimate of yields (Q_{20}), the results are as follows:

Method #1

Total Depth of Well(s)	=	70	metres (below ground surface)
Pump Depth	=	60	metres
Static Water Level	=	10	metres (below ground surface)
Saturated thickness	=	50	metres
Available drawdown (H_A)	=	37	metres (75% of saturated thickness)
Aquifer Transmissivity (T)	=	1.0	m^3/day/m (from NSE Toolkit)
Safety Factor (Sf)	=	0.7	
Estimated Yield (rounded)	=	17.7	cubic metres per day
	=	17,700	litres per day
	=	12	litres per minute (rounded)

$Q_{20} = (0.683)(T)(H_A)(S_f)$ Farvolden Method

Method #2

The second method of predicting the yields of wells to be constructed on the Property is to examine the well construction and yield data for existing wells located within 500 metres of the Property. Knowing that Driller's Estimates of well yield are significantly greater than the long term sustainable yield of most drilled wells, we have added a factor of 50% of Driller's Estimate significantly to generate the following:

Range of Well Depths	=	22.8 to 99.0	metres
Range of Driller's Estimates of Yield	=	2 to 114	litres/minute
Mean of Driller's Estimates	=	38	litres/minute
50% of Mean of Driller's Estimate	=	19	litres/minute

Therefore, the two methods of estimating yields of future wells to be constructed on the Property are in reasonable agreement with the results indicating anticipated well yields between 10 and 20 litres per minute.

6.0 Water Balance (Groundwater Recharge)

Considering proposed potable water supply to the Property will be provided by private wells with one well per lot, this water balance and groundwater recharge estimate utilizes the entire 11.6 hectare property as the recharge area (capture zone). In this method, we utilized the annual groundwater recharge estimate for the Sackville River Primary Watershed as published by the Nova Scotia Department of Environment of 197 mm, an estimated impervious surface estimate of 30% and NSE's recommended Ecological Maintenance Factor of 50%.

Ecological use refers to groundwater that helps maintain ecological habitats by discharging as baseflow to surface water bodies. Ecological use is assumed to be 50% of the groundwater recharge. The following are the inputs to generate the groundwater recharge estimate:

Table #2

Whites Lake Property

Long Term Water Balance & Groundwater Recharge

(for Properties with On-Site Septic Systems and Road Drainage Control)

Part A: Anticipated Daily Water Use

Number of Residential Units		12
People per Unit		3.0
Population Served		36
Water Use per Person per day	litres/day	240
Water Use Per Day	litres/day	8,640

Part B: Annual GW Recharge to Property

Total Recharge Area	hectares	11.6
	sq. metres	116,000
GW Recharge Rate (Sackville River Watershed)	metres/year	0.197
Impervious Surfaces	decimal	0.3
Pervious Surfaces	decimal	0.7
Ecologic Maintenance (NSE's Constant)	decimal	0.5
Engineering Design Credits (50% of annual water use)	cubic metres	1,577

Part C: Summary of Available Groundwater

Total Annual Recharge to Property	cubic metres	9,575
	litres	9,575,000
Daily Recharge to Property	litres/day	26,233

Therefore the long term groundwater recharge to the Property is estimated to be 26,000 litres per day (rounded) which is significantly more than the anticipated groundwater withdrawals of 8,000 to 10,000 litres per day.

7.0 Expected Water Quality

The NSE Water Quality Database does not contain any water quality data for groundwater samples within 500 metres of the Property. However, anecdotal evidence from well drilling contractors indicates the well water quality in the area is of general good quality.

The Property is located in a part of Nova Scotia that is considered a low to medium risk of groundwater having elevated concentrations of uranium, iron, manganese and low pH that may exceed the Guidelines for Canadian Drinking Water Quality.

Water treatment requirements, if any, will depend on the actual quality of water withdrawn from the planned water supply wells and whether the water quality conforms to the Canadian Drinking Water Quality Guidelines. Treatment costs will depend on the type of treatment system employed and the quantity of water withdrawn from the wells on a daily basis.

8.0 Evaluation of Potential Effects

8.1 Potential Well Interference

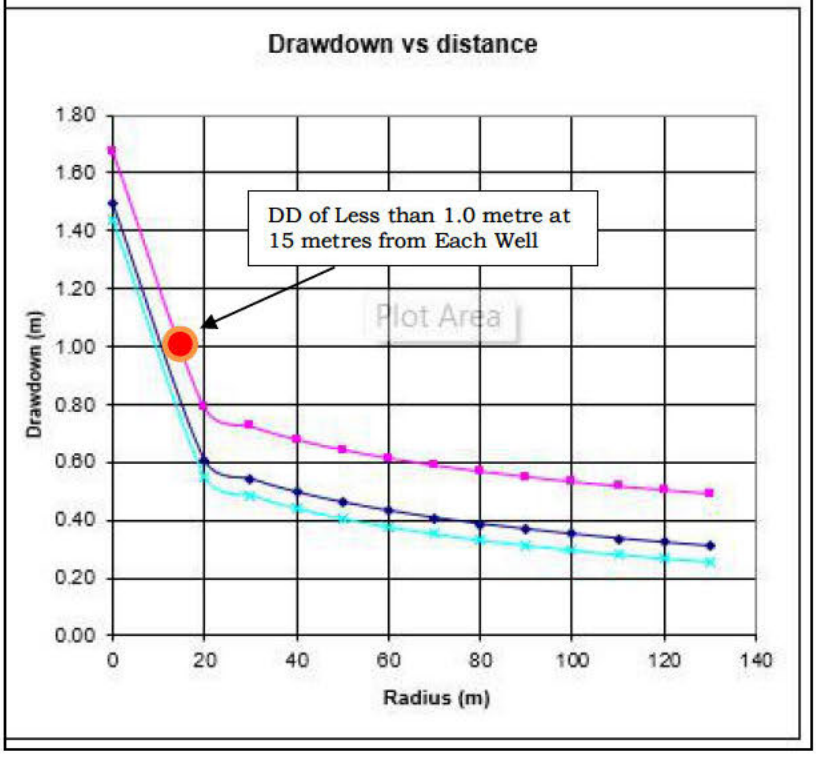
A calculated estimate of the radius of influence of each water well can be made by using the Theis method that is provided in the Nova Scotia Environment Groundwater Toolkit. The following chart provides a graphical illustration of the expected drawdown from wells withdrawing water at a rate of 1,000 litres per day from the granite aquifer. The results indicate less than 1.0 metre of drawdown at 15 metres radius from each water supply well. If we consider each lot will be 0.5 hectares in size, the risk of interference between adjacent wells is very low.

Distance-drawdown calculations using Theis equation

Aquifer parameters		
T	1	m2/d
S	0.001	

Pumping rate		
Q	1	m3/d

Time (days)	180	365	3650
Radius (m)	Drawdown (m)	Drawdown (m)	Drawdown (m)
0.076	1.437	1.494	1.677
20	0.551	0.607	0.790
30	0.486	0.542	0.726
40	0.440	0.497	0.680
50	0.405	0.461	0.644
60	0.376	0.432	0.615
70	0.352	0.408	0.591
80	0.331	0.387	0.569
90	0.312	0.368	0.551
100	0.295	0.351	0.534
110	0.281	0.336	0.519
120	0.267	0.322	0.505
130	0.254	0.310	0.492



8.2 Potential Effects on Surface Water and the Environment

The proposed development may have an influence on surface water resources by increasing the amount of impervious surfaces within the Property after full build-out. The degree to which the facility will affect surface water resources will depend on the amount of the Property covered by hard surfaces such as roofs, paved areas, concrete areas and lawns, and the mitigating measures that are included in the development.

8.3 Risk of On-Site Septic Systems on Water Wells

The waste water management plan for the Property is to construct on-site, septic systems, one system per lot in accordance with Provincial guidelines.

8.4 NSECC Well Construction Regulations

Planned water wells on the Property should be constructed in conformance with the Nov Scotia Provincial guidelines.

8.5 Mitigation Measures for Low Yield Wells

In the event a property owner constructs a water well that demonstrates a yield on the lower end of the expected yields and determines the well cannot provide a suitable quantity of water to the property, the following methods could be employed:

1) Construct the well to a deeper total depth
(Cost Estimate = $2,000 to $4,000);

2) Conduct a hydrofrac of the well.
(Cost Estimate = $4,000)

9.0 Summary

Proposed plans for the 11.6 hectare Property consist of a residential development including 12 individual lots with the potable water supplies consisting of private wells, one well per lot. The following is a summary of the findings of this report.

Summary

Total Size of Property	=	11.6	hectares
Number of Lots & Wells	=	12	
Anticipated Yield of Wells	=	10 to 20	litres per minute
Anticipated Total Withdrawals	=	8,000 to 10,000	litres per day
Anticipated Per Well Withdrawals	=	660 to 830	litres per day per well
Groundwater Recharge	=	26,000	litres per day
Risk of Well Interference	=	very low	

The results of this Level 1 Groundwater Assessment indicate the quantity of water required by the proposed residential development has a high probability of being supplied with fresh water from groundwater resources available within the Property.

The quality of groundwater on the Property is currently unknown and will depend on the results of well drilling and water sample analyses.

Appendix A

Survey Plan

NOVA SCOTIA

Drilled Well Report

NSE Well No. (Departmental use) _____

Certified Well Contractor

Name: Tony Clapp
Certificate No.: 630
Company: Walter Clapp
Address:
Helpers Name(s): Pete

Well Owner/Contractor Information

Well drilled for: Owner: ZACHARY LAVERS
or Contractor/Builder/Consultant/etc.: [redacted]
Civic Address of well: 2740 PROSPECT RD.
Lot No. and Subdivision of well: WHITES LAKE
County: HALIFAX Postal Code: Phone:
Nearest Community in: ☐ NS Atlas ☐ NS Map Book

Stratigraphic Log

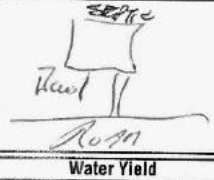
Depth in feet From	To	Colour	General Description of Overburden/Bedrock	Water Found	Well Sketch
0	5	Brown	Clay	Y [N]	
5	140	white	gravity	Y [N]	
140	165	Red	granite	Y [N]	

Attach Another Sheet if Needed

Well Location

Property (PID):
GPS (WGS84 UTM)
Northing: m
Easting: m
☐ NS Atlas ☐ NS Map Book
Page Column Row
Roamer Letter Roamer Number

Well Location Sketch



Well Construction Information

Total depth below surface: 165 ft
Depth to bedrock: 5 ft
Water bearing fractures encountered: 90 ft
150 ft ft ft ft

Well Casing

Outer Casing: From 0 To 20 ft; Diameter 6 in; Wall Thickness 19 in; Material: ☐ steel or; ASTM spec.
Inner Casing: From To ft; Diameter in; Wall Thickness in; Material: ☐ steel or; ASTM spec.

Length of casing above ground: 1 ft 0 in
☐ driveshoe: type Steel
☐ grout: type Bent ☐ packer: type

Well Finish

☐ open hole ☐ slotted casing ☐ screen ☐ gravel pack
Screens: make material
length ft from to ft slot size
length ft from to ft slot size
Gravel pack: size from to ft

Clearance Distance to Nearest

Oil tank ft
Roadway outer boundary 100+ ft
Road name PROSPECT
On-site sewage system 60 ft
Off-site sewage system 100+ ft
Cesspool or other potential source of contamination ft (please identify source)
Watercourse ft Well ft

Water Yield

Method: ☐ Air blown ☐ Bail ☑ Pump
Rate 15 igpm Duration 1 hrs
Test depth ft
Depth to water at end of test ft
Total drawdown ft
Water level recovered to ft
by hrs mins after test ended.
Depth to static level 15 ft
☐ Overflow

Water Quality

Colour Taste Odour Other

Final Status of Well

☑ Water supply
☐ Observation Well
☐ Test Hole
☐ Recharge Well
☐ Abandoned, insufficient supply
☐ Abandoned, poor quality
☐ Abandoned, salt water
☐ Unfinished
☐ Other

Water Use

☑ Domestic
☐ Industrial
☐ Commercial
☐ Municipal
☐ Irrigation
☐ Public Supply
☐ Agricultural
☐ Heat Pump
☐ Other

Method of Drilling

☑ Rotary
☐ Cable Tool
☐ Jet
☐ Other
☐ Drilling Fluids
Type: Foam

Driller's Comments

Certification

I certify this well has been constructed in accordance with the *Nova Scotia Environment Act* and *Well Construction Regulations*.
Date Well completed: Jan 2023
Signa[redacted]
Date Signed: Jan 2023

Mail to:

Nova Scotia Department of Environment
30 Damascus Road, Suite 115
Bedford, Nova Scotia B4A 0C1

Important Home Owner's Document - Safeguard with legal documents.