

# Pumping Test Hydrogeological Assessment Report

Residential Triplex, 14 William Street, Buckhorn, Ontario

**Buckhorn Sand & Gravel** 

08 November 2024

The Power of Commitment

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## 1. Introduction

This report presents the results of a pumping test hydrogeological assessment for the development of a single lot located at 14 William Street in Buckhorn, Ontario (the Site). The location of the Site is depicted on the **Vicinity Plan**, **Figure 1**. The **Site Plan**, **Figure 2** provides additional information of the Site and surrounding area. The development consists of a triplex with two 1-bedroom units and one 2-bedroom unit. The Site is located in an area that is privately serviced for well and septic. GHD was retained by Buckhorn Sand and Gravel to conduct this hydrogeological assessment.

## 2. Scope of Investigation

The purpose of the hydrogeological assessment was to:

- Define prevailing hydrogeologic conditions at the Site including local hydrochemistry, subsurface soil stratigraphy, and groundwater levels;
- Assess the availability of adequate groundwater supplies based on a pumping test;
- Carry out engineering analyses based upon the pumping test and groundwater sampling and provide appropriate recommendations for the Site.

The scope of work for this assessment included the following:

- Conducted a pumping test of a drilled well located on the Site. The test was conducted at a controlled and constant rate for six (6) hours to assess if an adequate source of potable water is available to service the development. Collected measurements of the discharged groundwater from the well. Collected manual water levels from the test well and also utilized a data logger to obtain detailed water level readings from the pumped well and a neighbouring well.
- Water samples were collected during the testing for general chemistry and bacteriological parameters to evaluate the water quality. A sample was collected after one (1) hour and six (6) hours of pumping (i.e. at the end of the testing). The analysis was conducted by SGS Canada Inc., an environmental laboratory accredited for testing of these parameters.
- Reviewed and analyzed the data logger information and prepared this report documenting the pumping test results and work completed.

## 3. Well Construction

One (1) drilled water well was constructed on the Site for the purpose of aquifer performance testing. The new drilled test well was constructed by Joe Legge & Sons (Ministry of the Environment, Conservation and Parks (MECP) License No. 7052) and completed in August 2024. The MECP well record is presented in **Appendix A**. The well location is shown on the **Plot Plan** within the **Figures** section of this report and is labelled as TW-1.

Test well TW-1 (MECP Well Tag No. A397958) has the following characteristics:

- Drilled to 91.4 m encountering overburden materials consisting of topsoil and then bedrock at 0.3 m;
- Constructed with 6 m of casing and sealed with bentonite slurry, followed by open hole to 91.4 m; and
- Recommended for pumping at 45 litres per minute (L/min) or about 12 US gallons per minute (gpm).

#### Aquifer Performance Testing 4

A pumping test program was carried out on September 30, 2024 to assess aquifer response and confirm the availability of a suitable groundwater resource. A controlled constant rate pumping test was conducted for six (6) hours with recovery measurements completed after the pumping. A submersible pump was installed in the well to conduct the testing. Water levels were monitored throughout the aquifer performance testing manually and through the use of a data logger. The discharge water was directed away from the pumped well a minimum distance of 30 m downgradient and was allowed to flow overland away from the test well. This practice safeguards against artificial recharge of the well from occurring during the pumping test. Chlorine levels were confirmed in the field prior to conducting bacteriological sampling the groundwater from the test well. The residual chlorine was non-detect prior to obtaining the bacteriological sample.

Field measurements of methane, pH, temperature, free chlorine, turbidity, and conductivity were completed with a Hach Pocket Pro+ Multi 2. Calibration of the instruments was completed prior to the pumping test.

The results of the constant rate pumping test is graphically presented in **Appendix B**. The Constant Rate Drawdown, Recovery and Testing Details curves include flow rate, conductivity, pH, turbidity, temperature, free chlorine and methane gas. Pumping test information is summarized below.

#### **Test Well TW-1** 4.1

The water level during the pumping test at TW-1 is illustrated on Figures B-1 and B-2 showing water level versus time. The plot shows the water level dropping quickly for the first few minutes at a pumping rate of 17 L/min (4.5 gpm). After six (6) hours of pumping at 17 L/min, the water level was about 26 metres below the top of the casing (mbtoc) with nearly 60 m of available drawdown above the bottom of the well remaining. The plotted data indicates this well can safely provide long-term quantities of groundwater at a pumping rate of 17 L/min.

Drawdown data from the constant rate test was plotted on a drawdown versus time semi-log plot in order to evaluate transmissivity and specific capacity coefficients. The coefficients are summarized in **Table 1**. The estimated transmissivity for TW-1 was 0.23 m<sup>2</sup>/day (15.4 gpd/ft) based on the drawdown and 0.37 m<sup>2</sup>/day (25.0 gpd/ft) based on the recovery period and represents a relatively low to moderate transmissivity.

#### 4.2 Summary of Aquifer Performance

Table 1 presents a summary of the values obtained from the aquifer performance pump testing and the corresponding calculated coefficients. The drawdown within the pumped test well was observed to be 26 m while pumping 17 L/min for six (6) hours.

Well No.	Step No.	tep Yield		Test Time		Maximum Drawdown		Available Drawdown*		Specific Capacity		Estimated Transmissivity	
		gpm	L/min	Jpc	minutes	feet	metres	feet	metres	gpm/ft	L/min/m	gpd/ft	m²/day
TW-1 (A397958)	1	0	0	Static	0	0	0	280	85.2				
	2	4.5	17.0	Const	360	85	26.0	195	59.3	0.05	0.65	15.4	0.23
	3	0	0	Recvy	95% recovery after ~ 91 minutes         25.0         0.37							0.37	
Notos:													

Table 1 Aquifer Performance Testing Summary

Notes:

gpm = US gallons per minute; gpd/ft = US gallons per day per foot

"Recvy" refers to Recovery measurements; "Const" refers to the 6 hr Constant Rate test

\*Available Drawdown refers to the height of water in the well above the bottom of the well.

The pumping data reflects a relatively low to moderate transmissivity of the aquifer complexes below the Site. The recovery measurements indicate a relatively rapid recharge with 95% recovery after about 1.5 hours. It is concluded that the well can provide groundwater yields on the order of 17 L/min (4.5 gpm) based on an adequate period of recharge. Over the duration of the 6-hour pumping test, the well yielded about 6,120 litres or 1,620 gallons of water.

## 5. Test Well Water Quality

Water samples were collected during the course of the pumping test for the purpose of water quality analyses. The discharge water was sampled after one (1) hour into the constant rate test and at the end of the test (i.e. 6 hours). Certificates of chemical analyses are presented in **Appendix C**. The water quality data is summarized and compared with the Ontario Drinking Water Standards (ODWS) in **Table 2**.

DADAMETED	Test V	/ell TW-1		ODWS	
PARAMETER	(1 hour)	(6 hours)	MAC	IMAC	AO/OG
Alkalinity (as CaCO <sub>3</sub> )	208	193			30 to 500
Ammonia+Ammonium	<0.04	<0.04			
Arsenic	<0.0002	0.0002		0.025	
Barium	0.385	0.328	1		
Boron	0.055	0.119	5		
Calcium	101	102			
Chloride	390	350			250
Chromium	0.00013	0.00017	0.05		
Colour (T.C.U.)	10	8			5
Conductivity (mS/cm)	1560	1420			
Copper	0.006	0.005			1.0
Fluoride	0.49	0.49 0.62 1.5			
Hardness (as CaCO <sub>3</sub> )	282	288			80 to 100
Iron	0.018	<0.017			0.3
Lead	<0.0009	<0.0009	0.01		
Magnesium	7.38	8.18			
Manganese	0.271	1.19			0.05
Nitrogen-Kjeldahl (N)	<0.05	<0.05			
Nitrite (N)	<0.03	<0.03	1.0		
Nitrate (N)	2.50	1.55	10		
Organic Nitrogen	<0.05	<0.05			0.15
pH (units)	7.97	8.11			6.5 to 8.5
Phosphorus	<0.03	<0.03			
Potassium	4.62	4.01			
Selenium	0.00011	0.00011	0.01		

 Table 2
 Test Well Water Quality Summary

DADAMETED	Test W	/ell TW-1	ODWS				
PARAMEIER	(1 hour) (6 hours)		MAC	IMAC	AO/OG		
Sodium	192	158			(20*) 200		
Sulphate	24	23			500		
Total Dissolved Solids	857	826			500		
Total Organic Carbon	3	2			5		
Total Suspended Solids	6	5					
Turbidity (N.T.U.)	2	0.45			5		
Uranium	0.0328	0.0321	0.02				
Zinc	0.009	0.007			5.0		
E. coli		0	0				
Total Coliform		0	<6				
Fecal Coliform		0	0				

#### Notes:

All units in mg/L (i.e. parts per million) unless otherwise noted. Time indicates when the sample was obtained during the pumping test. MAC = maximum acceptable concentration (health related); IMAC = Interim MAC (insufficient data to establish MAC or not feasible to establish MAC to desired level); AO/OG = aesthetic objective or operational guideline (not health related)

Bacteriological data is presented in Colony Forming Units per 100 mL (CFU/100 mL). Highlighted value exceeds ODWS

\*The local Medical Officer of Health should be notified when the sodium concentration exceeds 20 mg/L, so that this information may be passed on to local physicians.

The results indicate exceedances of the aesthetic objective for hardness, colour, total dissolved solids, manganese and chloride. No health-related maximum allowable concentrations were exceeded. Sodium was noted to be elevated and does exceed the threshold value of 20 mg/L where those on a sodium restricted diet should be made aware of the presence of sodium in the water; however, the overall sodium concentration was below the aesthetic objective of 200 mg/L where an objectionable taste may be detected.

Elevated hardness is a common trait of groundwater supplies in Southern Ontario and can be treated using commercially available equipment such as a water softener. The elevated colour and total dissolved solids can be attributed to the elevated manganese which can also be reduced through water softening. Water softening typically uses a sodium media as part of the process and will likely increase the sodium content above the 200 mg/L aesthetic objective. To reduce sodium levels, an under-the-counter reverse osmosis treatment unit can be installed within each unit of the triplex with a dedicated tap for consumption purposes.

The bacteriological parameters of total coliform, fecal coliform and E.Coli were all reported to be zero (0) colony forming units. GHD recommends that bacteriological treatment (i.e. ultraviolet treatment) be installed as a safeguard against potential bacteriological concerns.

## 6. Conclusions and Recommendations

Based on the results of our investigation, it is our professional opinion that the Site drilled well is suitable for the proposed residential triplex. Based on the pumping test, the well can produce sufficient amount of water provided there is adequate recharge.

In assessing water demand, Section 8 of the Ontario Building Code, was reviewed, specifically section 8.2.1.3. Sewage System Design Flows. This section provides a relatively conservative value of flow requirements for various uses. Table 8.2.1.3.A. indicates flows for Residential Occupancy for Apartments, Condominiums, Other Multi-family Dwellings to be 275 L/day/person. For a triplex with two 1-bedroom units and one 2-bedroom unit, the number of persons was calculated to be seven (7). This equates to a flow of 1,925 litres for the building. Our constant rate pumping test produced over 6,100 litres of water during the six (6) hours. Based upon the calculations, the triplex requires about one-third of the water pumped during the pumping test with a large amount of available drawdown remaining in the well.

The groundwater users may desire commercial water treatment for hardness, manganese and other related parameters to reduce build-up and staining of fixtures, but treatment should be at the discretion of the individual units. If desired, sodium, chloride and other parameters can be reduced with under-the-counter reverse osmosis treatment units with a dedicated tap for consumption purposes. Ultraviolet treatment is recommended for bacteriological parameters.

We trust that this report meets your immediate requirements. Should you have any questions, please contact our office.

Sincerely,

**Steven Gagne, H.B.Sc.** Associate, Project Director



Robert Neck, P.Geo. (Limited) Senior Geoscientist, Project Director

## 6.1 Scope and Limitations

This report: has been prepared by GHD for Buckhorn Sand & Gravel and may only be used and relied on by Buckhorn Sand & Gravel for the purpose agreed between GHD and Buckhorn Sand & Gravel as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Buckhorn Sand & Gravel arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

#### Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.



Source: Base map compiled from Google Earth

<u>Scale:</u> NTS



14 William Street, Buckhorn, Ontario Buckhorn, Ontario

Vicinity Plan

12614051-02 November 2024

Figure 1





Source: Base map compiled from County of Peterborough, GIS, Let Me Map 2.0







14 William Street Buckhorn, Ontario

Plot Plan

12614051 November 2024

# Appendices

# Appendix A

Ministry of Environment, Conservation and Parks Well Records

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6	OPEN	HOLE		25	200	Dbsen	vation and/or	Well-p	production	(Vmin / GPM)	- 4	0	40	120.9
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186 (n	n/ft) 🗌 Gas	Other, spe	ecify		From	10	(cm/in)		R	AP				7
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(n	n/ft) □Gas	Other sne	cifv						1 6	JILLIAMS	STRA	ET		
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Depth S	et at (m/l	7)	Type of Sealar	nt Used	Volume Placed	After test of well yie	Id, water was:	Draw Down	F	Recovery
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Cable To	col loc	Diamond	Public	: Con	nmercial 🗌 Not used			4 26-	1 4	26.6
Rotary (	Conventi	onal) 🗍 Jetting	a Dome	stic 🗌 Mur	nicipal Dewaterin	Duration of pumpin	ng °min	5 78-	7 5	249
Boring	Reverse)			ion Cod	ling & Air Conditioning	Final water level en	d of pumping (m/ft	10 27	1 10	20 2
Air percu	ussion pecify		Indus	rial		40		10 33-	7 10	20.2
		Construction Re	cord - Casin	d	Status of Wall	If flowing give rate	(I/min / GPM)	15 37. 4	2 15	18.5
Inside	Open	Hole OR Material	Wall	Depth (m/ft)	Water Supply	Recommended pu	mp depth (m/ft)	20 40-	<i>O</i> 20	16.9
Diameter (cm/in)	(Galva Concr	anized, Fibreglass, rete, Plastic, Steel)	Thickness (cm/in)	From To	Replacement Well	140		25 1	25	15.7
611."	1 <	EEE	.100	0 22	Recharge Well	Recommended pu	imp rate	30 11	30	14.9
1 4	27	il	.700		Dewatering Well	16		40 11	40	13.8
6	OPR	W HOLE		2 34	Monitoring Hole	Well production (I/	min / <u>GPM</u> )	50 4	50	12.2
					(Construction)	Disinfected?				12 0
					Abandoned,	Yes Nc		60 40.0	2   50	12.7
Outrido		Construction Re	ecord - Screer		Abandoned, Poor	Plaga amuida a m	Map of W	Iell Location	a baok	
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(17	v/ft) 🗌 (	Gas Other, spe	cify	20	zun L"		2D		11	
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Business A	ddress (	Street Number/Na	me)		Municipality	Comments:	HOPMER	AC RE	Qui	RED
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## Appendix B Aquifer Performance Testing Curves





CONSTANT RATE DRAWDOWN, RECOVERY AND TESTING DETAILS A397958: September 30, 2024





## Appendix C Certificates of Chemical Analysis



SGS Canada Inc. P.O. Box 4300 - 185 Concession St. Lakefield - Ontario - KOL 2HO Phone: 705-652-2000 FAX: 705-652-6365

#### GHD Limited - 735

Attn : Gus Bolin

347 Pido Rd., Unit #29 Peterborough, ON K9J 6Z8, Canada

Phone: 705-749-3317 Fax:

Project: 126140514-02, Buckhorn

07-October-2024

Date Rec.: 30 September 2024 LR Report: CA15809-SEP24 Reference: SSOW, 126140514-02, Gus Bolin

0003882947

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1

## CERTIFICATE OF ANALYSIS **Final Report**

Analysis	1:	3:	5:	8:	9	
	Analysis Start Date	Analysis Completed	RL1	14 William - 1 Hour	14 William - 6 Hours	
Sample Date & Time		Date		30-Sep-24 10:00	30-Sep-24 15:00	
Temp Upon Receipt [°C]	***	***	***	30-3ep-24 10.00 ***	30-3ep-24 13.00	
IV Transmittance [%T]	02-Oct-24	02-Oct-24		86 5	88.6	
Alkalinity [mg/L as CaCO3]	02-Oct-24	02-001-24	2	208	193	
	01-Oct-24	01-Oct-24	- 3	10	8	
Conductivity [uS/cm]	02-Oct-24	03-Oct-24	2	1560	1420	
pH [No unit]	02-Oct-24	03-Oct-24	0.05	7.97	8 11	
TSS [mg/L]	01-Oct-24	02-Oct-24	2	6	5	
	01-Oct-24	02-Oct-24	30	857	826	
Turbidity [NTU]	01-Oct-24	02-Oct-24	0.1	2.0	0.45	
Organic N [mg/L]	01-Oct-24	07-Oct-24	0.05	< 0.05	< 0.05	
TKN [as N mg/L]	01-Oct-24	07-Oct-24	0.05	< 0.05	< 0.05	
NH3+NH4 [as N mg/L]	01-Oct-24	02-Oct-24	0.04	< 0.04	< 0.04	
TOC [mg/L]	01-Oct-24	02-Oct-24	1	3	2	
DOC [mg/L]	01-Oct-24	02-Oct-24	1	3	3	
CI [mg/L]	01-Oct-24	02-Oct-24	0.20	390	350	
F [mg/L]	01-Oct-24	02-Oct-24	0.06	0.49	0.62	
NO2 [as N mg/L]	01-Oct-24	02-Oct-24	0.030	< 0.03	< 0.03	
NO3 [as N mg/L]	01-Oct-24	02-Oct-24	0.06	2.50	1.55	
SO4 [mg/L]	01-Oct-24	02-Oct-24	0.20	24	23	
Total P [mg/L]	01-Oct-24	02-Oct-24	0.03	< 0.03	< 0.03	
Tot.Reactive P [mg/L]	01-Oct-24	03-Oct-24	0.03	< 0.03	< 0.03	
Hg (diss) [mg/L]	02-Oct-24	02-Oct-24	0.00001	< 0.00001	0.00002	
Hardness (dissolved) [mg/L as CaCO3]	02-Oct-24	03-Oct-24	0.05	282	288	
AI (diss) [mg/L]	02-Oct-24	03-Oct-24	0.001	0.004	0.003	
Sb (diss) [mg/L]	02-Oct-24	03-Oct-24	0.0009	< 0.0009	< 0.0009	
As (diss) [mg/L]	02-Oct-24	03-Oct-24	0.0002	< 0.0002	0.0002	
Ba (diss) [mg/L]	02-Oct-24	03-Oct-24	8e-05	0.385	0.328	
B (diss) [mg/L]	02-Oct-24	03-Oct-24	0.002	0.055	0.119	

Results relate only to the sample tested. Data reported represents the sample submitted to SGS. Reproduction of this analytical report in full or in part is prohibited without prior written approval. Please refer to SGS General Conditions of Services located at https://www.sgs.ca/en/terms-and-conditions (Printed copies are available upon request.) Test method information available upon request. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples. SGS Canada Inc. Environment-Health & Safety statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or



SGS Canada Inc. P.O. Box 4300 - 185 Concession St. Lakefield - Ontario - KOL 2HO Phone: 705-652-2000 FAX: 705-652-6365

LR Report : CA15809-SEP24

Analysis	1:	3:	5:	8:	9:
	Analysis Start Date	Analysis Completed Date	RL14 William - 1 Hour		14 William - 6 Hours
Cd (diss) [mg/L]	02-Oct-24	03-Oct-24	3e-06	0.000095	0.000099
Ca (diss) $[mg/L]$	02-Oct-24	03-Oct-24	0.01	101	102
Cr (diss) [mg/L]	02-Oct-24	03-Oct-24	8e-05	0.00013	0.00017
Cu (diss) [mg/L]	02-Oct-24	03-Oct-24	0.0002	0.006	0.005
Fe (diss) [mg/L]	02-Oct-24	03-Oct-24	0.007	0.018	< 0.007
Pb (diss) [mg/L]	02-Oct-24	03-Oct-24	9e-05	< 0.00009	< 0.00009
Mg (diss) [mg/L]	02-Oct-24	03-Oct-24	0.001	7.38	8.18
Mn (diss) [mg/L]	02-Oct-24	03-Oct-24	1e-05	0.271	1.19
K (diss) [mg/L]	02-Oct-24	03-Oct-24	0.009	4.62	4.01
Na (diss) [mg/L]	02-Oct-24	03-Oct-24	0.01	192	158
Se (diss) [mg/L]	02-Oct-24	03-Oct-24	4e-05	0.00011	0.00011
U (diss) [mg/L]	02-Oct-24	03-Oct-24	2e-06	0.0328	0.0321
Zn (diss) [mg/L]	02-Oct-24	03-Oct-24	0.002	0.009	0.007
Cation Sum [meq/L]				14.15	12.83
Anion Sum [meq/L]				15.60	14.29
Anion-Cation Balance [% difference]				-4.88	-5.41
Ion Ratio				0.91	0.90
TDS (calculated) [mg/L]				843	764
Conductivity (calc) [uS/cm]				1487	1356
Langelier's Index [@ 4° C]				0.29	0.41
Saturation pH [pHs @ 4°C]				7.68	7.70
Fecal Coliform [cfu/100mL]	01-Oct-24	03-Oct-24			0
E.coli [cfu/100mL]	01-Oct-24	03-Oct-24			0
Total Coliform [cfu/100mL]	01-Oct-24	03-Oct-24			0

MAC - Maximum Acceptable Concentration

AO/OG - Aesthetic Objective / Operational Guideline NR - Not reportable under applicable Provincial drinking water regulations as per client.

Total phospuorous includes all Ortho-phosphates as well as Organics and hydrolyzable Phosphorous.

Temperature of Sample upon Receipt: 17 degrees C Cooling Agent Present: No Custody Seal Present: No

Chain of Custody Number: N/A

Jill Cumpbell

Jill Campbell, B.Sc., GISAS Project Specialist, Environment, Health & Safety

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