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Hydrogeological Investigation – Proposed Development at 125 Arthur St W. and 123 Louisa St W., Thornbury, Ontario

Palmer Project #
2105901

Prepared For
Blue Meadows Inc.

March 1, 2022

March 1, 2022

Shekhar Dalal
125 Arthur St W,
Thornbury, ON
N0H 2P0

Dear Shekhar:

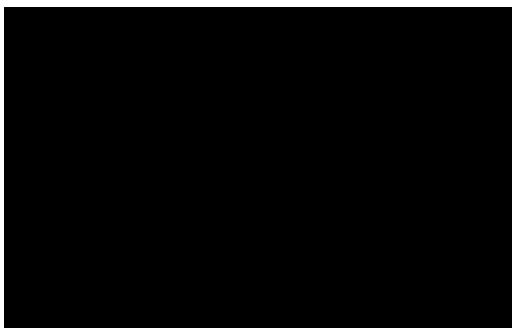
Re: Hydrogeological Investigation – Proposed Development at 125 Arthur St W. and 123 Louisa St W., Thornbury, Ontario
Project #: 2105901

Palmer Environmental Consulting Group was retained by Blue Meadows Inc (the “client”) to complete a hydrogeological investigation including a Water Balance Study to support the proposed future development of 125 Arthur St. W. (Block 2), and 123 Louisa St W. (Block 3), Thornbury, Ontario. Based on the Concept Plan prepared by Montgomery Philip King Architect Inc (2021), it is Palmer’s understanding that it is intended that the site be developed into mixed use commercial and residential buildings and townhouses that may include up to one (1) level of basement (**Appendix A**).

This report summarizes the results of the hydrogeological assessment including a characterization of site geology and hydrostratigraphy, groundwater levels, a dewatering estimate, and a Water Balance Study. We trust that this report will be satisfactory for your current needs. If you have any questions or require further information, please contact our office at your convenience. This report is subject to the Statement of Limitations provided at the end of this report.

Please let us know if you have question or comments on this submission. Thank you for the opportunity to work with your team on this project.

Yours truly,
Palmer



Jason Cole, M.Sc., P. Geo.
Principal, Senior Hydrogeologist

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1. Introduction

Palmer Environmental Consulting Group was retained by Blue Meadows Inc. (the “client”) to complete a Hydrogeological Investigation to support the proposed future development of 125 Arthur St West and 123 Louisa St West, Thornbury Ontario. It is Palmer’s understanding the site is intended to be developed into residential buildings consisting of townhouses, with 1-level of basement and mixed use commercial buildings with apartments in the upper floors. The Concept Plan, prepared by Montgomery Philip King Architect Inc., is provided in **Appendix A**. The site is currently occupied by a series of rural residential dwellings, historical agricultural fields and natural features. Little Beaver Creek runs along the northwestern property boundary and drains into Georgian Bay.

This report provides site information, including a characterization of site geology and hydrostratigraphy, groundwater conditions (i.e. groundwater levels, hydraulic gradient, and flow direction), nearby water wells and Source Water Protection. Dewatering rates were estimated for the construction of the residential blocks and the SWM pond. A pre-development water balance was also completed to provide recommendations for potential LID measures to help promote infiltration on the site. Palmer has also completed an effects assessment based on the site conditions and provided a series of hydrogeological development considerations.

1.1 Scope of Work

This Hydrogeological Investigation was completed based on borehole drilling and groundwater monitoring well installations completed by Palmer’s geotechnical team. We have relied on these boreholes logs and well records in its hydrogeological assessment. The logs are presented in **Appendix B**.

Palmer’s scope of work for the Hydrogeological Investigation included the following main tasks:

- Obtain and review applicable background information including surficial geology, bedrock geology, physiography mapping, and previous reporting including: “Geotechnical Investigation 125 Arthur Street W, 123 Louisa Street W, Thornbury” (2105901), Palmer Environmental Consulting Group, August 13, 2021; and grain size distribution data for the site provided by Terrapex (Appendix C);
- Review the borehole (BH) drilling and groundwater monitoring well (MW) installation logs. In total, ten (10) BH/MWs were completed at the site to depths ranging from 6.7 to 9.8 metres below ground surface (mbgs);
- Collect two (2) rounds of groundwater level measurements to establish water table and piezometric head levels;
- Determine the hydraulic conductivity of the geological materials through completing a single well response test (i.e., slug test) on a selected well and analyzing grain-size of selected soil samples;
- Collect three (3) groundwater samples for analysis to compare groundwater quality against the Ontario Drinking Water Standards Criteria;
- Complete a pre-development water balance to meet Grey Sauble Conservation Authority (GSCA) requirements and provide recommendations for potential LID measures to maintain the water balance for the site, if required;
- Provide hydrogeological development considerations and constraints based on the study findings;
- Provide Source Water Protection considerations for the site and recommendations for land use/mitigation based on source protection policy; and
- Produce a Hydrogeological Investigation Report outlining the results of the investigation.



LEGEND

- Borehole
- Monitoring Well
- Watercourse
- Subject Site (Approximate)

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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Source Notes:
Imagery (Maxar, 2019) provided by Esri basemap service. Watercourses provided by Ontario MNRF (Ontario Hydro Network).

NORTH

CLIENT	Blue Meadows Inc.	
PROJECT	125 Arthur St W and 123 Louisa St W Thornbury	
TITLE	Site Map and Monitoring Well Locations	
	REF. NO.	2105901-1-1
	Figure 1	

2. Regional Conditions

2.1 Surficial Geology and Physiography

The site is located on the northern portion of the Beaver Valley physiographic region (**Figure 2**) which occupies an area of 200 km² (Chapman and Putnam, 1984). The Beaver Valley physiographic region extends from the shoreline of Thornbury to Camperdown, south to Loree and the Blue Mountains. The region then narrows and tapers off just below Flesherton pulling back up north to Heathcote and rounding out just north of Griersville. The region is characterized by a steep-sided, broad-bottomed, valley with rare occurrences of drumlins. It also includes a variety of landforms such as lake plains, beaches, moraines and cliffs (Chapman and Putnam, 1984). The presence of a steep-sided and broad-bottomed valley can be attributed to the region's erosional history during glacial periods.

The surficial geology of the site indicates that the site consists of a series of unconsolidated sediments, deposited during the last glaciation. Ontario Geological Survey (OGS) mapping (**Figure 3**) depicts that the study area is underlain by fine-textured glaciolacustrine deposits of silt and clay, with minor sand and gravel. The deposits are further described as massive to well-laminated in nature. The northwestern portion of the site borders modern alluvial deposits in the form of clay, silt, sand and gravel with some organic content.

2.2 Bedrock Geology

Regional bedrock consists of the Georgian Bay Formation (OGS, 2017). The Georgian Bay Formation overlies the Blue Mountain Formation and is of Upper Ordovician age. The Georgian Bay Formation is characterized as interbedded grey-green to dark grey shale and fossiliferous calcareous siltstone to limestone (hard beds) (Armstrong and Dodge, 2007). The abundance and thickness of these hard beds generally decreases from north to south (Johnson et al., 1992). The bedrock is estimated to be located at more than 18 m below ground and was not considered as part of this assessment (MNDM, 2021).

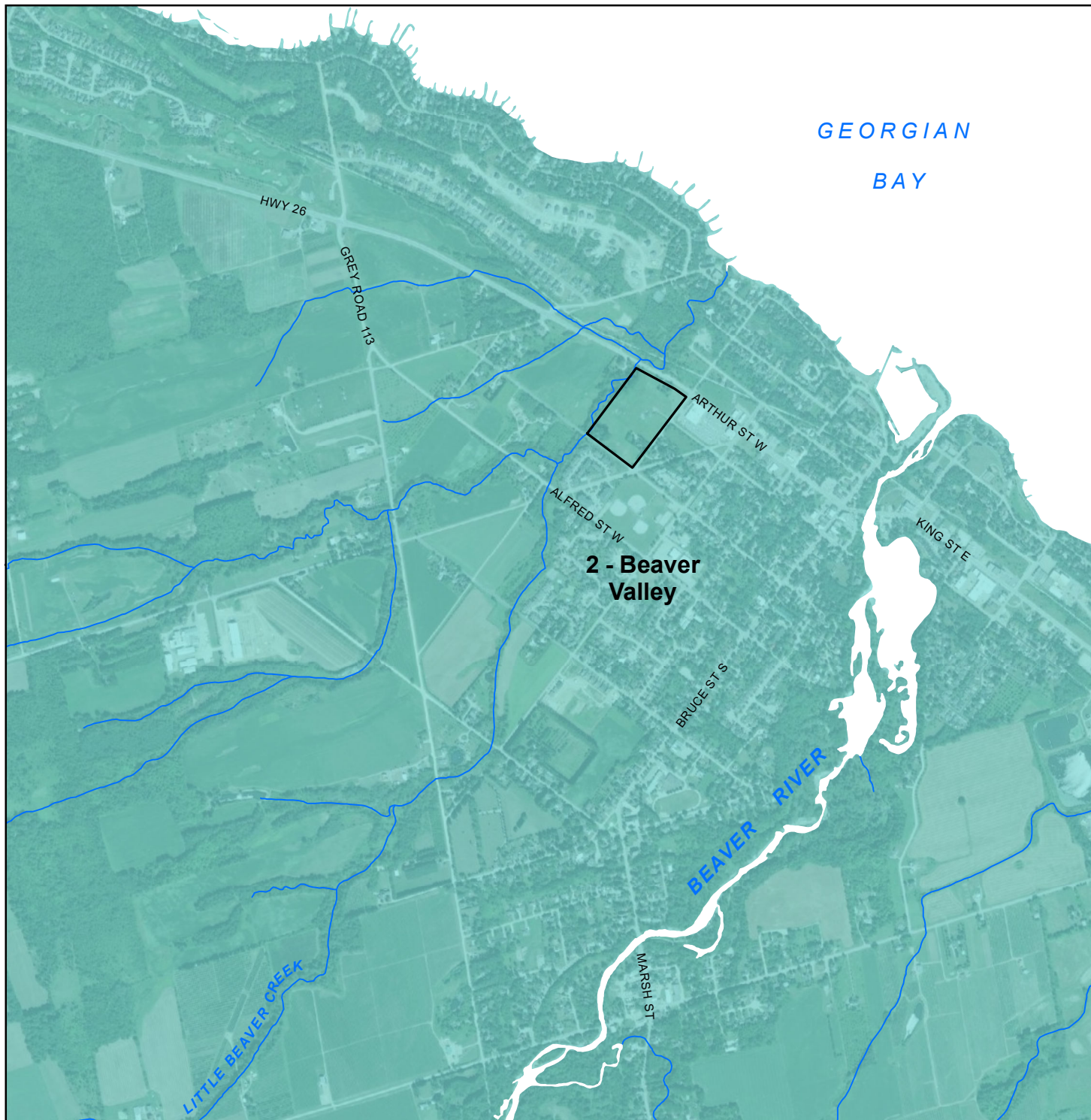
2.3 Drainage and Natural Features

The study area lies within the Little Beaver subwatershed that covers an area of 14.4 km² and outlets into Nottawasaga Bay at Thornbury (Saugeen Conservation et al. 2015). It borders the Beaver River Watershed to the south and east and falls under the jurisdiction of the Grey Sauble Conservation Authority (GSCA, 2018). The watershed flows north west predominantly through rural areas (Saugeen Conservation et al. 2015). Little Beaver Creek is present immediately northwest of the site on an adjacent property. This creek flow northeastwards towards Georgian Bay.

2.4 Source Water Protection

The site located in the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region. The Source Water Protection Plan identifies three main regulatory factors under the *Clean Water Act (2006)* relating to local hydrogeology to consider for site development: Significant Groundwater Recharge Areas (SGRAs), Highly Vulnerable Aquifers (HVAs), and Wellhead Protection Areas (WHPAs).

Based on available MECP Source Protection information mapping, the site is not situated within a SGRA HVA, or a WHPA (**Figure 4**). The northwestern portion of the site is located within an Intake Protection Zone 2 (IPZ-2) and Event Based Area due to the contributing drainage area to Little Beaver Creek which is located upstream of a surface water intake in Georgian Bay.



LEGEND

Subject Site (Approximate)

Watercourse

Physiographic Region¹

2 - Beaver Valley

1 - Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey, Miscellaneous Release—Data 228.

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North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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Source Notes:
Imagery (Maxar, 2019) provided by Esri basemap service. Watercourses provided by Ontario MNR (Ontario Hydro Network).

CLIENT

Blue Meadows Inc.

PROJECT

125 Arthur St W and
123 Louisa St W Thornbury

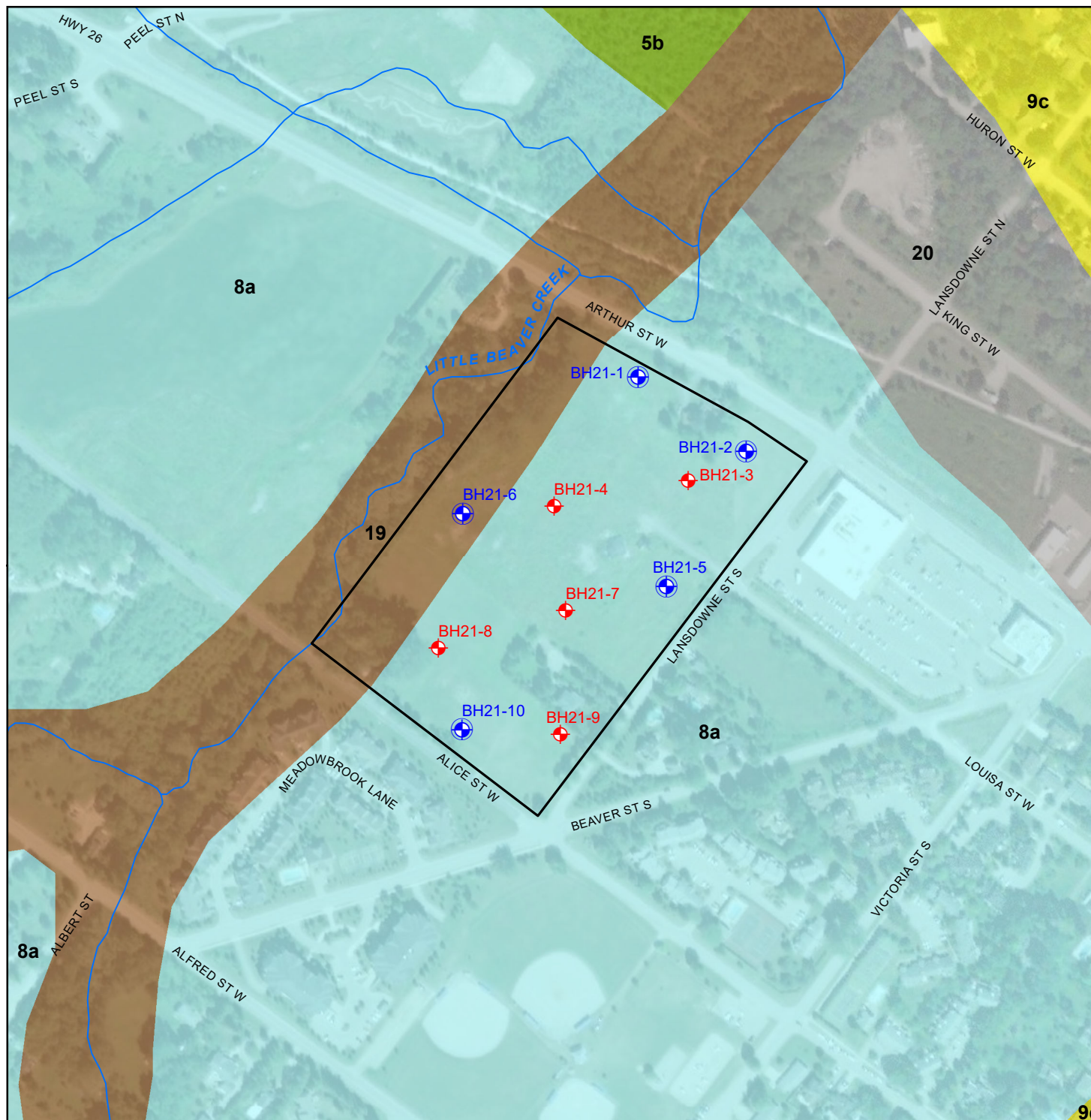
TITLE

Physiographic Region

Palmer™

REF. NO. 2105901-2-1

Figure 2



LEGEND

- Borehole
- Monitoring Well
- Watercourse
- Subject Site (Approximate)

Surficial Geology¹

- 20** Organic deposits: peat, muck, marl
- 19** Modern alluvial deposits: clay, silt, sand, gravel, may contain organic remains
- 9c** Coarse-textured glaciolacustrine deposits (Foreshore and basinal): sand, gravel, minor silt and clay
- 8a** Fine-textured glaciolacustrine deposits (Massive-well laminated): silt and clay, minor sand and gravel
- 5b** Till: Stone-poor, carbonate-derived silty to sandy till on Paleozoic terrain

1 - Source: Ontario Geological Survey 2010 (Mapped at 1:50,000). Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release- Data 128 - Revised

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METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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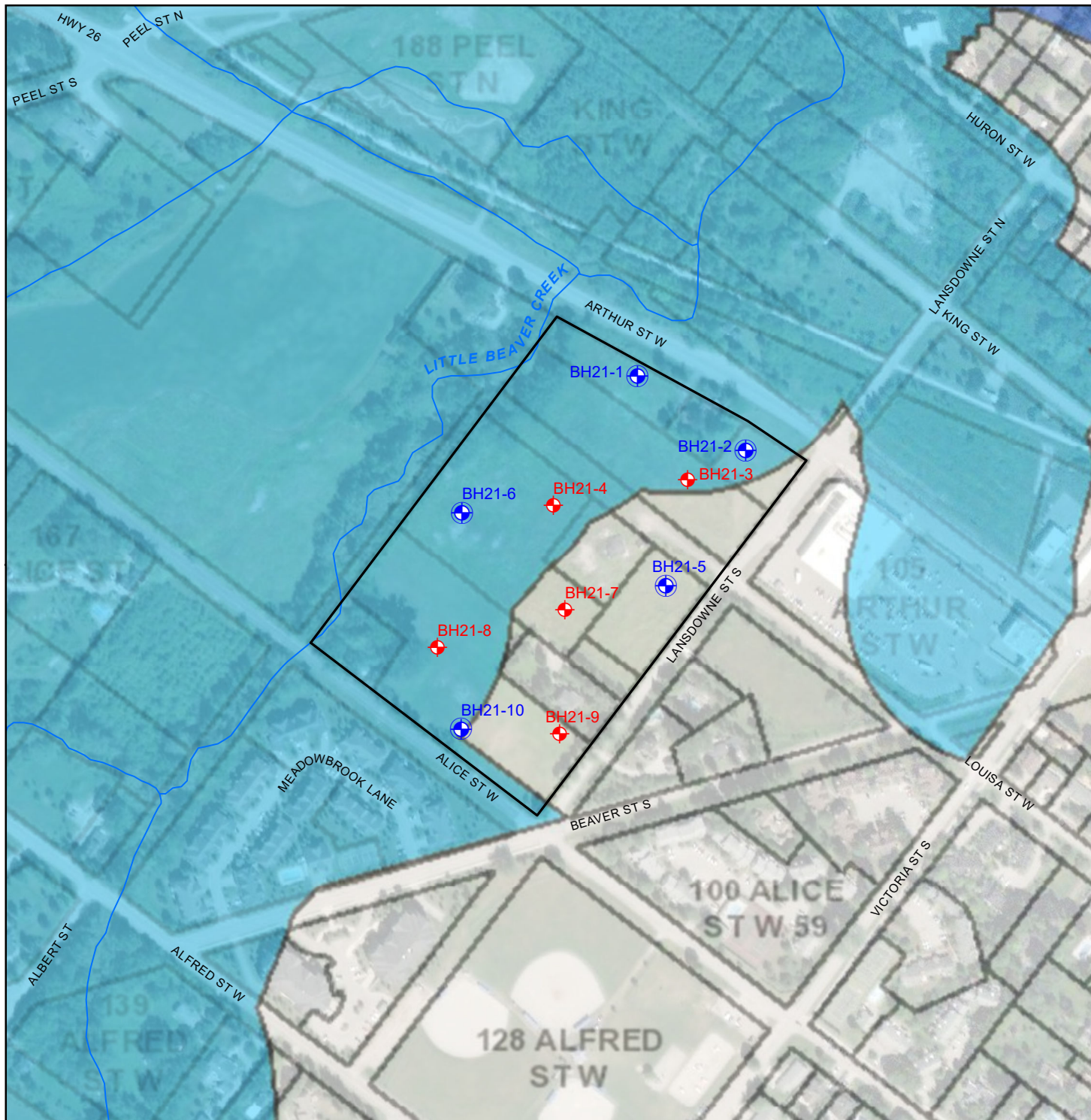
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Imagery (Maxar, 2019) provided by Esri basemap service. Watercourses provided by Ontario MNRF (Ontario Hydro Network).

NORTH

CLIENT	Blue Meadows Inc.	
PROJECT	125 Arthur St W and 123 Louisa St W Thornbury	
TITLE	Surficial Geology	
	REF. NO.	2105901-3-1
	Figure 3	



LEGEND

- Borehole
- Monitoring Well
- Watercourse
- Subject Site (Approximate)
- Intake Protection Zone 1¹
- Intake Protection Zone 2¹

¹ - Ontario Ministry of the Environment, Conservation and Parks (Source Water Protection Atlas)

0 50 100 150
METRE SCALE

North American Datum 1983
Universal Transverse Mercator Projection Zone 17

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Date: Aug 30, 2021

Source Notes:
Imagery (Maxar, 2019) provided by Esri basemap service. Watercourses provided by Ontario MNRF (Ontario Hydro Network).

NORTH

CLIENT	Blue Meadows Inc.
PROJECT	125 Arthur St W and 123 Louisa St W Thornbury
TITLE	Source Water Protection
REF. NO.	2105901-4-1
Palmer™	
Figure 4	

3. Site Conditions

3.1 Drilling and Installation of Monitoring Wells

A geotechnical assessment was conducted by drilling specialists subcontracted by Palmer on July 12th and 13th, 2021 which included the drilling of ten (10) boreholes and installation of groundwater monitoring wells. The boreholes were drilled to depths ranging from 6.7 to 9.8m below the existing ground surface (mbgs). Standard penetration tests were carried out at frequent intervals of depth throughout borehole drilling to take representative soil samples. Observations of groundwater conditions were made and monitoring wells were installed in five boreholes from 6.20 to 9.80 mbgs for the monitoring of stabilized groundwater levels at the site. Corresponding borehole locations are provided on **Figure 1**.

The boreholes were advanced with power auger drilling machine, where soil stratigraphy was recorded by observing the quality and changes of augered materials which were retrieved from the boreholes, and by sampling the soils at regular intervals of depth using a 50mm O.D. split spoon sampler, in accordance with the Standard Penetration Test (ASTM D 1586) method. Details of the monitoring well installations are provided in **Table 1**. Boreholes without monitoring wells installed were backfilled and sealed upon completion of drilling.

Table 1. Borehole and Monitoring Well Installation Details

Borehole/MW ID	Depth (mbgs)	Top of Screen (mbgs)	Bottom of Screen (mbgs)	Screened Geology	Hydrostratigraphic Unit
BH21-1	9.50	6.10	9.10	Silty Clay	Silty Clay
BH21-2	6.20	3.10	6.10	Silty Clay/Sand and Silt Till	Silty Clay/ Sand and Silt Till
BH21-3	6.70	N/A	N/A	N/A	N/A
BH21-4	6.70	N/A	N/A	N/A	N/A
BH21-5	6.70	3.10	6.10	Clayey Silt to Silty Clay	Silty Clay
BH21-6	9.80	6.15	9.15	Silty Clay/Silty Sand	Silty Clay
BH21-7	6.70	N/A	N/A	N/A	N/A
BH21-8	6.70	N/A	N/A	N/A	N/A
BH21-9	6.70	N/A	N/A	N/A	N/A
BH21-10	6.70	3.10	6.10	Clayey Silt/Silty Clay	Clayey Silt

3.2 Site-Specific Geology

The results of the borehole drilling investigations were generally consistent with the regional OGS mapping (**Figure 3**). Soil samples and borehole logs of the five (5) boreholes advanced were reviewed and the soil profile of the site was described as follows:

Topsoil. The site is overlain with a 200 to 350 mm thick layer of surficial topsoil across the site.

Fill Materials. Fill Materials consisting of clayey silt, silt, sandy silt, silty sand or sand textures were encountered at all boreholes locations and extended to depths ranging from about 0.7 to 1.1m below existing ground surface. For the clayey silt fill materials, standard penetration tests carried out measured N-values ranging from 5 to 11 blows/300mm, indicating a firm to stiff consistency. The silty sand and sand textures had N-values ranging from 2-10 blows/300mm, indicating a very loose to loose compactness condition. The in-situ moisture contents measured in the fill samples ranged from approximately 17% to 39%.

Silty Clay/Clayey Silt. Silty clay/ clayey silt deposits were encountered beneath fill materials or silt/sandy silt deposits in all boreholes, and extended to depths ranging from 4.1 to 9.3 m below existing ground surface. Standard penetration tests yielded N values ranging from 2 to greater than 50 blows per 300mm, indicating a soft to hard consistency. The natural moisture contents measured in the soil samples ranged from approximately 17% to 31%.

Silt/Sandy Silt. Silt/sandy silt deposits were also encountered below the fill materials or silty clay/clayey silt deposits in BH21-1, BH21-3, BH21-5, BH21-7 to BH21-10 and extending to depths ranging from 1.5 to 9.5 m below the existing ground surface. Standard penetration tests yielded N values ranging from 5 to over 50 blows per 300 mm, indicating a loose to very dense compactness condition across the site. The natural moisture contents measured in the soil samples ranged from approximately 6% to 25%.

Sand and Silt Till. Sand and silt till deposit was encountered below the silty clay/clayey silt deposit in BH21-2 and extended to the maximum depth drilled of about 6.2 m below existing ground surface in this borehole. Standard penetration tests yielded N values ranging from 9 to over 50 blows per 300 mm indicating a loose to very dense compactness condition. The natural moisture contents measured in the soil samples were approximately 13%.

Silty Sand. Silty sand deposit was encountered below silty clay/clayey silt deposits in BH21-6 and extended to the maximum explored depth of about 9.8 m below the existing ground surface at this borehole. Standard penetration tests yielded an N value of 9 blows per 300 mm indicating a loose compactness condition.

3.3 Groundwater Level and Flow

Water levels were measured by Palmer staff using a water level tape and recorded to the nearest centimetre. Stabilized water levels in the shallow well (BH21-2) ranged from 1.30 to 1.37 mbgs. Within the deep wells (BH21-1 and BH21-6) the depth to groundwater ranged from 3.70 to >3.90 mbgs during the August 13th, 2021 monitoring event.

Based on the initial groundwater level measurements, groundwater flow is expected to be towards the northwest, as shown on **Figure 2**.

Monitoring of groundwater levels will continue in accordance with the schedule outlined in the previously submitted proposal, and any additional data will be available to Blue Meadows Inc.

Table 2. Groundwater Levels

MW ID	Depth (mbgs)	Unit	Water Level	
			August 10 th , 2021	August 13 th , 2021
BH21-1	9.50	mbgs	4.0	4.37
BH21-2	6.20	mbgs	1.30	1.37
BH21-5	6.70	mbgs	1.10	1.29
BH21-6	9.80	mbgs	3.70	3.97
BH21-10	6.70	mbgs	0.80	0.89

Note: mbgs = meter below ground surface

3.4 Hydraulic Conductivity

Monitoring wells were purged dry on August 10th, 2021 by Palmer Staff prior to hydraulic conductivity testing. Hydraulic conductivity testing was then performed on all installed wells on site on August 13th, 2021, using falling head (slug) test method to determine the hydraulic conductivity (K) of the screened, saturated geological material.

For falling head tests, a slug of known volume was placed in the well and the rate of recovery was measured as the water level returned to static. Measurements were recorded using a datalogger which was set to record water levels at one-second intervals. Additionally, manual water level measurements were collected during the test in order to gauge recovery. The test was terminated once either 80% recovery had been attained or 30 minutes had elapsed. Hydraulic conductivity (K) values were calculated from the displacement-time data using the Bouwer and Rice (1976) Method as implemented in AQTESOLV ver. 4.5, HYDROSolve Inc. (**Appendix C**). The hydraulic conductivity of the saturated, screened soils at that location.

A K of 1.09×10^{-6} m/s for the clayey silt unit and a K of 4.58×10^{-8} m/s (geometric mean) for the self-confined silty clay unit were used in dewatering calculations. BH21-2 was screened in both the silty clay and underlying sand and silt till (approximately half in each). The hydraulic conductivity of the screened interval in this well was found to be 1.03×10^{-7} m/s. BH21-10 was screened in both the silty clay and clayey silt (approximately $\frac{2}{3}$ clayey silt and $\frac{1}{3}$ silty clay). The hydraulic conductivity of the screened interval in this well was found to be 1.09×10^{-6} m/s.

Table 3. Hydraulic Conductivity Results from Single Well Response Tests

MW ID	Test Type	Solution	K (m/s)	Geometric Mean K (m/s)	Screened Stratigraphy
BH21-1	Falling Head	Bouwer-Rice Confined	2.02×10^{-7}	4.58×10^{-8}	Silty Clay
BH21-2	Falling Head	Bouwer-Rice Confined	1.03×10^{-7}	—	Sand and Silt Till

MW ID	Test Type	Solution	K (m/s)	Geometric Mean K (m/s)	Screened Stratigraphy
BH21-5	Falling Head	Bouwer-Rice Confined	4.67×10^{-8}	4.58×10^{-8}	Silty Clay
BH21-6	Falling Head	Bouwer-Rice Confined	2.00×10^{-8}	4.58×10^{-8}	Silty Clay
BH21-10	Falling Head	Bouwer-Rice Confined	1.09×10^{-6}	—	Clayey Silt

As part of the hydrogeological investigation, three (3) representative samples of native silty clay/clayey silt soil underwent sieve/hydrometer particle size distribution analysis. The soil samples were collected from BH21-2, BH21-6 and BH21-10. Site-specific hydraulic conductivity values were determined from the grain size analysis using the HydrogeosieveXL program. The completed grain size distribution curves are provided in Appendix C, and the results of the empirical analyses are provided in **Table 4**.

$$K \text{ (Sauerbrei, 1932)} = \frac{\rho g}{\mu} [(3.75 \times 10^{-5}) \times \tau] \left[\frac{n^3}{(1-n)^2} \right] d_{17}^2 \frac{cm}{s}$$

Where K	=	hydraulic conductivity (cm/s)
ρ	=	$3.1 \times 10^{-8} T^3 - 7.0 \times 10^{-6} T^2 + 4.19 \times 10^{-5} T + 0.99985$
g	=	980 cm/s^2
μ	=	$-7.0 \times 10^{-8} T^3 + 1.002 \times 10^{-5} T^2 - 5.7 \times 10^{-4} T + 0.0178$
τ	=	$1.093 \times 10^{-4} T^2 + 2.102 \times 10^{-2} T + 0.5889$
n	=	porosity as a fraction of aquifer volume
T	=	water temperature ($^{\circ}C$)

The hydraulic conductivity of the sand and silt till at BH21-2 was calculated to be 1.4×10^{-7} m/s which is consistent with the expected range of sand and silt till. The hydraulic conductivity of the silty clay at BH21-6 was calculated to be 1.1×10^{-9} m/s which is consistent with the expected range of silty clay. The hydraulic conductivity of the clayey silt at BH21-10 was calculated to be 4.5×10^{-9} m/s which is on the lower end of the expected range of clayey silt. These values are approximately one order of magnitude lower than the results of the recovery test. This is anticipated to result from the inability of grain size-based methods to allow for the effects of soil structure, e.g., layering.

Table 4. Hydraulic Conductivity from Grain Size Analysis

BH ID	Soil Sample	Borehole Geology	Grain Size Determined Geology	Method of Analysis	K (m/s)
BH21-2	Sample 6	Sand and Silt Till	Poorly Sorted Sandy Silt	Sauerbrei	1.40×10^{-7}

BH ID	Soil Sample	Borehole Geology	Grain Size Determined Geology	Method of Analysis	K (m/s)
BH21-6	Sample 7	Silty Clay	Poorly Sorted Silt	Sauerebrei	1.10×10^{-9}
BH21-10	Sample 4	Clayey Silt	Poorly Sorted Silt	Sauerebrei	4.67×10^{-8}

3.5 Groundwater Quality

Groundwater chemistry samples were collected on August 13th, 2021 from BH21-2, BH21-6, and BH21-10 and analyzed at ALS Environmental, a CALA-accredited laboratory, for parameters included in the Ontario Drinking Water Quality Standards (ODWQS) criteria. A summary table of the groundwater analysis exceedances is presented in **Table 5** and a copy of the Certificate of Analysis is provided in **Appendix E**.

The samples all exceeded the Ontario Drinking Water Quality Standard Limits, for Total Dissolved Solids (TDS), Dissolved Manganese, Dissolved Sodium, Dissolved Aluminum, Colour, Turbidity, Total Alkalinity, and Hardness (as CaCO₃). These results are typical for raw groundwater in the area and it is expected that the concentrations of the parameters that exceed Ontario Drinking Water Quality Standard Limits could be easily reduced through reducing the TSS and turbidity in the groundwater.

Table 5. Groundwater Quality Exceedances of ODWQS

Parameter	Detection Limit	Ontario Drinking Water Quality Standard Limits	Units	Sample Concentration	Sample Concentration	
				BH21-2	BH21-6	BH21-10
Colour, Apparent	2.0	5	CU	N/A - did not exceed	5.1	32.0
Hardness (as CaCO ₃)	0.50	80-100	mg/L	541	437	721
Turbidity	0.10	5	NTU	36.7	51.7	261
Total Dissolved Solids	20	500	mg/L	765	626	917
Alkalinity, Total (as CaCO ₃)	1.0	30-500	mg/L	N/A - did not exceed	N/A - did not exceed	611
Dissolved Solids, Aluminum	0.0050	0.1	mg/L	0.167	0.174	N/A - did not exceed
Dissolved Solids, Manganese	0.00050	0.05	mg/L	0.158	0.530	0.402
Dissolved Solids, Sodium	0.050	20	mg/L	34.9	21.9	42.2

4. Water Balance

4.1 Pre-Development Water Balance

A pre-development water balance was completed for the site to determine the existing runoff and groundwater recharge (infiltration) conditions of the site. The area of the subject property is approximately 5.6 ha.

The pre-development water budget was calculated over the site area using a monthly soil-moisture balance approach as described in Thornthwaite and Mather (1957). The water balance calculation estimates average annual evapotranspiration (evaporation and plant transpiration) using factors such as monthly precipitation, temperature, and latitude. Long term climate data were obtained from the nearest meteorological station to the study area with long term data. Data was obtained over the 30-year duration from 1981 to 2010 from the Thornbury Slama Station which is approximately 2.5 km from the site.

The average available water surplus, which is the water available for infiltration and runoff, was calculated by subtracting the average annual evapotranspiration from the average annual precipitation (**Table 6**). A soil moisture retention value of 125 mm was utilized to represent the combination of silt loam and shallow-rooted crops, as described by Thornthwaite and Mather (1957). The resulting annual water surplus for the area was then partitioned using MOEE (1995) infiltration factors (**Table 7**).

Table 6. Water Balance Annual Surplus

Water Balance (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Precipitation	100	68.4	64	65.3	82.7	79.7	72.1	78.2	95.9	87.3	99.6	99.4	992
Temperature (°C)	-6.3	-5.4	-1.5	5.5	11.5	16.7	19.8	19.2	15.5	9.1	3.1	-2.7	7
Potential Evapotranspiration (PET)	0	0	0	29	72	107	130	117	81	42	11	0	590
P-PET	100	68	64	36	11	-28	-58	-39	15	45	88	99	402
Change in Soil Moisture Storage	0	0	0	0	0	-26	-38	-16	6	222	52	0	0
Soil Moisture Storage	125	125	125	125	125	99	61	45	51	73	123	123	-
Actual Evapotranspiration (AET)	0	0	0	29	72	105	110	94	81	42	0	0	544
Soil Moisture Deficit	0	0	0	0	0	2	20	23	0	0	0	0	45
Surplus (P-AET)	100	68	64	36	11	-26	-38	-16	15	45	88	99	447.6

Based on OGS surficial geology mapping and drilling results, the site is underlain by fine-textured glaciolacustrine deposits (infiltration factor of 0.1) The site has a combination of flat and hilly topography (infiltration factor of 0.15). The land use is dominated by open agricultural fields (infiltration factor of 0.1) **Table 8** presents the interpreted soil infiltration factors used for the site-wide water budget. The selection of these values, shown in **Table 7**, is based on the MOEE (1995) values and site-specific conditions.

Table 7. MOEE (1995) Infiltration Factors

Description of Area/Development Site	Value of Infiltration Factor
TOPOGRAPHY -Average slope factor of 2.5%	0.15
SOIL -Fine-texture glaciolacustrine deposits: Massive to well laminated	0.10
COVER -Open Agricultural Field	0.10

Note: Reproduced from MOEE (1995), Technical Guidelines for the Preparation of Hydrogeological Studies for Land Development Applications.

Table 8. Infiltration and Runoff Factors

Description of Area	Topography Factor	Soils Factor	Cover Factor	Infiltration Factor	Runoff Factor
Agricultural	0.15	0.10	0.10	0.35	0.65

The calculated actual ET (or AET) based on the Thornthwaite and Mather monthly water balance model is approximately 544 mm/year, or approximately 55% of the total annual precipitation (**Table 6**). The actual evapotranspiration is calculated based on a potential ET (or PET) and soil-moisture storage withdrawal. Monthly PET is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation covered area that never lacks water (Thornthwaite, 1948; Mather, 1978). The calculated PET for the study area is 590 mm/year, or about 59% of the total precipitation.

The estimated pre-development water surplus was calculated using the soil moisture retention value for the site is approximately 448 mm/year (**Table 6**). The water surplus has two components: a runoff component which occurs when the soil moisture capacity is exceeded leading to overland flow, and an infiltration component. Using the previously calculated range of infiltration factors, it is estimated that, as site-wide averages, approximately 291 mm/year of the surplus runs off, and the remaining 157 mm/year infiltrates to the groundwater. Over the full site of 5.6 ha, this represents approximately 10,103 m³/year of infiltration and 18,763 m³/year of runoff (**Table 9**).

Table 9. Pre-Development Water Budget

Water Balance Components	Site
Total (ha)	5.6
Impervious Factor	0.00
Impervious area (ha)	0.00
Water Surplus on Impermeable Surfaces (m³/year)	0.893
Run off from Impervious Area (m³/year)	0.00
Estimated Pervious Area (ha)	5.6
Water Surplus on Vegetated Pervious Areas (m³/year)	0.448

Water Balance Components	Site
Runoff Coefficient	0.65
Runoff Volume From Pervious Area (m³/year)	16,307
Infiltration Coefficient	0.35
Infiltration Volume from Pervious Area (m³/year)	8,781
Total Runoff Volume (m³/year)	16,307
Total Infiltration Volume (m³/year)	8,781

4.2 Low Impact Development Considerations

Based on Source Water Protection Policies and the geology of the site, maintaining the pre-to-post development infiltration rates is not required for this site. However, to help manage stormwater on site and to provide options for the potential use of LID measures, some guidance based on the groundwater conditions is provided.

For sites with deep water table conditions and high permeability soils, LID practices can significantly improve infiltration and groundwater water recharge to maintain the groundwater characteristics of the underlying aquifer. However, for sites with low permeability solid and high water table conditions, the amount of infiltration is limited by the saturated hydraulic conductivity of the soil (i.e., the rate at which water can infiltrate). Under these conditions, LID practices should focus on filtration, evaporation, detention and re-use to minimize pre-to-post changes in the site water budget.

The site is underlain by low permeability fine-textured glaciolacustrine deposits overlying Till. Groundwater was found at shallow depths in the summer ranging from 0.80 to 4.37 mbgs across the site. These conditions will limit groundwater recharge function and limit LID depth/design. Under Source Water Protection Policies, the site was not identified as a SCRA nor is located in a WHPA or a WHPA-Q2. Post-development, stormwater runoff could be infiltrated with the use of LID measures that are commensurate with the existing hydrogeological function of the site.

The lower permeability soils on site will limit the groundwater recharge function of these areas under both pre-development and post-development conditions. LID practices should focus on detention and enhanced infiltration. A series of rear yard infiltration trenches and vegetated swales located along the northwestern property boundary where the water table appears to be deepest may be effective in promoting infiltration of stormwater. It is important to note that LIDs should be installed at least one (1) meter above the water table.

5. Development Considerations and Potential Effects

5.1 Dewatering and Groundwater Control

Short-term construction dewatering may be required for the installation of the building foundation, the one level of basement, and for site servicing. Under MECP requirements, registration on the Environmental and Site Activity Registry (EASR) is required when dewatering is greater than 50,000 L/day and less than 400,000 L/day. A Permit to Take Water (PTTW) is required when dewatering is expected to be greater than 400,000 L/day.

Given the presence of low permeability soils present at the site, construction dewatering rates are expected to be low for the construction of townhouse developments (i.e., <50,000 L/day) and be manageable by sump pumping from the base of the excavation. Under these conditions, a PTTW or registration on the EASR is not expected to be required. Based on this, the radius of water table drawdown would be minimal, no adverse effects to local water wells or natural features would be expected from the minor dewatering predicted.

Given the potential for shallow groundwater levels, the use of sump pumps for each building is recommended. The sump pumps should discharge to surface to be allowed to infiltrate on site.

5.2 Natural Environment

No adverse impacts on the natural environment are expected as a result of this project's dewatering or changes to the water balance. No natural environment features are located within the radius of influence of dewatering and based on the site geology, Little Beaver Creek is not expected to be significantly supported by groundwater discharge from the low permeability soils at the site.

5.3 Private Water Wells

Local Water Well Records (WWRs) obtained from the Ministry of the Environment, Conservation and Parks (MECP) show that there are approximately thirty wells within a 0.5 km radius of the site. These wells document static water levels of approximately 3.0-5.0 mbgs, generally in-accordance with depths to water measured by Palmer staff on-site. The nearest Permit to Take Water (PTTW) on record with the MECP is for a location approximately 1.3 km southwest of the site at a permitted maximum rate of 1,800,000 L/day. Other sites in close proximity to the site where dewatering has occurred are registered on the EASR, and therefore means that dewatering rates were 400,000 L/day or less. It is not expected that private water wells will be impacted as a result of dewatering activities as no private groundwater users were identified within a 500 m radius of the site.

6. Conclusions and Recommendations

Based on the results of our Hydrogeological Investigation for a proposed development at 125 Arthur St West and 123 Louisa St West, Thornbury, Ontario, the following summary of conclusions and recommendations are presented:

- The site is approximately 5.6 ha in area and proposed to be redeveloped into a townhouse development with one level of basement and mixed use commercial buildings with residential apartments in the upper floors. Currently, the site is occupied by undeveloped fields agricultural field and rural residential homes.
- The site is underlain by low permeability fine-textured glaciolacustrine deposits overlying Till soils. The site is generally underlain by a 0.2 to 0.9 m intermixed silty sand fill layer with some clay, followed by fine-textured glaciolacustrine silty clay and clayey silt soils extending to the drilled depth of 9.8 m.
- The groundwater levels on the site range from 0.80 to 4.37 mbgs and groundwater flow is towards the northwest.
- Based on grain size distribution analyses, the silty clay unit at BH21-6 has a K-value of 1.1×10^{-9} m/s respectively. A falling head test that was conducted at BH21-6 the K-value was found to be 2.0×10^{-8} m/s which is in-line with the findings of the grain size (which does not consider soil structure). Based on grain size distribution analysis, the clayey silt unit at BH21-10 has a K-value of 4.67×10^{-8} m/s. This value is again within two magnitudes of the falling head test conducted at BH21-10 which had a K-value of 1.09×10^{-6} m/s and can be attributed to the grain size analysis not taking into consideration heterogeneity in the soil structure.
- A groundwater sample was collected from BH21-2, BH21-6, and BH21-10 on August 13th, 2021 and analyzed for comparison against the Ontario Drinking Water Quality Standards (ODWQS) criteria. The samples exceeded ODWQS criteria for Total Dissolved Solids (TDS), Dissolved Manganese, Dissolved Sodium, Dissolved Aluminum, Colour, Turbidity, Total Alkalinity, and Hardness (as CaCO_3). The exceedances of some physical parameters (such as colour) could be due to lab processing times.
- Source water protection mapping indicates that the site is not located within a SGRA, WHPA or HVA but is located within an intake protection zone IPZ-2.
- No private groundwater users were identified within a 500 m radius of the development site.
- Based on the site-wide water balance, approximately 291 mm/year of the precipitation surplus runs off and the remaining 157 mm/year infiltrates to the groundwater. Over the full site of 5.6 ha, this represents approximately 8,781 m³/year of infiltration and 16,307 m³/year of runoff.
- Based on Source Water Protection policies and the hydrogeological conditions, the pre-to-post development infiltration rates are not required to be maintained.

- Given the presence of low permeability soils present at the site, construction dewatering rates are expected to be low for the construction of townhouse developments (i.e., <50,000 L/day) and be manageable by sump pumping from the base of the excavation. Under these conditions, a PTTW or registration on the EASR is not expected to be required.

7. Statement of Limitations

The extent of this study was limited to the specific scope of work for which we were retained and that is described in this report. Palmer has assumed that the information provided by the client or any secondary sources of information are factual and accurate. Palmer accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or negligent acts from relied upon data. Judgment has been used by Palmer in the interpretation of the information provided but subsurface physical and chemical characteristics may differ from regional scale geology mapping and vary between or beyond well/borehole locations given the inherent variability in geological conditions.

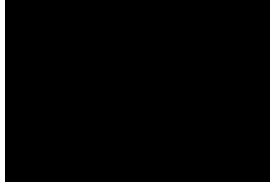
Palmer is not a guarantor of the geological or groundwater conditions at the subject site, but warrants only that its work was undertaken and its report prepared in a manner consistent with the level of skill and diligence normally exercised by competent geoscience professionals practicing in the Province of Ontario. Our findings, conclusions and recommendations should be evaluated in light of the limited scope of our work.

The information and opinions expressed in the Report are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT PALMER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS PALMER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belongs to Palmer. Any use which a third party makes of the Report is the sole responsibility of such third party. Palmer accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Palmer's express written permission. Should the project design change following issuance of the Report, Palmer must be provided the opportunity to review and revise the Report in light of such alteration or variation.

8. Closure

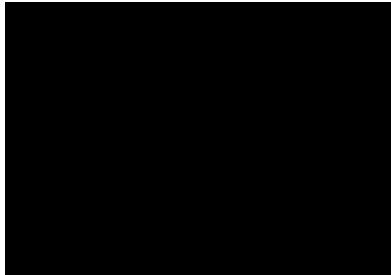
This report was prepared, reviewed and approved by the undersigned.

Prepared By:



Cole Thompson, B.Sc.
Environmental Scientist (Hydrogeology)

Reviewed By:



Jason Cole, M.Sc., P.Geo.
Principal, Senior Hydrogeologist

9. References

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Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0 – Appendix D.

Appendix A – Blue Meadows Development Concept Plan (Montgomery Philip King Architect Inc.)

ISSUED FOR REVIEW
ISSUED FOR TENDER
ISSUED FOR PERMIT
ISSUED FOR CONSTRUCTION



GENERAL NOTES:

- INFORMATION USED OR ACQUIRED IN THE DEVELOPMENT OF THIS SITE PLAN WAS FROM RUDY MAX SURVEYING LTD. (ONTARIO LAND SURVEYOR) BARRIE ONTARIO, JOB NO. 13384, SHOWING TOPOGRAPHY ON PART OF LOTS 46-44, INCLUSIVE, 46 & 47 SOUTHWEST SIDE OF ARTHUR STREET AND ALL OF LOTS 40 TO 44 INCLUSIVE, PARTS OF LOTS 46 TO 48 INCLUSIVE, NORTHEAST SIDE OF LOUISA STREET AND ALL OF PARK LOTS 11 TO 14 INCLUSIVE, SOUTHWEST SIDE OF LOUISA STREET AND PART OF PARK LOTS 11 AND 12, AND ALL OF PARK LOTS 13, 14, AND 15, NORTHEAST SIDE OF ALICE STREET, TOWN OF THORNHURST, GEORGIC TOWN OF THORNHURST, TOWN OF THE BLUE MOUNTAINS COUNTY OF SIMCOE.
- TOTAL SITE AREA IS 5.6 HECTARES (13.8 ACRES).
- MOST OF THE LANDS SHOWN ARE DESIGNATED PRIMARY SETTLEMENT AREA IN THE COUNTY OFFICIAL PLAN, WITH A PORTION DESIGNATED AS HAZARDOUS LAND. THE LANDS ARE DESIGNATED DOWNTOWN AREA, COMMUNITY LIVING AREA AND HAZARD LAND WITHIN THE TOWN OF BLUE MOUNTAINS OFFICIAL PLAN.
- PARKING STALL SIZES SHOWN ARE 2.75m WIDE X 5.5m LONG.
- HANDICAPPED PARKING STALL SIZE SHOWN ARE 3.4m WIDE X 5.5m LONG.
- AUTOMOBILE DRIVE AISLE WIDTH TO BE 6.0m WIDE.
- SHARED PARKING FOR THE COMMERCIAL BUILDINGS AND APARTMENTS ABOVE AS PER TABLE 5.4 OF THE TOWN OF BLUE MOUNTAINS ZONING BYLAW.
- NO OUTDOOR GARBAGE OR RECYCLING PROPOSED. ALL GARBAGE AND RECYCLING TO BE WITHIN THE BUILDING.
- ANY NEW SIGNAGE IS SUBJECT TO THE TOWN OF THE BLUE MOUNTAINS SIGN BYLAW.
- BICYCLE PARKING IS SHOWN NEAR THE COMMERCIAL BUILDINGS.
- SNOW STORAGE TO BE STORED ON SITE IN THE DESIGNATED SNOW STORAGE AREA. ANY ADDITIONAL SNOW IS TO BE REMOVED FROM THE SITE.
- SHIPPING AND RECEIVING FOR THE COMMERCIAL BLOCKS 1 AND 2 TO BE IN THE PARKING GARAGE.
- ROW HOUSES HAVE A 6.0m WIDE LOT FRONTAGE, 6.0m FRONT YARD SETBACK, 7.5m REAR YARD SETBACK.
- ALL AISLE WIDTHS WITHIN THE PARKING LOTS ARE 6.0m.



SITE STATISTICS (TOTAL SITE AREA = 5.6 HECTARES)			
LAND USE	NUMBER OF UNITS	GROUND FLOOR AREA	PARKING PROVIDED
RESIDENTIAL TOWNHOUSES ROW HOUSES	98 UNITS	9658 m ²	2 spaces per unit
COMMERCIAL RESIDENTIAL TOWNHOUSES	18 UNITS	1171 m ²	2 spaces per unit residential 1 space for 20% of commercial
COMMERCIAL BUILDINGS	2 BUILDINGS CONTAINING A TOTAL OF 17 COMMERCIAL UNITS	1755 m ²	89 parking spaces required
APARTMENT UNITS ABOVE THE COMMERCIAL BUILDINGS	2 BUILDINGS CONTAINING A TOTAL OF 75 APARTMENTS	no ground floor area	as per the zoning bylaw

SCHEDULE OF LAND USE			
PROPOSED LAND USE	BLOCKS	YIELD UNITS, BLOCKS	AREA
RESIDENTIAL ROW HOUSES & SEMI-DETACHED DWELLING	1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 14, 15, 16	98 UNITS PER 3 BLOCKS	2,082.2 HECTARES 26,822.2 M ²
COMMERCIAL RESIDENTIAL TOWNHOUSES	18, 25, 21	18 UNITS PER 3 BLOCKS	2,082.2 HECTARES 26,822.2 M ²
COMMERCIAL BUILDINGS 1 & 2	18, AND 22	17 UNITS PER 2 BLOCKS	7,083 HECTARES 88,611 M ²
RESIDENTIAL UNITS ABOVE THE 2 COMMERCIAL BUILDINGS	18, AND 22	75 UNITS PER 2 BLOCKS	SHARED SPACE WITH COMMERCIAL BUILDINGS 1 & 2 2,082 HECTARES 26,822 M ²
STORM WATER FACILITY	17		1,039 HECTARES 12,987 M ²
PUBLIC PARK	13		803.2 HECTARES 10,040 M ²
OPEN SPACE	5, 6, AND 23		8,032 HECTARES 100,400 M ²
ROAD ALLOWANCE			1,314 HECTARES 16,368 M ²
TOTAL			4.6 HECTARES 57,600 M ²

ADDED & REVISED INFORMATION	9.	22/02/04	MPK
ADDED DIMENSIONS	8.	22/02/02	MPK
REVISED SITE TRIANGLES & DIMENSIONS	7.	22/01/26	MPK
REVISED LOT LINES	7.	22/01/26	MPK
REVISED DRAWING DIM COMMENTS	6.	22/01/21	MPK
REVISED LOT LINES	5.	22/01/07	MPK
ADDED 15m SETBACK LINE	4.	22/01/05	MPK
REVISED CHART	3.	21/12/31	MPK
REVISED DRAWING	2.	21/12/06	MPK
ISSUED FOR COMMENT	1	21/12/02	MPK
Particulars	No.	Date	By

Revisions to drawing



Project title
BLUE MEADOWS DEVELOPMENT
LANDSDOWNE & ALICE STREET
THORNHURST
TOWN OF THE BLUE MOUNTAINS

Project number	Date	Scale
2021-1000	DEC 2021	as noted
Sheet title	Drawn by	Checked by
SITE LAYOUT (NOTES)	MPK	MPK
		Drawing no.
		A1.0

Appendix B – Borehole Logs

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W

CLIENT: Blue Meadows Inc.

Method: Solid Stem Augers

PROJECT LOCATION: Thornbury, ON

Diameter: 150mm

REF. NO.: 2105901

DATUM: N/A

Date: Jul-13-2021

ENCL NO.: 1

BH LOCATION: See Borehole Location Plan

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)		WATER CONTENT (%)		W _P		W				
0.0	Ground Surface TOPSOIL: 350 mm		1	SS	4		Concrete											
0.4	FILL: sand, some silt, trace clay, some organics, trace rootlets, contains sandy silt pockets, dark brown to brown, wet, loose		2	SS	10													
1.1	SILT: some clay, trace sand, contains sand seams, brown, wet, loose to compact		3	SS	11													
2.2	SILTY CLAY: some to trace sand, trace gravel, brown, wet, firm to hard contains sand seams, contains silt layers		4	SS	7			Holeplug										
			5	SS	5												75	
			6	SS	7												150	
			7	SS	5												62	
			8	SS	6			Sand Screen									62	
9.3	SANDY SILT: some clay, trace gravel, contains cobbles, grey, moist, very dense		9	SS	55/230mm			Sand										
9.5	END OF BOREHOLE 1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (mBGS) Aug 10, 2021 3.98																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

BH LOCATION: See Borehole Location Plan

GRAPH NOTES + 3, X 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W

CLIENT: Blue Meadows Inc.

Method: Solid Stem Augers

PROJECT LOCATION: Thornbury, ON

Diameter: 150mm

REF. NO.: 2105901

DATUM: N/A

Date: Jul-12-2021

ENCL NO.: 3

BH LOCATION: See Borehole Location Plan

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)					WATER CONTENT (%)					
	Ground Surface																	
0.0	TOPSOIL: 200 mm																	
0.2	FILL: sandy silt, trace clay, trace gravel, trace rootlets, trace organics, dark brown to brown, moist, very loose to loose		1	SS	3													
1.1	CLAYEY SILT: some sand, contains sand seams, contains silt layers, brown, wet, stiff to very stiff		2	SS	9													
			3	SS	16													
2.2	SILT: some clay, some sand, trace gravel, contains sand seams, brown, moist, compact		4	SS	13													
	contains clayey silt layers		5	SS	16													
4.7	CLAYEY SILT: trace sand, contains silty clay layers, contains sand seams, brown, wet to moist, stiff to very stiff		6	SS	14													
			7	SS	20													
6.7	END OF BOREHOLE 1. Borehole was open upon completion of drilling.																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH
NOTES

+ 3 , × 3 : Numbers refer to Sensitivity

○ = 3% Strain at Failure

BH LOCATION: See Borehole Location Plan

GRAPH NOTES + 3, X 3: Numbers refer to Sensitivity ○ ● = 3% Strain at Failure

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W

CLIENT: Blue Meadows Inc.

Method: Solid Stem Augers

PROJECT LOCATION: Thornbury, ON

Diameter: 150mm

REF. NO.: 2105901

DATUM: N/A

Date: Jul-12-2021

ENCL NO.: 5

BH LOCATION: See Borehole Location Plan

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)		
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)										WATER CONTENT (%)	
								20 40 60 80 100										10 20 30	
	Ground Surface																GR SA SI CL		
0.0	TOPSOIL: 220 mm						Concrete												
0.2	FILL: sandy silt, trace clay, trace gravel, trace rootlets, trace organics, contains sand layers, dark brown to brown, moist to wet, very loose to loose		1	SS	3														
1.1	SILT: some clay, trace sand, trace gravel, contains clayey silt layers, brown, wet, compact to loose		2	SS	10														
			3	SS	9		W. L. 1.2 mBGL Aug 10, 2021												
2.2	CLAYEY SILT TO SILTY CLAY: trace sand, brown, wet, firm to stiff		4	SS	9														
			5	SS	8														
			6	SS	6		Sand Screen												
			7	SS	8		Sand												
6.7	END OF BOREHOLE 1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (mBGS) Aug 10, 2021 1.12																		

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH
NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W

CLIENT: Blue Meadows Inc.

Method: Solid Stem Augers

PROJECT LOCATION: Thornbury, ON

Diameter: 150mm

REF. NO.: 2105901

DATUM: N/A

Date: Jul-12-2021

ENCL NO.: 6

BH LOCATION: See Borehole Location Plan

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m ³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)				W _p	W	W _L			
0.0	Ground Surface							20	40	60	80	100					
0.0	TOPSOIL: 300 mm							20	40	60	80	100	10	20	30		
0.3	FILL: sand, some silt, trace clay, trace gravel, trace rootlets, trace		1	SS	5												
0.5	orgaincs, contains sandy silt																
0.7	pockets, dark brown to brown, wet, loose		2	SS	10												
	FILL: clayey silt, trace sand, trace rootlets, trace organics, brown, wet, firm																
	CLAYEY SILT: trace sand, contains sand seams, brown, wet to moist, stiff		3	SS	10												Spoon wet
2.2	SILTY CLAY: trace sand, trace gravel, contains sand seams, brown to grey, wet, firm to soft		4	SS	7												
			5	SS	8												
			6	SS	5										75		
			7	SS	3										50	0	1 63 36
			8	SS	2										7		
8.7	SILTY SAND: some clay, some gravel, grey, moist, loose		9	SS	9												
9.8	END OF BOREHOLE 1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (mBGS) Aug 10, 2021 3.70																

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W

CLIENT: Blue Meadows Inc.

Method: Solid Stem Augers

PROJECT LOCATION: Thornbury, ON

Diameter: 150mm

REF. NO.: 2105901

DATUM: N/A

Date: Jul-12-2021

ENCL NO.: 7

BH LOCATION: See Borehole Location Plan

[illegible]

GROUNDWATER ELEVATIONS

	1st	2nd	3rd	4th
Measurement				

GRAPH
NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ $\epsilon = 3\%$ Strain at Failure

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W

CLIENT: Blue Meadows Inc.

Method: Solid Stem Augers

PROJECT LOCATION: Thornbury, ON

Diameter: 150mm

REF. NO.: 2105901

DATUM: N/A

Date: Jul-12-2021

ENCL NO.: 8

BH LOCATION: See Borehole Location Plan

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			POCKET PEN (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)					WATER CONTENT (%)					
	Ground Surface																	
0.0	TOPSOIL: 200 mm																	
0.2	FILL: silty sand, trace clay, some organics, trace rootlets, dark brown, wet, very loose		1	SS	3													
0.7	SANDY SILT: trace clay, trace gravel, contains sand seams, brown, moist, compact		2	SS	12													
1.5	CLAYEY SILT: trace to some sand, trace gravel, contains sand seams, contains silt layers, brown, moist to wet, stiff to firm		3	SS	10													
			4	SS	8													
			5	SS	8													
4.1	SILTY CLAY: trace sand, brown to grey, wet, stiff		6	SS	9													
		grey	7	SS	9													
6.7	END OF BOREHOLE																	

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

BH LOCATION: See Borehole Location Plan

GRAPH NOTES + 3, × 3: Numbers refer to Sensitivity ○ 8=3% Strain at Failure

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W

CLIENT: Blue Meadows Inc.

Method: Solid Stem Augers

PROJECT LOCATION: Thornbury, ON

Diameter: 150mm

REF. NO.: 2105901

DATUM: N/A

Date: Jul-13-2021

ENCL NO.: 10

BH LOCATION: See Borehole Location Plan

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT			POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			SHEAR STRENGTH (kPa)				W _p	W	W _L			
0.0	Ground Surface							20	40	60	80	100					GR SA SI CL
0.0	TOPSOIL: 230 mm																
0.2	FILL: silty sand, some clay, trace gravel, trace rootlets, trace organics, contains sandy silt pockets, dark brown to brown, wet, very loose		1	SS	3		Concrete										
0.7	SANDY SILT: trace clay, trace gravel, contains sand seams, brown, moist, loose to compact contains silt layers		2	SS	7		W. L. 0.8 mBGL Aug 10, 2021										
			3	SS	11		Holeplug										
2.2	SILT: some clay, trace sand, brown, moist, compact		4	SS	11												0 3 80 17
3.0	CLAYEY SILT: trace sand, contains silt layers, brown, moist to wet, stiff		5	SS	10												
			6	SS	12		Sand Screen										Spoon wet below
5.6	SILTY CLAY: trace sand, grey, wet, stiff		7	SS	12		Sand										
6.7	END OF BOREHOLE 1. Upon completion of drilling, a 50mm diameter monitoring well was installed in the borehole. 2. Water Level Readings: Date W. L. Depth (mBGS) Aug 10, 2021 0.75																

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

Appendix C – Grain Size Analysis

Particle Size Distribution Report



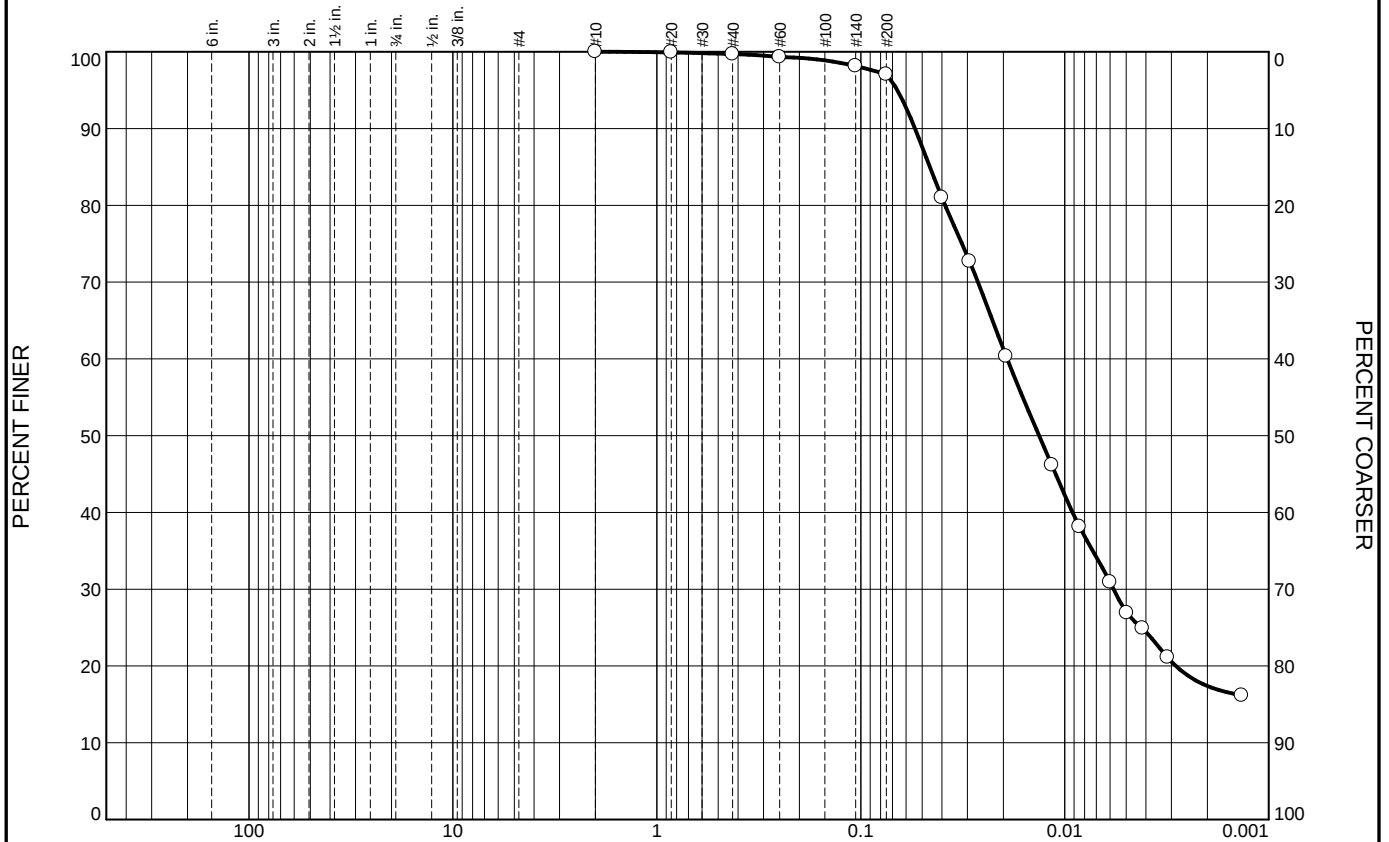
GRAIN SIZE - mm.

	% +3"		% Gravel		% Sand		% Fines			
					Coarse	Fine	Silt		Clay	
☐	0.0		0.0		0.0	0.6	63.6		35.8	
☐	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
☐			0.0136	0.0055	0.0041					

Material Description								USCS	AASHTO
☐ SILT AND CLAY trace sand									

Project No. CA19009 Client: Palmer Environmental Consulting Group Inc. (PECG) Project: PECG Prj No 2105901 ☐ Sample Number: BH 21-6, Sample 7	Remarks: ☐ Tested on July 27, 2021
Terrapex	

Particle Size Distribution Report

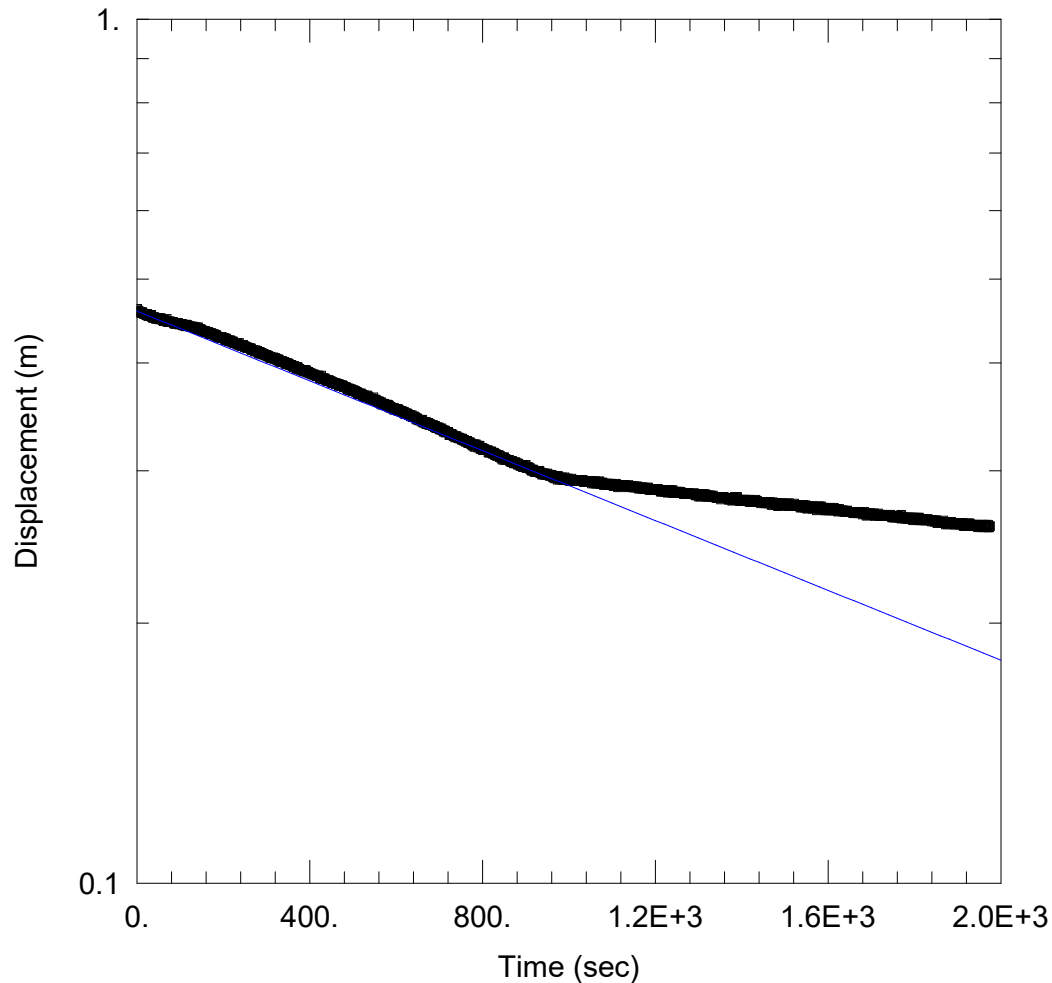


GRAIN SIZE - mm.										
% +3"		% Gravel			% Sand		% Fines			
					Coarse	Fine	Silt		Clay	
○	0.0		0.0			0.3	2.7	79.6		17.4
×	LL	PL	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
○			0.0458	0.0192	0.0134	0.0058				

Material Description							USCS	AASHTO
SILT some clay trace sand								

Project No. CA19009 Client: Palmer Environmental Consulting Group Inc. (PECG) Project: PECG Prj No 2105901 Sample Number: BH 21-10, Sample 4	Remarks: Tested on July 27, 2021
Terrapex	

Appendix D – AQTESOLV Analysis (Palmer, 2021)



WELL TEST ANALYSIS

Data Set: C:\Users\Andrei\Documents\Palmer\Arthur St - Thornbury\BH21-1 FH.aqt
 Date: 08/24/21 Time: 16:33:44

PROJECT INFORMATION

Company: Palmer
 Client: Blue Meadows Inc.
 Project: 2105901
 Location: 125 Arthur Street
 Test Well: BH21-1
 Test Date: August 13th

AQUIFER DATA

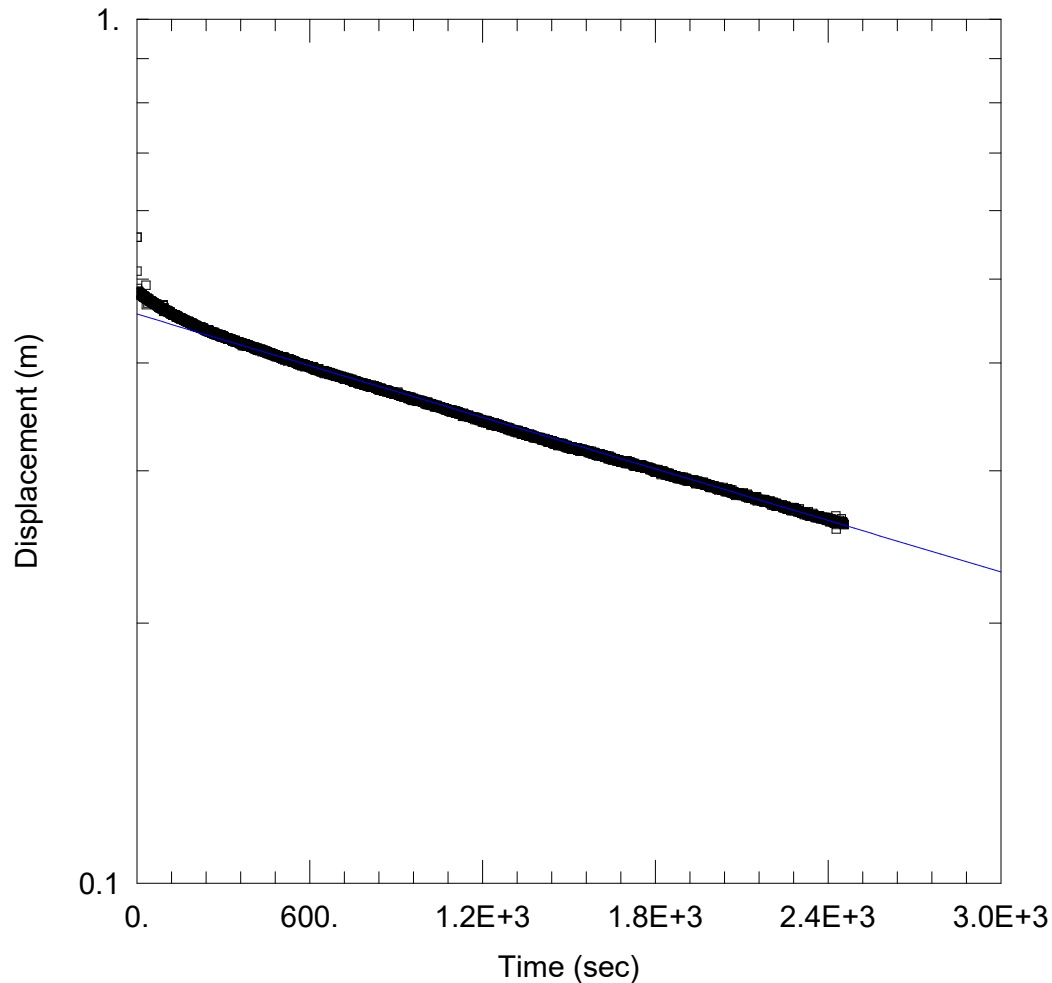
Saturated Thickness: 4.21 m Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (BH21-1)

Initial Displacement: 0.462 m Static Water Column Height: 4.21 m
 Total Well Penetration Depth: 3.81 m Screen Length: 3. m
 Casing Radius: 0.0254 m Well Radius: 0.15 m
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
 K = 2.016E-7 m/sec y0 = 0.4593 m



WELL TEST ANALYSIS

Data Set: C:\Users\Andrei\Documents\Palmer\Arthur St - Thornbury\BH21-2 FH.aqt
 Date: 08/24/21 Time: 16:33:03

PROJECT INFORMATION

Company: Palmer
 Client: Blue Meadows Inc.
 Project: 2105901
 Location: 125 Arthur Street
 Test Well: BH21-2
 Test Date: August 13th

AQUIFER DATA

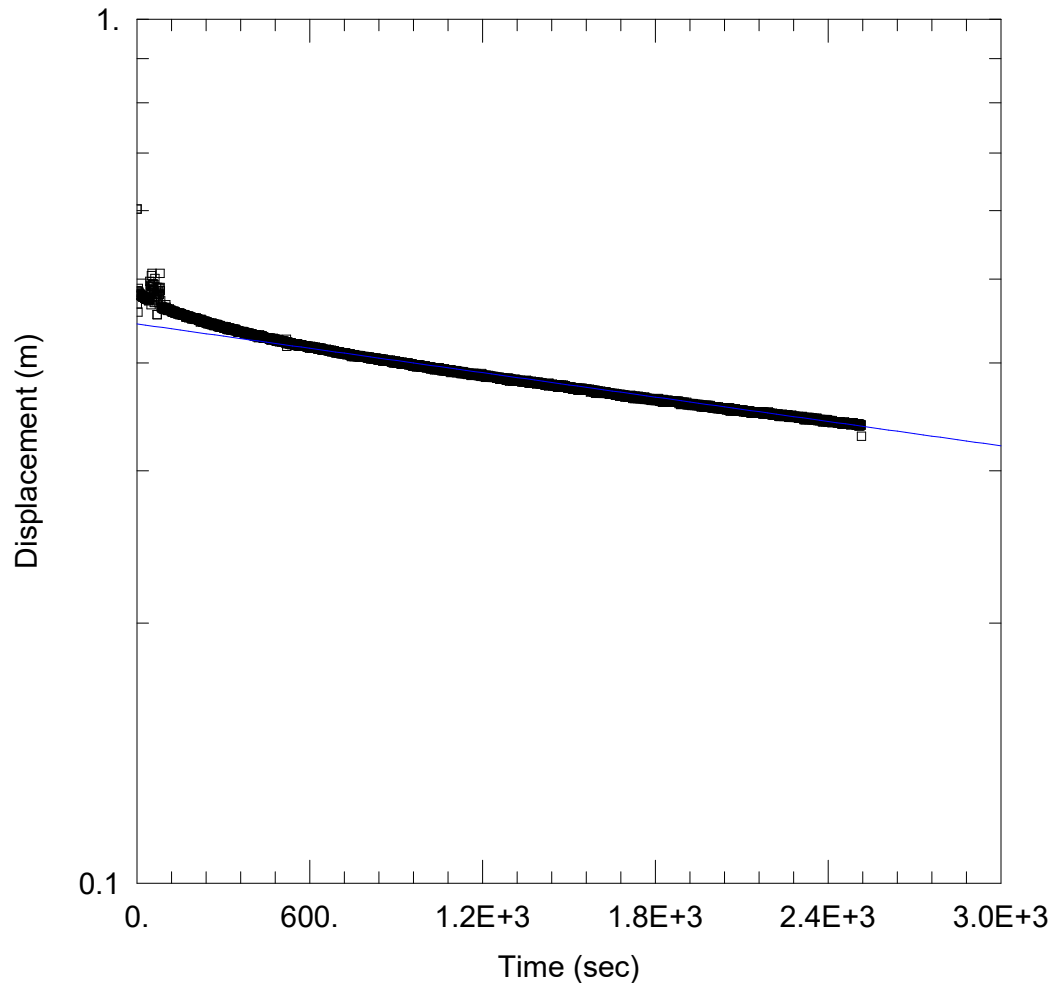
Saturated Thickness: 3.99 m Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (BH21-2)

Initial Displacement: 0.559 m Static Water Column Height: 3.99 m
 Total Well Penetration Depth: 3.89 m Screen Length: 3. m
 Casing Radius: 0.0254 m Well Radius: 0.15 m
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
 K = 1.029E-7 m/sec y0 = 0.4556 m



WELL TEST ANALYSIS

Data Set: C:\Users\Andrei\Documents\Palmer\Arthur St - Thornbury\BH21-5 FH.aqt
 Date: 08/24/21 Time: 16:32:33

PROJECT INFORMATION

Company: Palmer
 Client: Blue Meadows Inc.
 Project: 2105901
 Location: 125 Arthur Street
 Test Well: BH21-5
 Test Date: August 13th

AQUIFER DATA

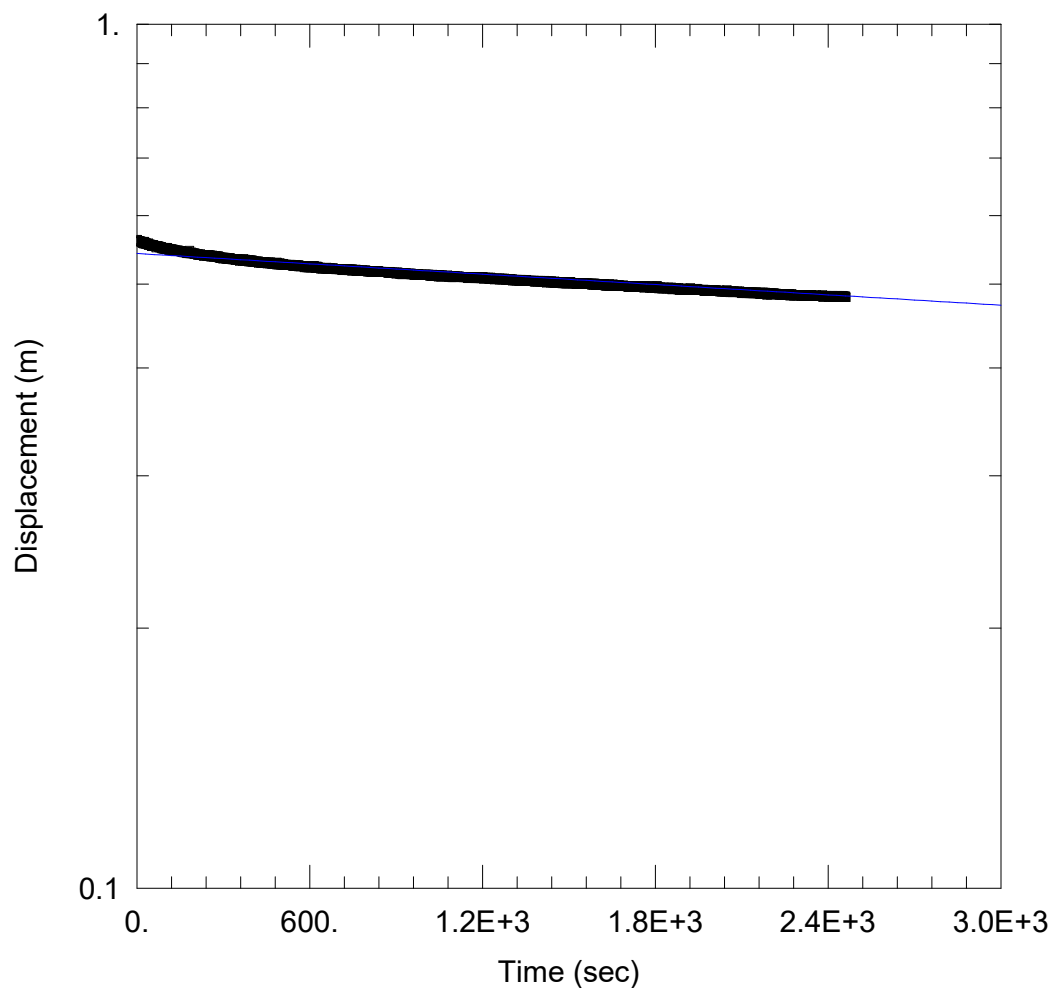
Saturated Thickness: 4.53 m Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (BH21-5)

Initial Displacement: 0.603 m Static Water Column Height: 4.53 m
 Total Well Penetration Depth: 3.93 m Screen Length: 3. m
 Casing Radius: 0.0254 m Well Radius: 0.15 m
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
 K = 4.67E-8 m/sec y0 = 0.4438 m



WELL TEST ANALYSIS

Data Set: C:\Users\Andrei\Documents\Palmer\Arthur St - Thornbury\BH21-6 FH.aqt
 Date: 08/24/21 Time: 16:30:54

PROJECT INFORMATION

Company: Palmer
 Client: Blue Meadows Inc.
 Project: 2105901
 Location: 125 Arthur Street
 Test Well: BH21-6
 Test Date: August 13th

AQUIFER DATA

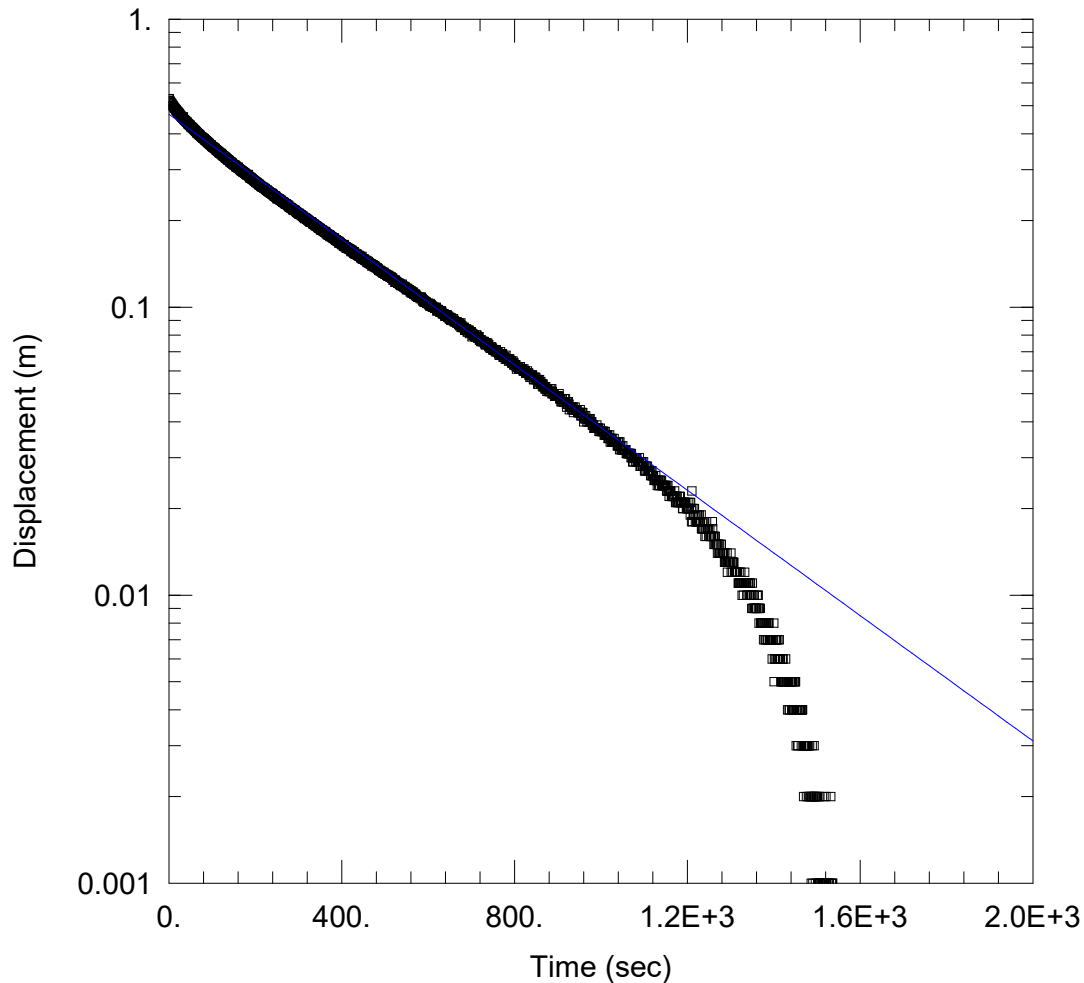
Saturated Thickness: 4.96 m Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (BH21-6)

Initial Displacement: 0.563 m Static Water Column Height: 4.96 m
 Total Well Penetration Depth: 4.26 m Screen Length: 3. m
 Casing Radius: 0.0254 m Well Radius: 0.15 m
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
 K = 1.995E-8 m/sec y0 = 0.5426 m



WELL TEST ANALYSIS

Data Set: C:\Users\Andrei\Documents\Palmer\Arthur St - Thornbury\BH21-10 FH.aqt
 Date: 08/24/21 Time: 16:31:05

PROJECT INFORMATION

Company: Palmer
 Client: Blue Meadows Inc.
 Project: 2105901
 Location: 125 Arthur Street
 Test Well: BH21-10
 Test Date: August 13th

AQUIFER DATA

Saturated Thickness: 4.91 m Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (BH21-10)

Initial Displacement: 0.53 m Static Water Column Height: 4.91 m
 Total Well Penetration Depth: 4.31 m Screen Length: 3. m
 Casing Radius: 0.0254 m Well Radius: 0.15 m
 Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice
 K = 1.094E-6 m/sec y0 = 0.4674 m

Appendix E – Certificate of Analysis (ALS, 2021)



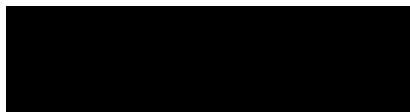
PALMER ENVIRONMENTAL CONSULTING
GROUP INC. (Richmond Hill)
ATTN: ANDREI MILER
74 Berkeley Street
Toronto ON M5V 1E3

Date Received: 16-AUG-21
Report Date: 19-AUG-21 07:08 (MT)
Version: FINAL

Client Phone: 647-795-8153

Certificate of Analysis

Lab Work Order #: L2627050
Project P.O. #: NOT SUBMITTED
Job Reference: 2105901
C of C Numbers: 20-892198
Legal Site Desc:



Jennifer Barkshire-Paterson
Account Manager

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ADDRESS: 95 West Beaver Creek Road, Unit 1, Richmond Hill, ON L4B 1H2 Canada | Phone: +1 905 881 9887 | Fax: +1 905 881 8062
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ANALYTICAL REPORT

Summary of Guideline Exceedances

Guideline						
ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 - Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)						
L2627050-1	BH21-2	Dissolved Metals	Sodium (Na)-Dissolved	34.9	20	mg/L
L2627050-2	BH21-6	Dissolved Metals	Sodium (Na)-Dissolved	21.9	20	mg/L
L2627050-3	BH21-10	Dissolved Metals	Sodium (Na)-Dissolved	42.2	20	mg/L
Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 - Ontario DW Aesthetic and Operational Guidelines (June, 2006)						
L2627050-1	BH21-2	Physical Tests	Hardness (as CaCO3)	541	80-100	mg/L
			Total Dissolved Solids	765	500	mg/L
			Turbidity	36.7	5	NTU
		Dissolved Metals	Aluminum (Al)-Dissolved	0.167	0.1	mg/L
			Manganese (Mn)-Dissolved	0.158	0.05	mg/L
L2627050-2	BH21-6	Physical Tests	Colour, Apparent	5.1	5	CU
			Hardness (as CaCO3)	437	80-100	mg/L
			Total Dissolved Solids	626	500	mg/L
			Turbidity	51.7	5	NTU
		Dissolved Metals	Aluminum (Al)-Dissolved	0.174	0.1	mg/L
			Manganese (Mn)-Dissolved	0.530	0.05	mg/L
L2627050-3	BH21-10	Physical Tests	Colour, Apparent	32.0	5	CU
			Hardness (as CaCO3)	721	80-100	mg/L
			Total Dissolved Solids	917	500	mg/L
			Turbidity	261	5	NTU
		Anions and Nutrients	Alkalinity, Total (as CaCO3)	611	30-500	mg/L
		Dissolved Metals	Manganese (Mn)-Dissolved	0.402	0.05	mg/L

* Please refer to the Reference Information section for an explanation of any qualifiers noted.



ANALYTICAL REPORT

Physical Tests - WATER

Table with 7 columns: Analyte, Unit, Guide Limits #1, Guide Limits #2, and three sample columns (L2627050-1, L2627050-2, L2627050-3) containing Lab ID, Sample Date, Sample ID, and test results for Colour, Conductivity, Hardness, pH, Total Dissolved Solids, and Turbidity.

Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)
Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)
Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.



ANALYTICAL REPORT

Anions and Nutrients - WATER

Analyte	Unit	Lab ID				
		Sample Date				
		Sample ID				
				L2627050-1	L2627050-2	L2627050-3
				13-AUG-21	13-AUG-21	13-AUG-21
				BH21-2	BH21-6	BH21-10
Analyte	Unit	Guide Limits				
		#1	#2			
Alkalinity, Total (as CaCO ₃)	mg/L	-	30-500	378	341	611
Ammonia, Total (as N)	mg/L	-	-	0.253	0.306	0.061
Chloride (Cl)	mg/L	-	250	30.2	2.87	55.9 ^{DLDS}
Fluoride (F)	mg/L	1.5	-	0.136	0.097	<0.10 ^{DLDS}
Nitrate (as N)	mg/L	10	-	0.038	<0.020	<0.10 ^{DLDS}
Nitrite (as N)	mg/L	1	-	<0.010	<0.010	<0.050 ^{DLDS}
Orthophosphate-Dissolved (as P)	mg/L	-	-	<0.0030	<0.0030	<0.0030
Sulfate (SO ₄)	mg/L	-	500	209	155	146 ^{DLDS}

Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)

Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)

 Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

 Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.



ANALYTICAL REPORT

Dissolved Metals - WATER

Analyte	Unit	Guide Limits		Lab ID	L2627050-1	L2627050-2	L2627050-3
		#1	#2	Sample Date	13-AUG-21	13-AUG-21	13-AUG-21
				Sample ID	BH21-2	BH21-6	BH21-10
Dissolved Metals Filtration Location		-	-	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	-	0.1	0.167	0.174	0.0079	
Antimony (Sb)-Dissolved	mg/L	0.006	-	0.00046	0.00047	0.00026	
Arsenic (As)-Dissolved	mg/L	0.0100	-	0.00458	0.00465	0.00154	
Barium (Ba)-Dissolved	mg/L	1	-	0.135	0.0702	0.0629	
Beryllium (Be)-Dissolved	mg/L	-	-	<0.00010	<0.00010	<0.00010	
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.000050	<0.000050	<0.000050	
Boron (B)-Dissolved	mg/L	5	-	0.309	0.191	0.074	
Cadmium (Cd)-Dissolved	mg/L	0.005	-	0.0000190	0.0000104	0.0000207	
Calcium (Ca)-Dissolved	mg/L	-	-	120	92.1	147	
Chromium (Cr)-Dissolved	mg/L	0.05	-	0.00054	0.00079	<0.00050	
Cobalt (Co)-Dissolved	mg/L	-	-	0.00109	0.00090	0.00099	
Copper (Cu)-Dissolved	mg/L	-	1	0.00315	0.00276	0.00328	
Iron (Fe)-Dissolved	mg/L	-	0.3	0.135	0.140	<0.010	
Lead (Pb)-Dissolved	mg/L	0.01	-	0.000171	0.000206	0.000065	
Magnesium (Mg)-Dissolved	mg/L	-	-	58.3	50.3	85.6	
Manganese (Mn)-Dissolved	mg/L	-	0.05	0.158	0.530	0.402	
Molybdenum (Mo)-Dissolved	mg/L	-	-	0.00319	0.00229	0.000776	
Nickel (Ni)-Dissolved	mg/L	-	-	0.00296	0.00286	0.00316	
Phosphorus (P)-Dissolved	mg/L	-	-	<0.050	<0.050	<0.050	
Potassium (K)-Dissolved	mg/L	-	-	3.90	2.93	3.74	
Selenium (Se)-Dissolved	mg/L	0.05	-	0.000137	0.000150	0.000178	
Silicon (Si)-Dissolved	mg/L	-	-	8.28	6.85	8.69	
Silver (Ag)-Dissolved	mg/L	-	-	<0.000050	<0.000050	<0.000050	
Sodium (Na)-Dissolved	mg/L	20	200	34.9	21.9	42.2	
Strontium (Sr)-Dissolved	mg/L	-	-	0.841	0.736	0.549	
Thallium (Tl)-Dissolved	mg/L	-	-	<0.000010	0.000015	0.000018	
Tin (Sn)-Dissolved	mg/L	-	-	0.00200	0.00106	0.00073	
Titanium (Ti)-Dissolved	mg/L	-	-	<0.0090 ^{LU1}	0.00834	<0.00030	
Tungsten (W)-Dissolved	mg/L	-	-	<0.00010	<0.00010	<0.00010	

Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)

Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)

* Please refer to the Reference Information section for an explanation of any qualifiers noted.



ANALYTICAL REPORT

L2627050 CONT'D....

Job Reference: 2105901

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Dissolved Metals - WATER

				Lab ID	L2627050-1	L2627050-2	L2627050-3
				Sample Date	13-AUG-21	13-AUG-21	13-AUG-21
				Sample ID	BH21-2	BH21-6	BH21-10
Analyte	Unit	Guide Limits					
		#1	#2				
Uranium (U)-Dissolved	mg/L	0.02	-	0.00364	0.00289	0.00650	
Vanadium (V)-Dissolved	mg/L	-	-	0.00070	0.00078	<0.00050	
Zinc (Zn)-Dissolved	mg/L	-	5	0.255	0.182	0.338	
Zirconium (Zr)-Dissolved	mg/L	-	-	0.00036	<0.00030	<0.00030	

Guide Limit #1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020)

Guide Limit #2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)

 Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

Analytical result for this parameter exceeds Guide Limits listed. See Summary of Guideline Exceedances.

* Please refer to the Reference Information section for an explanation of any qualifiers noted.

Reference Information

L2627050 CONT'D....
Job Reference: 2105901
PAGE 7 of 9
19-AUG-21 07:08 (MT)

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
DLUI	Detection Limit Raised: Unknown Interference generated an apparent false positive test result.

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
---------------	--------	------------------	--------------------

ALK-WT Water Alkalinity, Total (as CaCO3) APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint.

CL-IC-N-WT Water Chloride by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT Water Colour APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-SCREEN-WT Water Conductivity Screen (Internal Use Only) APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT Water Conductivity APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

F-IC-N-WT Water Fluoride in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT Water Hardness APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-D-CCMS-WT Water Dissolved Metals in Water by CRC ICPMS APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-F-WT Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with

Reference Information

L2627050 CONT'D....
 Job Reference: 2105901
 PAGE 8 of 9
 19-AUG-21 07:08 (MT)

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
		fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.	
NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
PH-WT	Water	pH	APHA 4500 H-Electrode
		Water samples are analyzed directly by a calibrated pH meter.	
		Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days	
P04-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS
		This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.	
SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)
		Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.	
SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C
		This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.	
TURBIDITY-WT	Water	Turbidity	APHA 2130 B
		Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.	

**ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody Numbers:

20-892198

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Reference Information

L2627050 CONT'D....
Job Reference: 2105901
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GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.

mg/kg - milligrams per kilogram based on dry weight of sample

mg/kg ww - milligrams per kilogram based on wet weight of sample

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight

mg/L - unit of concentration based on volume, parts per million.

< - Less than.

D.L. - The reporting limit.

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)

74 Berkeley Street

Toronto ON M5V 1E3

Contact: ANDREI MILER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-WT		Water						
Batch	R5554197							
WG3598471-4	DUP	WG3598471-3						
Alkalinity, Total (as CaCO ₃)		692	698		mg/L	0.9	20	17-AUG-21
WG3598471-2	LCS							
Alkalinity, Total (as CaCO ₃)			101.2		%		85-115	17-AUG-21
WG3598471-1	MB							
Alkalinity, Total (as CaCO ₃)			<1.0		mg/L		1	17-AUG-21
Batch	R5555638							
WG3598473-4	DUP	WG3598473-3						
Alkalinity, Total (as CaCO ₃)		294	291		mg/L	0.8	20	17-AUG-21
WG3598473-2	LCS							
Alkalinity, Total (as CaCO ₃)			101.9		%		85-115	17-AUG-21
WG3598473-1	MB							
Alkalinity, Total (as CaCO ₃)			<1.0		mg/L		1	17-AUG-21
CL-IC-N-WT		Water						
Batch	R5555776							
WG3599059-9	DUP	WG3599059-8						
Chloride (Cl)		2.86	2.86		mg/L	0.0	20	17-AUG-21
WG3599059-7	LCS							
Chloride (Cl)			100.4		%		90-110	17-AUG-21
WG3599059-6	MB							
Chloride (Cl)			<0.50		mg/L		0.5	17-AUG-21
WG3599059-10	MS	WG3599059-8						
Chloride (Cl)			97.9		%		75-125	17-AUG-21
COLOUR-APPARENT-WT		Water						
Batch	R5555056							
WG3599025-3	DUP	L2627050-1						
Colour, Apparent		5.0	5.2		CU	2.9	20	17-AUG-21
WG3599025-2	LCS							
Colour, Apparent			103.7		%		85-115	17-AUG-21
WG3599025-1	MB							
Colour, Apparent			<2.0		CU		2	17-AUG-21
EC-WT		Water						
Batch	R5554197							
WG3598471-4	DUP	WG3598471-3						
Conductivity		3260	3220		umhos/cm	1.2	10	17-AUG-21
WG3598471-2	LCS							
Conductivity			99.9		%		90-110	17-AUG-21

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)

74 Berkeley Street

Toronto ON M5V 1E3

Contact: ANDREI MILER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WT		Water						
Batch	R5554197							
WG3598471-1	MB							
Conductivity			<1.0		umhos/cm		1	17-AUG-21
Batch	R5555638							
WG3598473-4	DUP	WG3598473-3						
Conductivity		909	904		umhos/cm	0.6	10	17-AUG-21
WG3598473-2	LCS							
Conductivity			98.5		%		90-110	17-AUG-21
WG3598473-1	MB							
Conductivity			<1.0		umhos/cm		1	17-AUG-21
F-IC-N-WT		Water						
Batch	R5555776							
WG3599059-9	DUP	WG3599059-8						
Fluoride (F)		0.096	0.097		mg/L	1.3	20	17-AUG-21
WG3599059-7	LCS							
Fluoride (F)			100.9		%		90-110	17-AUG-21
WG3599059-6	MB							
Fluoride (F)			<0.020		mg/L		0.02	17-AUG-21
WG3599059-10	MS	WG3599059-8						
Fluoride (F)			90.8		%		75-125	17-AUG-21
MET-D-CCMS-WT		Water						
Batch	R5554299							
WG3598315-4	DUP	WG3598315-3						
Aluminum (Al)-Dissolved		0.167	0.162		mg/L	2.8	20	17-AUG-21
Antimony (Sb)-Dissolved		0.00046	0.00046		mg/L	0.0	20	17-AUG-21
Arsenic (As)-Dissolved		0.00458	0.00470		mg/L	2.6	20	17-AUG-21
Barium (Ba)-Dissolved		0.135	0.133		mg/L	1.4	20	17-AUG-21
Beryllium (Be)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-21
Bismuth (Bi)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	17-AUG-21
Boron (B)-Dissolved		0.309	0.314		mg/L	1.6	20	17-AUG-21
Cadmium (Cd)-Dissolved		0.0000190	0.0000166		mg/L	13	20	17-AUG-21
Calcium (Ca)-Dissolved		120	119		mg/L	0.9	20	17-AUG-21
Chromium (Cr)-Dissolved		0.00054	0.00062		mg/L	14	20	17-AUG-21
Cobalt (Co)-Dissolved		0.00109	0.00111		mg/L	1.2	20	17-AUG-21
Copper (Cu)-Dissolved		0.00315	0.00318		mg/L	1.0	20	17-AUG-21
Iron (Fe)-Dissolved		0.135	0.146		mg/L	8.3	20	17-AUG-21

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)

74 Berkeley Street

Toronto ON M5V 1E3

Contact: ANDREI MILER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT		Water						
Batch	R5554299							
WG3598315-4	DUP	WG3598315-3						
Lead (Pb)-Dissolved		0.000171	0.000177		mg/L	3.4	20	17-AUG-21
Magnesium (Mg)-Dissolved		58.3	57.8		mg/L	0.9	20	17-AUG-21
Manganese (Mn)-Dissolved		0.158	0.157		mg/L	0.3	20	17-AUG-21
Molybdenum (Mo)-Dissolved		0.00319	0.00316		mg/L	0.9	20	17-AUG-21
Nickel (Ni)-Dissolved		0.00296	0.00284		mg/L	3.9	20	17-AUG-21
Phosphorus (P)-Dissolved		<0.050	<0.050	RPD-NA	mg/L	N/A	20	17-AUG-21
Potassium (K)-Dissolved		3.90	3.86		mg/L	1.1	20	17-AUG-21
Selenium (Se)-Dissolved		0.000137	0.000120		mg/L	13	20	17-AUG-21
Silicon (Si)-Dissolved		8.28	8.53		mg/L	3.0	20	17-AUG-21
Silver (Ag)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	17-AUG-21
Sodium (Na)-Dissolved		34.9	34.8		mg/L	0.2	20	17-AUG-21
Strontium (Sr)-Dissolved		0.841	0.842		mg/L	0.0	20	17-AUG-21
Thallium (Tl)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	17-AUG-21
Tin (Sn)-Dissolved		0.00200	0.00197		mg/L	1.6	20	17-AUG-21
Titanium (Ti)-Dissolved		0.00826	0.00887		mg/L	7.1	20	17-AUG-21
Tungsten (W)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	17-AUG-21
Uranium (U)-Dissolved		0.00364	0.00360		mg/L	1.0	20	17-AUG-21
Vanadium (V)-Dissolved		0.00070	0.00073		mg/L	3.9	20	17-AUG-21
Zinc (Zn)-Dissolved		0.255	0.254		mg/L	0.4	20	17-AUG-21
Zirconium (Zr)-Dissolved		0.00036	0.00038		mg/L	4.3	20	17-AUG-21
WG3598315-2	LCS							
Aluminum (Al)-Dissolved			99.5		%		80-120	17-AUG-21
Antimony (Sb)-Dissolved			101.9		%		80-120	17-AUG-21
Arsenic (As)-Dissolved			102.1		%		80-120	17-AUG-21
Barium (Ba)-Dissolved			99.3		%		80-120	17-AUG-21
Beryllium (Be)-Dissolved			99.2		%		80-120	17-AUG-21
Bismuth (Bi)-Dissolved			98.3		%		80-120	17-AUG-21
Boron (B)-Dissolved			93.5		%		80-120	17-AUG-21
Cadmium (Cd)-Dissolved			97.8		%		80-120	17-AUG-21
Calcium (Ca)-Dissolved			95.4		%		80-120	17-AUG-21
Chromium (Cr)-Dissolved			98.4		%		80-120	17-AUG-21
Cobalt (Co)-Dissolved			98.4		%		80-120	17-AUG-21
Copper (Cu)-Dissolved			97.5		%		80-120	17-AUG-21

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)

74 Berkeley Street

Toronto ON M5V 1E3

Contact: ANDREI MILER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT		Water						
Batch	R5554299							
WG3598315-2		LCS						
Iron (Fe)-Dissolved			98.3		%		80-120	17-AUG-21
Lead (Pb)-Dissolved			99.9		%		80-120	17-AUG-21
Magnesium (Mg)-Dissolved			100.3		%		80-120	17-AUG-21
Manganese (Mn)-Dissolved			98.3		%		80-120	17-AUG-21
Molybdenum (Mo)-Dissolved			101.9		%		80-120	17-AUG-21
Nickel (Ni)-Dissolved			97.6		%		80-120	17-AUG-21
Phosphorus (P)-Dissolved			104.5		%		80-120	17-AUG-21
Potassium (K)-Dissolved			99.0		%		80-120	17-AUG-21
Selenium (Se)-Dissolved			101.1		%		80-120	17-AUG-21
Silicon (Si)-Dissolved			102.7		%		60-140	17-AUG-21
Silver (Ag)-Dissolved			103.5		%		80-120	17-AUG-21
Sodium (Na)-Dissolved			100.9		%		80-120	17-AUG-21
Strontium (Sr)-Dissolved			100.4		%		80-120	17-AUG-21
Thallium (Tl)-Dissolved			99.3		%		80-120	17-AUG-21
Tin (Sn)-Dissolved			99.9		%		80-120	17-AUG-21
Titanium (Ti)-Dissolved			97.7		%		80-120	17-AUG-21
Tungsten (W)-Dissolved			98.4		%		80-120	17-AUG-21
Uranium (U)-Dissolved			104.4		%		80-120	17-AUG-21
Vanadium (V)-Dissolved			99.4		%		80-120	17-AUG-21
Zinc (Zn)-Dissolved			95.4		%		80-120	17-AUG-21
Zirconium (Zr)-Dissolved			108.5		%		80-120	17-AUG-21
WG3598315-1		MB						
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	17-AUG-21
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-21
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-21
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-21
Beryllium (Be)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-21
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-21
Boron (B)-Dissolved			<0.010		mg/L		0.01	17-AUG-21
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	17-AUG-21
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	17-AUG-21
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-21
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-21
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	17-AUG-21

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)

74 Berkeley Street

Toronto ON M5V 1E3

Contact: ANDREI MILER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT		Water						
Batch	R5554299							
WG3598315-1 MB								
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	17-AUG-21
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-21
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	17-AUG-21
Manganese (Mn)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-21
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-21
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-21
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	17-AUG-21
Potassium (K)-Dissolved			<0.050		mg/L		0.05	17-AUG-21
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-21
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	17-AUG-21
Silver (Ag)-Dissolved			<0.000050		mg/L		0.00005	17-AUG-21
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	17-AUG-21
Strontium (Sr)-Dissolved			<0.0010		mg/L		0.001	17-AUG-21
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	17-AUG-21
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-21
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	17-AUG-21
Tungsten (W)-Dissolved			<0.00010		mg/L		0.0001	17-AUG-21
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	17-AUG-21
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	17-AUG-21
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	17-AUG-21
Zirconium (Zr)-Dissolved			<0.00020		mg/L		0.0002	17-AUG-21
WG3598315-5 MS		WG3598315-6						
Aluminum (Al)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Antimony (Sb)-Dissolved			91.2		%		70-130	17-AUG-21
Arsenic (As)-Dissolved			115.5		%		70-130	17-AUG-21
Barium (Ba)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Beryllium (Be)-Dissolved			97.4		%		70-130	17-AUG-21
Bismuth (Bi)-Dissolved			82.7		%		70-130	17-AUG-21
Boron (B)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Cadmium (Cd)-Dissolved			98.3		%		70-130	17-AUG-21
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Chromium (Cr)-Dissolved			100.4		%		70-130	17-AUG-21
Cobalt (Co)-Dissolved			94.4		%		70-130	17-AUG-21
Copper (Cu)-Dissolved			91.6		%		70-130	17-AUG-21

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT		Water						
Batch	R5554299							
WG3598315-5	MS	WG3598315-6						
Iron (Fe)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Lead (Pb)-Dissolved			91.5		%		70-130	17-AUG-21
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Manganese (Mn)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Molybdenum (Mo)-Dissolved			97.5		%		70-130	17-AUG-21
Nickel (Ni)-Dissolved			90.8		%		70-130	17-AUG-21
Phosphorus (P)-Dissolved			109.1		%		70-130	17-AUG-21
Potassium (K)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Selenium (Se)-Dissolved			132.5	MES	%		70-130	17-AUG-21
Silicon (Si)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Silver (Ag)-Dissolved			84.8		%		70-130	17-AUG-21
Sodium (Na)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Thallium (Tl)-Dissolved			92.6		%		70-130	17-AUG-21
Tin (Sn)-Dissolved			96.6		%		70-130	17-AUG-21
Titanium (Ti)-Dissolved			83.6		%		70-130	17-AUG-21
Tungsten (W)-Dissolved			93.6		%		70-130	17-AUG-21
Uranium (U)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Vanadium (V)-Dissolved			100.8		%		70-130	17-AUG-21
Zinc (Zn)-Dissolved			N/A	MS-B	%		-	17-AUG-21
Zirconium (Zr)-Dissolved			98.1		%		70-130	17-AUG-21
NH3-F-WT		Water						
Batch	R5555545							
WG3598231-3	DUP	WG3598231-5						
Ammonia, Total (as N)		0.399	0.401		mg/L	0.4	20	17-AUG-21
WG3598231-2	LCS							
Ammonia, Total (as N)			102.6		%		85-115	17-AUG-21
WG3598231-1	MB							
Ammonia, Total (as N)			<0.010		mg/L		0.01	17-AUG-21
WG3598231-4	MS	WG3598231-5						
Ammonia, Total (as N)			N/A	MS-B	%		-	17-AUG-21
NO2-IC-WT		Water						

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)

74 Berkeley Street

Toronto ON M5V 1E3

Contact: ANDREI MILER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-IC-WT		Water						
Batch	R5555776							
WG3599059-9	DUP	WG3599059-8						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	17-AUG-21
WG3599059-7	LCS							
Nitrite (as N)			99.4		%		90-110	17-AUG-21
WG3599059-6	MB							
Nitrite (as N)			<0.010		mg/L		0.01	17-AUG-21
WG3599059-10	MS	WG3599059-8						
Nitrite (as N)			97.0		%		75-125	17-AUG-21
NO3-IC-WT		Water						
Batch	R5555776							
WG3599059-9	DUP	WG3599059-8						
Nitrate (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	17-AUG-21
WG3599059-7	LCS							
Nitrate (as N)			99.5		%		90-110	17-AUG-21
WG3599059-6	MB							
Nitrate (as N)			<0.020		mg/L		0.02	17-AUG-21
WG3599059-10	MS	WG3599059-8						
Nitrate (as N)			94.2		%		75-125	17-AUG-21
PH-WT		Water						
Batch	R5554197							
WG3598471-4	DUP	WG3598471-3						
pH		7.47	7.49	J	pH units	0.02	0.2	17-AUG-21
WG3598471-2	LCS							
pH			7.00		pH units		6.9-7.1	17-AUG-21
Batch	R5555638							
WG3598473-4	DUP	WG3598473-3						
pH		7.87	7.84	J	pH units	0.03	0.2	17-AUG-21
WG3598473-2	LCS							
pH			7.00		pH units		6.9-7.1	17-AUG-21
PO4-DO-COL-WT		Water						
Batch	R5553284							
WG3598430-3	DUP	WG3598430-5						
Orthophosphate-Dissolved (as P)		0.227	0.231		mg/L	1.8	20	17-AUG-21
WG3598430-2	LCS							
Orthophosphate-Dissolved (as P)			100.8		%		80-120	17-AUG-21
WG3598430-1	MB							
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	17-AUG-21

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Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)

74 Berkeley Street

Toronto ON M5V 1E3

Contact: ANDREI MILER

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT		Water						
Batch	R5553284							
WG3598430-4	MS	WG3598430-5						
Orthophosphate-Dissolved (as P)			N/A	MS-B	%	-		17-AUG-21
SO4-IC-N-WT		Water						
Batch	R5555776							
WG3599059-9	DUP	WG3599059-8						
Sulfate (SO4)			155		mg/L	0.1	20	17-AUG-21
WG3599059-7	LCS							
Sulfate (SO4)			101.6		%		90-110	17-AUG-21
WG3599059-6	MB							
Sulfate (SO4)			<0.30		mg/L		0.3	17-AUG-21
WG3599059-10	MS	WG3599059-8						
Sulfate (SO4)			N/A	MS-B	%	-		17-AUG-21
SOLIDS-TDS-WT		Water						
Batch	R5556462							
WG3598704-3	DUP	L2627221-2						
Total Dissolved Solids			434		mg/L	2.2	20	17-AUG-21
WG3598704-2	LCS							
Total Dissolved Solids			95.6		%		85-115	17-AUG-21
WG3598704-1	MB							
Total Dissolved Solids			<10		mg/L		10	17-AUG-21
TURBIDITY-WT		Water						
Batch	R5554024							
WG3598484-3	DUP	L2627050-3						
Turbidity			261		NTU	2.3	15	17-AUG-21
WG3598484-2	LCS							
Turbidity			91.5		%		85-115	17-AUG-21
WG3598484-1	MB							
Turbidity			<0.10		NTU		0.1	17-AUG-21

Quality Control Report

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MES	Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

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Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Colour	1	13-AUG-21 14:00	17-AUG-21 00:00	48	82	hours	EHTR
	2	13-AUG-21 17:30	17-AUG-21 00:00	48	78	hours	EHTR
	3	13-AUG-21 18:50	17-AUG-21 00:00	48	77	hours	EHTR
Turbidity	1	13-AUG-21 14:00	17-AUG-21 13:37	48	96	hours	EHTR
	2	13-AUG-21 17:30	17-AUG-21 13:37	48	92	hours	EHTR
	3	13-AUG-21 18:50	17-AUG-21 13:37	48	91	hours	EHTR

Legend & Qualifier Definitions:

EHTR-FM: Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR: Exceeded ALS recommended hold time prior to sample receipt.
EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT: Exceeded ALS recommended hold time prior to analysis.
Rec. HT: ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2627050 were received on 16-AUG-21 09:00.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



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Chain o



L2627050-COFC

COC Number: 20 - 892198

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AFFIX ALS BARCODE LABEL HERE
(ALS use only)

Report To Contact and company name below will appear on the final report Company: Palmer Contact: Andrei Miler Phone: 647-808-5612 Company address below will appear on the final report Street: 74 Berkeley Street City/Province: Ontario Postal Code: M5V 1E3		Reports / Recipients Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL) Merge QC/QCI Reports with COA ☒ YES ☐ NO ☐ N/A ☒ Compare Results to Criteria on Report - provide details below if box checked Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax: andrei.miler@pccg.ca Email 2: cole.thompson@pccg.ca Email 3:		Turnaround Time (TAT) Requested ☒ Routine [R] if received by 3pm M-F - no surcharges apply ☐ 4 day [P4] if received by 3pm M-F - 20% rush surcharge minimum ☐ 3 day [P3] if received by 3pm M-F - 25% rush surcharge minimum ☐ 2 day [P2] if received by 3pm M-F - 50% rush surcharge minimum ☐ 1 day [E] if received by 3pm M-F - 100% rush surcharge minimum ☐ Same day [E2] if received by 10am M-S - 200% rush surcharge. Additional fees may apply to rush requests on weekends, statutory holidays and non-routine tests Date and Time Required for all E&P TATs:		AFFIX ALS BARCODE LABEL HERE (ALS use only)	
Invoice To Same as Report To ☐ YES ☒ NO Copy of Invoice with Report ☐ YES ☒ NO Company: accounting@pccg.ca (Palmer) Contact:		Invoice Recipients Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX Email 1 or Fax: accounting@pccg.ca Email 2:		Analysis Request Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below			
Project Information ALS Account # / Quote #: Palmer Quote 2165901 Job #: 2165901 PO / AFE: LSD:		Oil and Gas Required Fields (client use) AFE/Cost Center: PO# Major/Minor Code: Routing Code: Requisitioner: Location:		NUMBER OF CONTAINERS General Chem Metals are field filtered			
ALS Lab Work Order # (ALS use only): L2627050		ALS Contact: Jennifer Parkshire		Sampler: AM			
ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type			
	BH21-2	13-08-21	2:06 PM	GW	4	X	
	BH21-6	13-08-21	5:30 PM	GW	4	X	
	BH21-10	13-08-21	6:56 PM	GW	4	X	
Drinking Water (DW) Samples¹ (client use) Are samples taken from a Regulated DW System? ☐ YES ☒ NO Are samples for human consumption/ use? ☐ YES ☒ NO		Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only) Ontario Drinking Water Standards (OWDS)		SAMPLE RECEIPT DETAILS (ALS use only) Cooling Method: ☐ NONE ☐ ICE ☒ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A INITIAL COOLER TEMPERATURES °C: 7.6 FINAL COOLER TEMPERATURES °C: 7.1			
SHIPMENT RELEASE (client use) Released by: Andrei Miler Date: August 16th 2013 Time: 3:20 PM		INITIAL SHIPMENT RECEPTION (ALS use only) Received by: ES Date: Aug 16/21 Time: 9:00		FINAL SHIPMENT RECEPTION (ALS use only) Received by: QA Date: 8/16/21 Time: 12:15			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.
 1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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