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Geotechnical Investigation – 125 Arthur St W and 123 Louisa St W, Thornbury, Ontario

Palmer Project #

2105901

Prepared For

Blue Meadows Inc.

December 10, 2021

December 10, 2021

Shekhar Dalal
Blue Meadows Inc.
125 Arthur St W,
Thornbury, ON
N0H 2P0

Dear Shekhar:

Re: Geotechnical Investigation – 125 Arthur St W and 123 Louisa St W, Thornbury, Ontario
Project #: 2105901

Palmer is pleased to submit the attached report describing the results of our Geotechnical Investigation for the project at the subject site ("the Site") located at 125 Arthur St W and 123 Louisa St W, Thornbury, Ontario.

The report provides site information from site investigation, laboratory testing, records reviews, and our interpretations/recommendations for your consideration.

Thank you for the opportunity to be of service on this project. 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.

Yours truly,

Ted Pan, M.Eng., P.Eng.

Geotechnical Engineer

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1. Introduction

Palmer was retained by Blue Meadows Inc. (the Client) to undertake a Geotechnical Investigation to support a development proposal for the Site, located at 125 Arthur St W and 123 Louisa St W, Thornbury, Ontario.

It is understood that the proposed development consists of residential and commercial buildings. The objective of this geotechnical investigation was to determine the subsurface conditions at the locations of the proposed development by means of ten (10) exploratory boreholes, and from the findings in the boreholes make engineering recommendations for the following:

1. Foundations
2. Floor slab and permanent drainage
3. Excavations and backfilling
4. Earth pressure
5. Pipe trenching and bedding
5. Seismic considerations
6. Access road and pavements
7. Geotechnical quality of excavated soil
8. Chemical Analysis

The report is provided on the basis of the terms of reference presented above, and on the assumption that the design will be in accordance with applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report deals with geotechnical issues only. Hydrogeological Assessment and D4 Study for the subject property are provided in separate Palmer reports.

This report has been prepared for the Client and its designers. Use of this report by third party without Palmer's consent is prohibited. The limitations of the report presented in this report form an integral part of the report and they must be considered in conjunction with this report.

2. Site and Regional Geology

The Site is located at the property bordered by Arthur St W (Hwy 26), Landsdowne St S and Alice St W in Thornbury, Ontario. The site is located within the Beaver Valley physiographic region (Chapman & Putnam, 1984). The Beaver Valley exhibits considerable complexity of landforms including lake plains, beaches, moraines, steep valley sides, and vertical cliffs. The Site currently contains low-rise residential buildings and vacant lots.

A review of available online surficial geology mapping indicated that the site is underlain by fine-textured glaciolacustrine deposits composed of silt and clay, and minor sand and gravel. (Ontario Geological Survey, 2010). Bedrock geology mapping indicated that the site is underlain by materials comprised of shale, limestone, dolostone and siltstone of the Georgian Bay Formation (Ontario Geological Survey, 2011).

3. Field and Laboratory Work

The field work for the geotechnical investigation was carried out on July 12 and 13, 2021 by drilling specialists subcontracted to Palmer, during which time ten (10) boreholes (BH21-1 to BH21-10) were advanced at the locations shown on the Borehole and Monitoring Well Location Plan, **Drawing 1**. The boreholes were drilled to depths ranging from 6.7 to 9.8m below existing ground surface.

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. This sampling method recovers samples from the soil strata, and the number of blows required to drive the sampler 300mm depth into the undisturbed soil (SPT 'N' values) gives an indication of the compactness condition or consistency of the sampled soil material. The SPT 'N' values are indicated on the borehole logs (Refer to **Appendix A**). The field work for this investigation was supervised by Palmer engineering staff, who also logged the boreholes and cared for the recovered samples.

Groundwater condition observations were made in the boreholes during drilling and upon completion of drilling. Five (5) monitoring wells (50mm dia.) were installed in Boreholes BH21-1, BH21-2, BH21-5, BH21-6, and BH21-10 to determine stabilized groundwater levels. The stabilized groundwater levels were measured on August 10, 2021. These data are summarized in the individual borehole logs and in **Table 1**. Boreholes without monitoring well installed were backfilled and sealed upon completion of drilling.

All soil samples obtained during this investigation were brought to our laboratory for further examination. These soil samples will be stored for a period of two (2) months after the day of issuing draft report, after which time they will be discarded unless Palmer is advised otherwise in writing. In addition to visual examination in the laboratory, all soil samples from geotechnical boreholes were tested for moisture

contents. Grain size analyses of three (3) selected soil samples and Atterberg limits tests of three (3) selected soil samples were conducted and the results are presented in **Appendix B**.

The elevations of the as-drilled boreholes are not available at the time of preparing the report. The borehole locations plotted on the Borehole and Monitoring Well Location Plan, **Drawing 1** were based on the measurement of site features and should be considered as approximate.

4. Subsurface Conditions

The borehole locations (BH21-1 to BH21-10) are shown on **Drawing 1**. General notes on sample description are presented in **Appendix A**. The subsurface conditions in the boreholes are presented in the individual borehole logs (**Enclosures 1** to **10** inclusive, **Appendix A**). The subsurface conditions in the boreholes are summarized in the following paragraphs.

4.1 Soil Conditions

Topsoil

A 200 to 350 mm thick layer of surficial topsoil was encountered at all borehole locations. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site.

Fill Materials

Fill Materials consisting of clayey silt, silt, sandy silt, silty sand or sand textures were encountered in all boreholes and extended to depths ranging from about 0.7 to 1.1m below existing ground surface. For cohesive clayey silt fill materials, SPT N values ranging from 5 to 11 blows per 300 mm penetration indicated a firm to stiff consistency. For the cohesionless fill materials, SPT N values ranging from 2 to 10 blows per 300 mm penetration indicated 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 the 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. SPT N values ranging from 2 to greater than 50 blows per 300 mm penetration indicated a soft to hard consistency. The natural moisture contents measured in the soil samples ranged from approximately 17% to 31%.

Grain size analysis was conducted on one (1) sample (BH21-6/SS7) from the silty clay deposit. The result is presented on individual borehole logs and in **Appendix B**, with the following fractions:

Gravel:	0%
Sand:	1%
Silt:	63%
Clay:	36%

Consistency (Atterberg) limits tests on three (3) samples (BH21-1/SS6, BH21-5/SS4, and BH21-7/SS5) of the fines content of the soil matrix component of the samples indicate liquid limits ranging from 24 to 30, plastic limits ranging from 17 to 19, and plasticity indices ranging from 7 to 11 (see **Appendix B**). According to the modified Unified Soil Classification System, BH21-5/SS4 and BH21-7/SS5 are classified as low plasticity clayey silt (CL-ML). BH21-1/SS6 is classified as low plasticity silty clay (CL).

Silt / Sandy Silt

Silt / sandy silt deposits were encountered below the fill materials or silty clay / clayey silt deposits in Boreholes BH21-1, BH21-3, BH21-5, and BH21-7 to BH21-10, and extended to depths ranging from about 1.5 to 9.5m below existing ground surface. Borehole BH21-1 was terminated in these deposits. SPT 'N' values ranging from 5 to over 50 blows per 300mm penetration indicated a loose to very dense compactness condition. The natural moisture contents measured in the soil samples ranged from approximately 6% to 25%.

Grain size analysis was conducted on one (1) sample (BH21-10/SS4) from the silt deposit. The results are presented on individual borehole log and in **Appendix B**, with the following fractions:

Gravel:	0%
Sand:	3%
Silt:	80%
Clay:	17%

Sand and Silt Till

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

Grain size analysis was conducted on one (1) sample (BH21-2/SS6) from sand and silt till deposit. The results are presented on individual borehole log and in **Appendix B**, with the following fractions:

Gravel:	3%
Sand:	36%
Silt:	50%
Clay:	11%

Silty Sand

Silty sand deposit was encountered below silty clay / clayey silt deposits in Borehole BH21-6, and extended to the maximum explored depth of about 9.8m below existing ground surface in this borehole. SPT 'N' value of 9 blows per 300mm penetration indicated a loose compactness condition. The natural moisture content measured in the soil sample was approximately 8%.

4.2 Groundwater Conditions

Water was encountered during drilling in Boreholes BH21-2, BH21-4, BH21-6, BH21-7, and BH21-10 at depths ranging from 0.8 to 6.1m below existing ground surface. Upon completion of drilling, water level was measured in Boreholes BH21-4 and BH21-7 at depths ranging from 1.8 to 2.1m below existing ground surface. Five (5) monitoring wells (50mm dia.) were installed to monitor stabilized groundwater levels. The monitoring well installation details and the measured groundwater levels are shown in the borehole logs and summarized in **Table 1**.

Table 1: Monitoring Well Details and Water Levels

Monitoring Well ID	Screen Interval (mBGS)	Water Level Depth (mBGS)
		August 10, 2021
BH21-1	6.1 ~ 9.1	4.0
BH21-2	3.1 ~ 6.1	1.3
BH21-5	3.1 ~ 6.1	1.1
BH21-6	3.1 ~ 6.1	3.7
BH21-10	3.1 ~ 6.1	0.8

Note: mBGS = meter below ground surface

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to weather events.

5. Discussion and Recommendations

It is understood that the proposed development plan may consist of low-rise to mid-rise buildings with up to one level of basement, internal servicing, roadways and parking lots.

5.1 Proposed Building Foundation Design Considerations

Based on the borehole information, the proposed low-rise to mid-rise buildings can be supported by spread and strip footings founded on the undisturbed native soils for a bearing capacity of 50 to 150 kPa at SLS (serviceability limit states), and for a factored geotechnical resistance of 75 to 225 kPa at ULS (ultimate limit states). The bearing values and the corresponding founding depths at borehole locations are summarized on **Table 2**.

Table 2: Bearing Values and Founding Levels of Spread and Strip Footings

BH No.	Anticipated Funding Material	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Grade (m)
BH21-1	Silt Silty Clay	100 50	150 75	1.3 3.1
BH21-2	Clayey Silt	100	150	1.1
BH21-3	Clayey Silt	100 150	150 225	1.3 1.7
BH21-4	Clayey Silt	100 150	150 225	1.3 1.7
BH21-5	Silt Clayey Silt to Silty Clay	100 50	150 75	1.3 4.6
BH21-6	Clayey Silt Silty Clay	100 50	150 75	1.1 4.6
BH21-7	Silt	100 50	150 75	1.1 2.3
BH21-8	Sandy Silt	100	150	1.1
BH21-9	Sandy Silt Silt	100 150	150 225	1.1 3.4
BH21-10	Sandy Silt	50 100	75 150	1.1 1.7

5.1.1 Engineered Fill

It should be noted that weak silt clay / clayey silt or silt / sandy silt deposits were encountered in some boreholes. Upon reaching the design foundation level, the foundation base must be inspected by qualified geotechnical personnel prior to pouring concrete. Where soft/weak soils are encountered at the foundation level, they should be sub-excavated and replaced with engineered fill. Engineered fill may need to be placed to raise the grade to the design elevation.

Prior to the placement of the engineered fill, all of the existing fill and soft/weak native soils and disturbed materials must be removed, and the exposed surface proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered. The engineered fill consisting of approved inorganic material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential. Despite full time supervision, it has been found that contractors frequently bulldoze loose fill into areas and compact only the surface. The owner and his representatives must accept the risk involved in the use of engineered fill and offset this risk with the monetary savings of avoiding deep foundations. This potential problem must be recognized and discussed at a pre-construction meeting. Procedures can then be instigated to reduce the risk of settlement resulting from un-compacted fill.

The detailed requirements for engineered fill are given in **Appendix C**. The footings founded on engineered fill can be designed for a bearing capacity value of 150 kPa at the serviceability limit states (SLS), and for a factored geotechnical resistance of 225 kPa at the ultimate limit states (ULS).

5.1.2 Deep Foundation

The underlying soils at the Site are not suitable for supporting design loads exceeding the bearing capacities listed in **Table 2**. If higher bearing capacities are required for design, considerations may be given to support the proposed buildings on deep foundations founded in deeper, more competent soils or bedrock. Additional deeper boreholes will be required to confirm the extent and the depth of the deep foundations.

5.1.3 Additional Comments

All footing bases must be inspected by qualified geotechnical engineering personnel prior to pouring concrete. The excavated footing bases can be covered with 50 mm thick lean concrete slab immediately after inspection and cleaning in order to avoid disturbance of the founding soil due to water, construction activity and weathering/drying.

Foundations designed to the specified bearing capacity at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential, if designed as per **Table 2**.

All foundations exposed to seasonal freezing conditions must have at least 1.4 metres of soil cover for frost protection.

In the vicinity of the existing buried utilities, all footings must be lowered to undisturbed native soils, or alternatively the services must be structurally bridged. Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

It should be noted that the recommended bearing resistances have been estimated by Palmer from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections to validate the information for use during the construction stage.

5.2 Floor Slab and Permanent Drainage

The undisturbed native soils encountered at the site are generally capable of supporting the floor slabs. The existing fill in the boreholes were found to be unsuitable to support the floor slabs and must be sub-excavated. The subgrade must be thoroughly proof-rolled and any loose/soft or disturbed material must be sub-excavated and replaced with compacted soils, placed in shallow lifts (200 mm) and compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD).

A moisture barrier consisting of at least 200 mm of 19 mm clear crushed stone should be installed under the floor slab.

For buildings with one level of basement, a permanent perimeter and underfloor drainage system as outlined in **Drawings 2** or **3** will be required.

For buildings without basement, if the floor slab is more than about 300 mm higher than the exterior grade, then a perimeter drainage system is not considered to be necessary. If the floor is lower, then the perimeter drainage system shown on **Drawing 4** is recommended.

5.3 Excavations and Backfilling

Excavations can be carried out with a heavy hydraulic backhoe. It should be noted that the (glacial) tills are non-sorted sediments and therefore may contain boulders. Possible large obstructions such as buried concrete pieces and existing foundations may be encountered at the site and in the fill materials. Provisions must be made in the excavation contract for the removal of possible boulders in the till or obstructions in the fill material.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, the fill materials, loose to compact silt/sandy silt/silty sand, and very soft to soft silty clay/clayey silt would be classified as Type 3 Soils above the groundwater table and Type 4 Soils below the groundwater table. The dense to very dense silt/sandy silt/silty sand would be classified

as Type 2 Soils above the groundwater table and Type 4 Soils below the groundwater table. The stiff to hard silty clay/clayey silt fall into the category of Type 2 Soils above the groundwater table and Type 3 Soils below the groundwater table.

It is anticipated that foundation excavations at the site will consist of temporary open cuts with side slopes not steeper than 1.5 horizontal to 1 vertical (1.5H:1V). However, depending on the construction procedures adopted by the contractor and weather conditions at the time of construction, some local flattening of the slopes might be required. Where side slopes of excavations are to be steepened, then a positive excavation support system should be considered.

The existing fill in the boreholes is generally not suitable for re-use as backfill. The native soils free from topsoil and organics can be used as general construction backfill. Loose lifts of soil, which are to be compacted, should not exceed 200 mm. It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake. Aeration of these materials may be required prior to their use.

Under floor fill should be compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD). The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular ”B” should be used. Imported granular fill, which can be compacted with handheld equipment, should be used in confined areas.

It is expected that any seepage above the groundwater table can be removed by pumping from sumps in the proposed development area. However, significant seepage should be expected if the excavations extend below the prevailing groundwater tables in the cohesionless sandy/silty soils at the site. Depending upon the actual thickness and extent of these soils, the prevailing groundwater level at the time of construction, “active, advance” dewatering measure using well points/eductors may be required to maintain the stability of the base and side slopes of the excavations in these areas. These ‘active dewatering’ measures would have to be installed and then operated for a week or two in advance of excavation work progressing to these areas. A contractor specializing in dewatering should be retained to design the active dewatering systems.

It should be noted that if the construction dewatering system/sumps result in a water taking of more than 50,000 L/day but less than 400,000 L/day, a registration should be made in the Environmental Activity and Sector Registry (EASR). If a water taking is more than 400,000 L/day, a permit to take water (PTTW), issued by the MECP, will be required. A separate Hydrogeological Assessment by Palmer provides the dewatering requirements for any excavations below the groundwater table.

5.4 Earth Pressures

The lateral earth pressures acting at any depth on foundation walls may be calculated from the following expression:

$$P_h = K (\gamma h + q)$$

where P_h = Lateral earth pressure acting at depth "h" (kPa)

K = Earth pressure coefficient, assumed to be 0.40 for vertical walls and horizontal backfill for permanent construction

γ = Unit weight of backfill, may assume a value of 21 kN/m^3

h = Depth below finished grade of the point of interest (m)

q = Equivalent value of surcharge on the ground surface (kPa)

The above expression assumes that the perimeter drainage system as shown on **Drawing 2** to **4** prevents the build-up of any hydrostatic pressure behind the wall.

5.5 Pipe Support and Bedding

All fill materials, weak or disturbed soils or other objectionable material must be removed from excavation base prior to placement of pipe bedding.

The borehole information indicates that the native soils encountered at the Site are capable of providing adequate pipe support using conventional Class "B" bedding, provided that construction dewatering using well points/eductors is conducted when the excavation is below the groundwater level. The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm where the subgrade consists of competent native soils.

Where weak or otherwise unsuitable materials are present at the proposed pipe invert or trench invert elevation, the unsuitable materials should be sub-excavated and replaced using conventional Class "B" bedding. In this case, the recommended minimum thickness of granular bedding below the invert of the pipes is 300 mm.

The bedding material and its minimum thickness for the pipes should be in accordance with the current revision of OPSD (Ontario Provincial Standard Drawing) and applicable municipal standards and may have to be increased depending on the pipe diameter and where weak layers of subgrade conditions are encountered.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the uniformly graded bedding material.

The compacted granular base and the cover material for the pipe should consist of OPSS 1010 Granular "A" type material. All granular materials should be placed in loose lifts of 150mm thickness and then compacted. The granular bedding and cover materials should be compacted to 100% of Standard Proctor Maximum Dry Density (SPMDD) at a placement water content within ±2% of the materials optimum. Care should be exercised when compacting the cover material on top of the pipes to avoid damaging them.

5.6 Seismic Considerations

The 2012 Ontario Building Code (OBC 2012) came into effect on January 1, 2014 and contains updated seismic analysis and design methodology. The seismic site classification methodology outlined in the code is based on the subsurface conditions within the upper 30 m below existing grade.

The conservative site classification is based on physical borehole information obtained at depths of less than 30 m and based on general knowledge of the local geology and physiography. In this regard, Palmer's drilling program included boreholes drilled to depths up to 9.8 m below the existing ground surface. Based on the borehole information and our local experience, a Site Class D may be used for the building design.

Should optimization of the site class be recommended by the structural engineer, in situ geophysical testing or a deep borehole extending to 30 m may be considered.

5.7 Internal Road and Pavements

The recommended pavement structures provided in **Table 3** are based upon borehole information obtained in this investigation. The values may need to be adjusted based on the municipality/regional standards. Consequently, the recommended pavement structures should be considered for preliminary design purposes only. A functional design life of eight to ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client.

Table 3: Recommended Pavement Structure Thickness

Pavement Layer	Compaction Requirements	Light Duty Pavement (Parking for Cars)	Heavy Duty Pavement (Access Road, Fire Routes, Parking for Delivery Trucks)
Asphaltic Concrete	97% Maximum Relative Density (MRD)	40 mm HL 3 40 mm HL 8	40 mm HL 3 70 mm HL 8
OPSS Granular "A" Base (or 20mm Crusher Run Limestone)	100% SPMDD*	150 mm	150 mm
OPSS Granular "B" (or 50mm Crusher Run Limestone)	100% SPMDD	200 mm	300 mm

* Denotes Standard Proctor Maximum Dry Density, ASTM-D698

The subgrade must be compacted to 98% SPMDD for at least the upper 500 mm unless accepted by Palmer.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved. In addition, the need for adequate drainage cannot be over-emphasized. The finished pavement surface and underlying subgrade should be free of depressions and should be sloped (preferably at a minimum grade of two percent) to provide effective surface drainage toward catch basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas. Subdrains should be installed to intercept excess subsurface moisture and prevent subgrade softening. This is particularly important in heavy-duty pavement areas.

Additional comments on the construction of internal roadways and parking areas are as follows:

1) As part of the subgrade preparation, proposed area for internal roads and pavements should be stripped of topsoil and other obvious objectionable material. Fill required to raise the grades to design elevations should conform to backfill requirements outlined in previous sections of this report. The subgrade should be properly shaped, crowned then proof-rolled in the full-time presence of a representative of this office. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved granular backfill compacted to 98% SPMDD.

2) The locations and extent of sub-drainage required within the roadways and other paved areas should be reviewed by a pavement engineer in conjunction with the proposed site grading. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines. Assuming that satisfactory crossfalls in the order of two percent have been provided, subdrains extending from and between catch basins may be satisfactory. If shallower crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by a pavement engineer.

3) The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted access lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavourable weather.

5.8 Geotechnical Quality of Excavated Soils

Reference to the borehole logs suggests that the excavated materials with respect to their compaction characteristics can be divided into three groups:

- **Group 1** comprises the native silty clay / clayey silt and have moisture content very close to or above its optimum water content. This material will excavate in clods and would thus require a heavy pad footed compactor or hoe pack to break it down and adequately compact it. Given the water content of the till, it may not be possible to obtain a degree of compaction of this fill much above 95% of SPMDD. This degree of compaction might be acceptable within landscaped areas above which pavements or infrastructure are not expected to be built in the future.

- **Group 2** comprises comprise the cohesionless to low plasticity silt, sand silt, silty sand or sand and silt till. The compaction of these soils will require a very tight control of their moisture content during placement and compaction. At moisture contents more than 3% below the optimum, the soil will likely be dusty and “flour” like while at moisture contents ±1% higher than optimum, the soil will be “spongy” and will “pump”.

- **Group 3** soils consist of unsuitable materials because of their high moisture or organic inclusions, including all the existing fill materials. These soils should be either disposed off-site or should be used only in “soft” landscaping areas where they can be placed with nominal compaction, and where surface settlements are tolerable.

As a general requirement, all backfill material should be placed in 200 to 300mm thick loose lifts and compacted to at least 96% of SPMDD, at a placement moisture content within ±2% of the optimum. Below existing/future roads, the backfill must be Granular “A” or “B” material, and the top 1.5m of subgrade backfill below the underside of the pavement structure should be compacted to 98% of SPMDD. Where a free-draining backfill is needed or where the backfill is needed for structural support of overlying structures, the site soils will not be suitable and OPSS Granular “A” or “B” sand and gravel will be required. Similarly, during work in the autumn, winter and spring months, re-use of the excavated soils as compacted fill may not be practical and imported OPSS Granular “B” should be used.

5.9 Chemical Analysis

Soil samples were collected by Palmer to assess the requirements for soil disposal and/or reuse purposes. Palmer collected three (3) sets of soil samples for bulk chemical analysis. The samples were submitted under a chain of custody to ALS Laboratories, a Canadian Association for Laboratory Accreditation Inc. (CALA) certified laboratory, for parameters listed in Ontario Regulation 153/04. Collected samples were analyzed for Metals and Inorganics (M&I), and compared against Ontario Regulation 153/04 Table 1 Site Condition Standards (SCS) for Residential/Parkland/Institutional/ Industrial/Commercial/Community (RPIICC) property uses.

Details of the samples tested are listed in **Table 4** below. The Certificates of Chemical Analysis (CoA) are provided in **Appendix D**.

Table 4: Summary of Soil Environmental Quality Tests

Sample ID	Soil Depth (mBGS)	Soil Type	Analytical Parameters
BH21-3 SS2	0.8 – 1.4	Sand silt fill / Clayey silt	M&I
BH21-5 SS2	0.8 – 1.4	Sandy silt fill / Silt	M&I
BH21-8 SS2	0.8 – 1.4	Sandy silt	M&I

Note: mBGS = meters below ground surface

In comparison with the Table 1 SCS for RPIICC properties, the results of the laboratory analyses on the three (3) soil samples indicated that the measured contaminant concentrations were below the Table 1 SCS, with no exceedances detected.

Based on the results, the following disposal options may be considered:

Soils excavated in the vicinity of Borehole BH21-3, BH21-5, and BH21-8 can be re-used on-site or at another property where the property use is for RPIICC. Toxicity Characteristic Leachate Procedure (TCLP) analysis will be required to characterize the soils prior to disposal.

Based on the proposed work, the excavation of soil will likely be required during the early stages of construction. Prior to the excavation of soil and in support of the building permit application process, the suitability of reusing the soil at an off-site receiving site or temporary storage site must be assessed in accordance with Ontario Regulation 406/19. This will include the completion of an Assessment of Past Uses, Soil Characterization, Excess Soil Destination Report, Tracking, and Registry on the Environmental Site Registry.

6. Certification

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

This report was prepared and reviewed by the undersigned:

Prepared By:

Ted Pan, M.Eng., P.Eng.
Geotechnical Engineer

Reviewed By:

Chi Cheng (Dennis) Tseng, M.Sc., P.Eng.
Senior Geotechnical Engineer

7. References

ASTM International. 2018. ASTM D1586 / D1586M-18, Standard test method for standard penetration test (SPT) and split-barrel sampling of soils.

Canadian Geotechnical Society. 2006. Canadian Foundation Engineering Manual, 4th Edition.

Chapman, L.J. and Putnam, D.F. 1984. Physiography of southern Ontario; Ontario Geological Survey

Ontario Geological Survey 2010. Surficial geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release— Data 128 – Revised.

Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

General Comments and Limitations of Report

Palmer should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Palmer will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes and test pits required to determine the localized underground conditions between boreholes and test pits affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole and test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to Palmer at the time of preparation. Unless otherwise agreed in writing by Palmer, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Palmer accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

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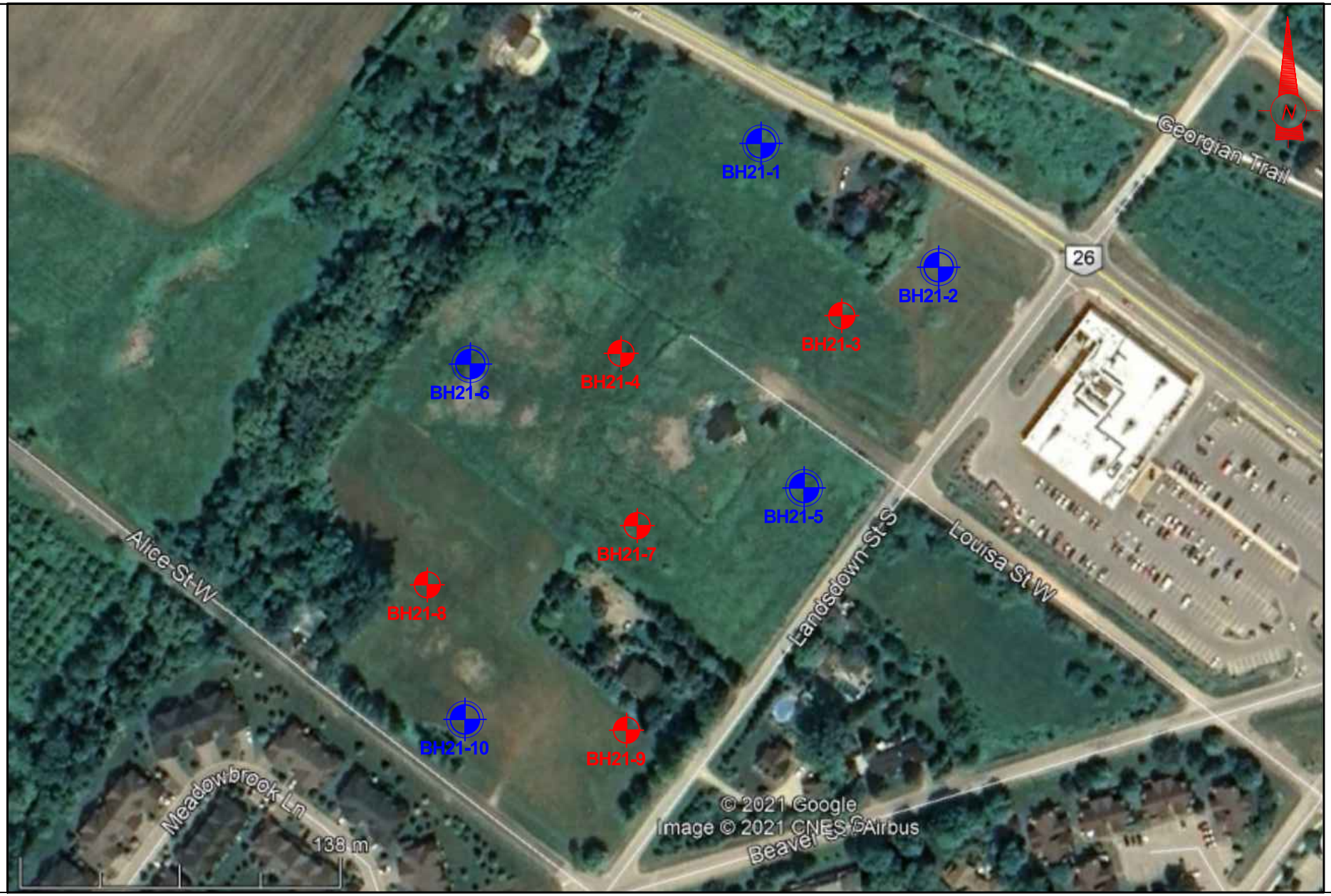
Drawings

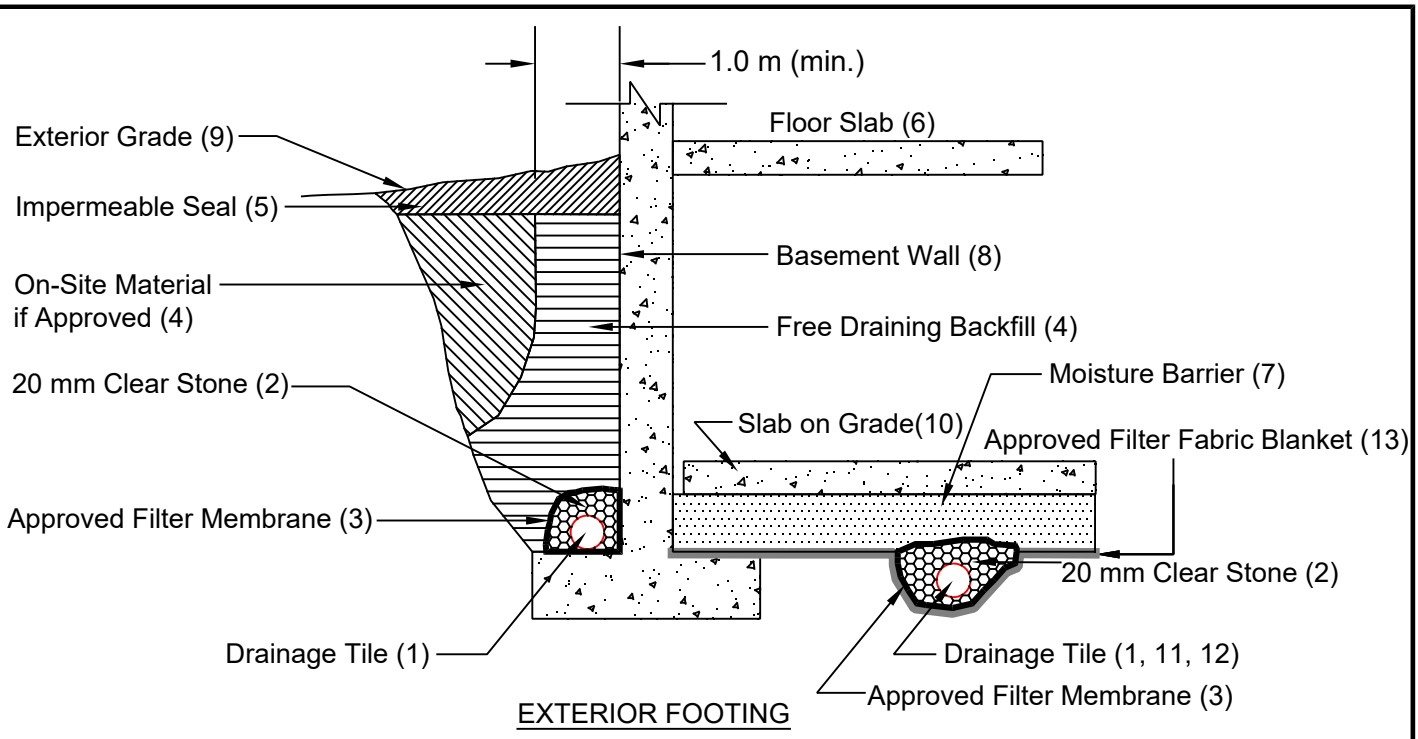


LEGEND

Borehole Locations

Monitoring Well Locations

Client:	**Blue Meadows Inc.**		Project No.:	**2105901**	Drawing No.: **1**
Drawn:	**TP**	Approved: **DT**	Title:	**Borehole and Monitoring Well Location Plan**	
Date:	**August, 2021**	Scale: **As Shown**	Project:	**Geotechnical Investigation** **125 Arthur St W and 123 Louisa St W, Thornbury, ON**	
Original Size:	**Letter**	Rev: **N/A**	Palmer™	74 Berkeley Street Toronto, Ontario M5A 2W7	



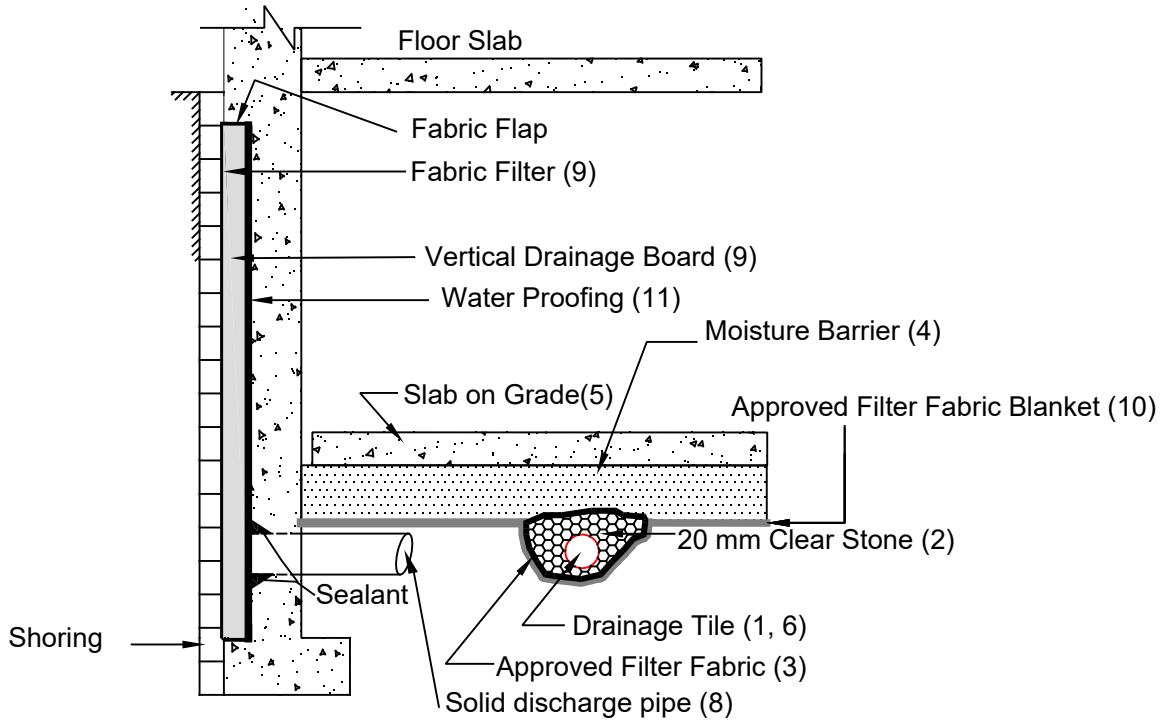
EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Free Draining backfill - OPSS Granular B or equivalent compacted to the specified density. Do not use heavy compaction equipment within 450 mm (18") of the wall. Use hand controlled light compaction equipment within 1.8 m (6') of wall. The minimum width of the Granular 'B' backfill must be 1.0 m.
5. Impermeable backfill seal - compacted clay, clayey silt or equivalent. If original soil is free-draining, seal may be omitted. Maximum thickness of seal to be 0.5 m.
6. Do not backfill until wall is supported by basement and floor slabs or adequate bracing.
7. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
8. Basement wall to be damp proofed /water proofed.
9. Exterior grade to slope away from building.
10. Slab on grade should not be structurally connected to the wall or footing.
11. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab.
12. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
13. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
14. Do not connect the underfloor drains to perimeter drains.
15. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Basement with Underfloor Drainage

(not to scale)



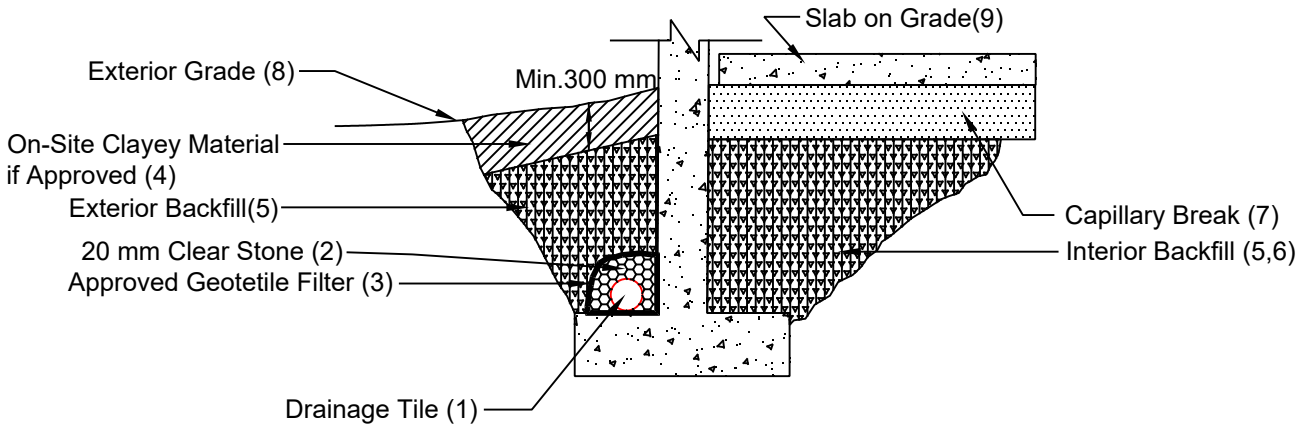
EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet, spaced between columns.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved filter membrane (Terrafix 270R or equivalent).
4. Moisture barrier to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors.
5. Slab on grade should not be structurally connected to the wall or footing.
6. Underfloor drain invert to be at least 300 mm (12") below underside of floor slab. Drainage tile placed in parallel rows 6 to 8 m (20 to 25') centers one way. Place drain on 100 mm (4") clear stone with 150 mm (6") of clear stone on top and sides. Enclose stone with filter fabric as noted in (3).
7. Do not connect the underfloor drains to perimeter drains.
8. Solid discharge pipe located at the middle of each bay between the solider piles, approximate spacing 2.5 m, outletting into a solid pipe leading to a sump.
9. Vertical drainage board with filter cloth should be kept a minium of 1.2 m below exterior finished grade.
10. The entire subgrade to be sealed with approved filter fabric (Terrafix 270R or equivalent) if non-cohesive (sandy) soils below ground water table encountered.
11. The basement walls should be water proofed using bentonite or equivalent water-proofing system.
12. Review the geotechnical report for specific details. Final detail must be approved before system is considered acceptable.

DRAINAGE RECOMMENDATIONS
Shored Basement wall with Underfloor Drainage System

(not to scale)



EXTERIOR FOOTING

Notes

1. Drainage tile to consist of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet.
2. 20 mm (3/4") clear stone - 150 mm (6") top and side of drain. If drain is not on footing, place100 mm (4 inches) of stone below drain .
3. Wrap the clear stone with an approved geotetile filter (Terrafix 270R or equivalent).
4. The on-site clayey material, if approved, can be used as backfill in the upper 300 mm.
5. The interior and exterior fill adjacent to foundation walls should be OPSS Granular 'B' Type I. Compact to at least 98% SPMDD.
6. Do not use heavy compaction equipment within 450 mm (18") of the wall. Do not fill or compact within 1.8 m (6') of the wall. Place fill on both sides simultaneously.
7. Capillary break to be at least 200 mm (8") of compacted clear 20 mm (3/4") stone or equivalent free draining material. A vapour barrier may be required for specialty floors (consult with archtect).
8. Exterior grade to slope away from building at min. 2%.
9. Slab on grade should not be structurally connected to the wall or footing.
10. Review the geotechnical report for specific details.

DRAINAGE AND BACKFILL RECOMMENDATIONS
Slab on Grade Construction Without Underfloor Drainage
(not to scale)

Appendix A

Borehole Logs

Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by Palmer also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Explanation of Terms Used in the Record of Test Pits

Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

Penetration Resistance

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

Dynamic Cone Penetration Resistance, N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

Textural Classification of Soils

Classification	Particle Size
Boulders	>300 mm
Cobbles	75 mm-300 mm
Gravel (Gr)	4.75 mm-75 mm
Sand (Sa)	0.075 mm-4.75 mm
Silt (Si)	0.002 mm-0.075 mm
Clay (Cl)	<0.002 mm

Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	>35%

Soil Description

a) Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

Soil Tests

w	Water content
w_p	Plastic limit
w_l	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D_R	Relative density (specific gravity, Gs)
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

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LOG OF BOREHOLE BH21-1

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

CLIENT: Blue Meadows Inc.

PROJECT LOCATION: Thornbury, ON

DATUM: N/A

BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers

Diameter: 150mm

Date: Jul-13-2021

REF. NO.: 2105901

ENCL NO.: 1

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface								
0.0	**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					
		5	SS	5		Holeplug	75		
					W. L. 4.0 mBGL Aug 10, 2021				
		6	SS	7			150		
		7	SS	5			62		
						Sand Screen			
		8	SS	6			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								

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH21-2

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.: 2

BH LOCATION: See Borehole Location Plan

ELEV / DEPTH (m)	DESCRIPTION	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface						
0.0	**TOPSOIL:** 300 mm	1	SS	5		Concrete	
0.3	**FILL:** clayey silt, trace sand, trace gravel, trace rootlets, trace organics, dark brown to brown, wet, firm						
0.7	**CLAYEY SILT:** trace sand, contains sand seams, brown, moist to wet, stiff	2	SS	10			
		3	SS	11		W. L. 1.3 mBGL Aug 10, 2021	
		4	SS	9			
3.0	**SILTY CLAY:** trace sand, contains sand seams, brown, wet, firm	5	SS	8			
4.1	**SAND AND SILT TILL:** trace clay, trace gravel, contains sand seams, grey, moist, loose to very dense	6	SS	9		Sand Screen	3 36 50 11
		7	SS	50/ Initial 125mm		Sand	Spoon wet
6.2	**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 1.28						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

Palmer

LOG OF BOREHOLE BH21-3

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

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION
	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 to wet, very loose to loose		1	SS	3		
			2	SS	9		
1.1	**CLAYEY SILT:** some sand, contains sand seams, contains silt layers, brown, wet, stiff to very stiff		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.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH21-4

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.: 4

BH LOCATION: See Borehole Location Plan

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface											
0.0	**TOPSOIL:** 250 mm											
0.3	**FILL:** silty sand, trace clay, trace rootlets, trace organics, contains sandy silt pockets, dark brown to brown, wet, very loose		1	SS	2							
0.7	**FILL:** clayey silt, trace sand, trace rootlets, brown, wet, stiff		2	SS	11							Spoon wet below
	CLAYEY SILT: trace sand, contains sand seams, contains silt layers, brown, wet, stiff		3	SS	15							
			4	SS	14							
			5	SS	12							
4.1	**SILTY CLAY:** trace sand, brown, wet, stiff to firm		6	SS	13						200	
			7	SS	8						100	
6.7	**END OF BOREHOLE** 1. Water level was at 2.1 m below ground surface (mBGS) upon completion of drilling.											

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH21-5

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

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface										
0.0	**TOPSOIL:** 220 mm										
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		Concrete				
			2	SS	10	▽	W. L. 1.2 mBGL Aug 10, 2021				
1.1	**SILT:** some clay, trace sand, trace gravel, contains clayey silt layers, brown, wet, compact to loose		3	SS	9						
2.2	**CLAYEY SILT TO SILTY CLAY:** trace sand, brown, wet, firm to stiff		4	SS	9						
			5	SS	8						
							Sand Screen				
			6	SS	6						
			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 ○ ε=3% Strain at Failure

Palmer

LOG OF BOREHOLE BH21-6

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

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface						
0.0	**TOPSOIL:** 300 mm	1	SS	5		Concrete	
0.3	**FILL:** sand, some silt, trace clay, trace gravel, trace rootlets, trace orgaincs, contains sandy silt pockets, dark brown to brown, wet, loose						
0.5		2	SS	10			
0.7	**FILL:** clayey silt, trace sand, trace rootlets, trace organics, brown, wet, firm						
1	**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			
3		5	SS	8		Holeplug	
4					▽	W. L. 3.7 mBGL Aug 10, 2021	
5		6	SS	5			0 1 63 36
6	grey below 6.1m	7	SS	3			
7		8	SS	2		Sand Screen	
8.7	**SILTY SAND:** some clay, some gravel, grey, moist, loose	9	SS	9		Sand	
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						

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa): 75; 50; 7

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

Palmer

LOG OF BOREHOLE BH21-7

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

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE & Sensitivity, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
Ground Surface											
0.0	**TOPSOIL:** 300 mm		1	SS	3						
0.3	**FILL:** sand, some silt, trace clay, trace rootlets, trace organics, contains sandy silt pockets, dark brown to brown, wet, very loose										
0.7			2	SS	8						Spoon wet below
0.9	**FILL:** silt, some clay, trace sand, trace rootlets, brown, wet, loose										
	SILT: some clay, trace sand, contains sand seams, contains clayey silt layers, brown, wet, loose to compact		3	SS	12						
			4	SS	5					87	
3.0	**CLAYEY SILT TO SILTY CLAY:** trace sand, trace gravel, contains sand seams, brown, wet, firm to stiff		5	SS	5					100	
			6	SS	7					137	
			7	SS	9						
6.7	**END OF BOREHOLE** 1. Borehole caved to 4.6 m below ground surface (mBGS) upon completion of drilling. 2. Water level was at 1.8 mBGS upon completion of drilling.										

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

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

Palmer

LOG OF BOREHOLE BH21-8

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

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface							20 40 60 80 100	10 20 30			
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; ○ 8=3% Strain at Failure

LOG OF BOREHOLE BH21-9

PROJECT: Geotechnical Investigation - 125 Arthur St W and 123 Louisa St W
CLIENT: Blue Meadows Inc.
PROJECT LOCATION: Thornbury, ON
DATUM: N/A
BH LOCATION: See Borehole Location Plan

Method: Solid Stem Augers
Diameter: 150mm
Date: Jul-13-2021

REF. NO.: 2105901
ENCL NO.: 9

(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS/0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH (kPa)	NATURAL MOISTURE CONTENT w (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface											
0.0	**TOPSOIL:** 250 mm											
0.3	**FILL:** sandy silt, some clay, trace gravel, some organics, trace rootlets, contains clayey silt pockets, dark brown to brown, wet, very loose		1	SS	3				~27			
0.7	**SANDY SILT:** trace clay, trace gravel, contains sand seams, brown, moist, compact to loose		2	SS	13				~16			
1.7	**CLAYEY SILT:** some sand, contains sand seams, brown, moist, stiff		3	SS	10				~19	200		
2.2	**SILT:** some clay, some sand, trace gravel, brown, moist, compact		4	SS	12				~18			
			5	SS	13				~17			
			6	SS	18				~19			
5.6	**SILTY CLAY:** trace sand, brown, wet, stiff		7	SS	9				~30			
6.7	**END OF BOREHOLE**											

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH (kPa): O UNCONFINED, + FIELD VANE & Sensitivity, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100
PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) 10 20 30

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: +3, ×3: Numbers refer to Sensitivity; O ε=3% Strain at Failure

Palmer

LOG OF BOREHOLE BH21-10

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

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Ground Surface							
0.0	**TOPSOIL:** 230 mm					Concrete		
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			
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 contains silty sand layers		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							

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

Appendix B

Geotechnical Lab Testing Results

Particle Size Distribution Report

	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	3.0	9.8	25.9	50.5	10.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3136	0.0714	0.0511	0.0153	0.0046			

Material Description	USCS	AASHTO
○ SILT AND SAND trace to some clay trace gravel		

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG Prj No 2105901

○ **Sample Number:** BH 21-2, Sample 6

Remarks:

○Tested on July 27, 2021

Terrapex

Figure 1

Tested By: AO/AM **Checked By:** DM

Particle Size Distribution Report

	% +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:

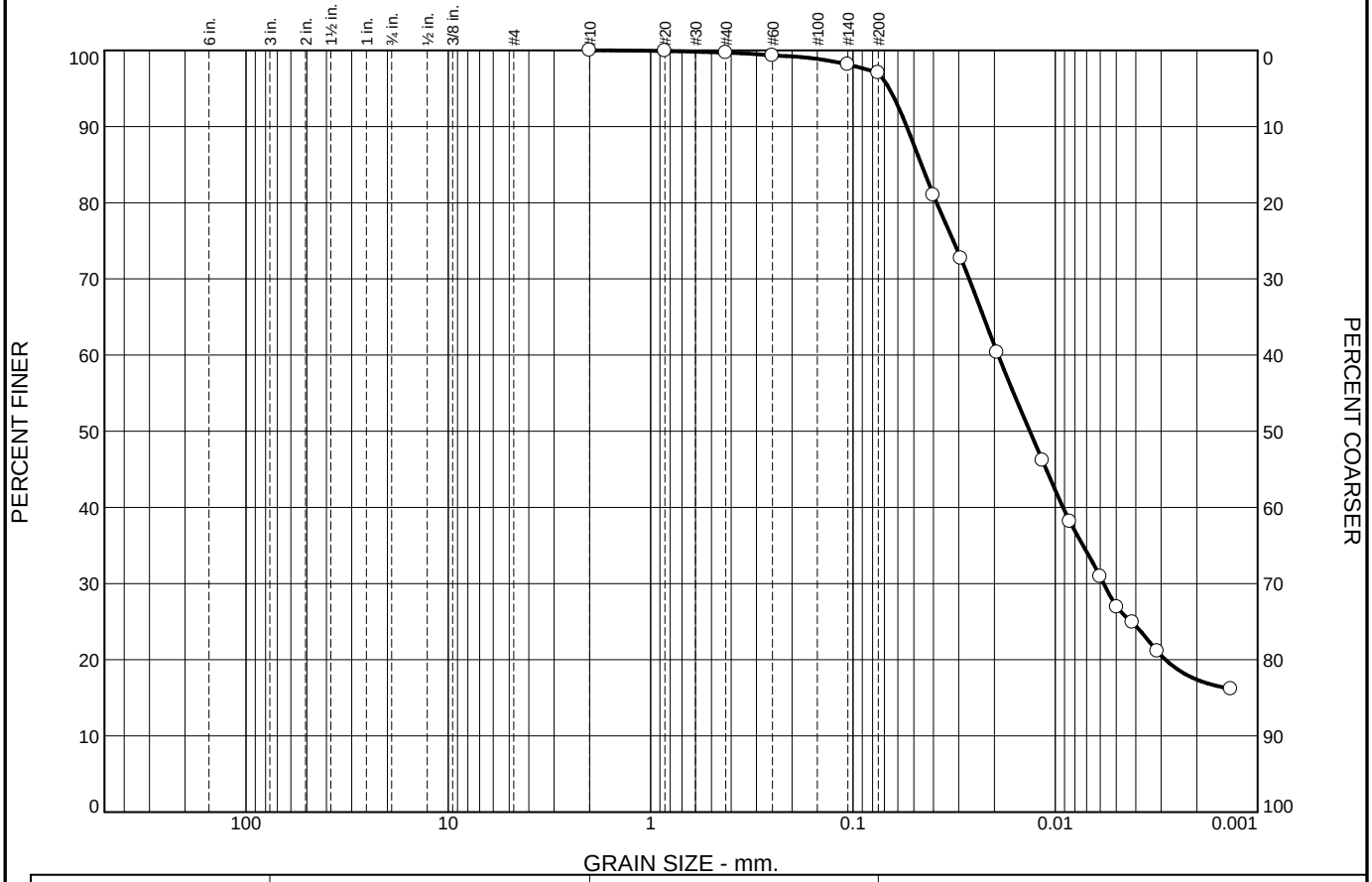
○Tested on July 27, 2021

Terrapex

Figure 2

Tested By: AO/AM

Particle Size Distribution Report



	% +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:

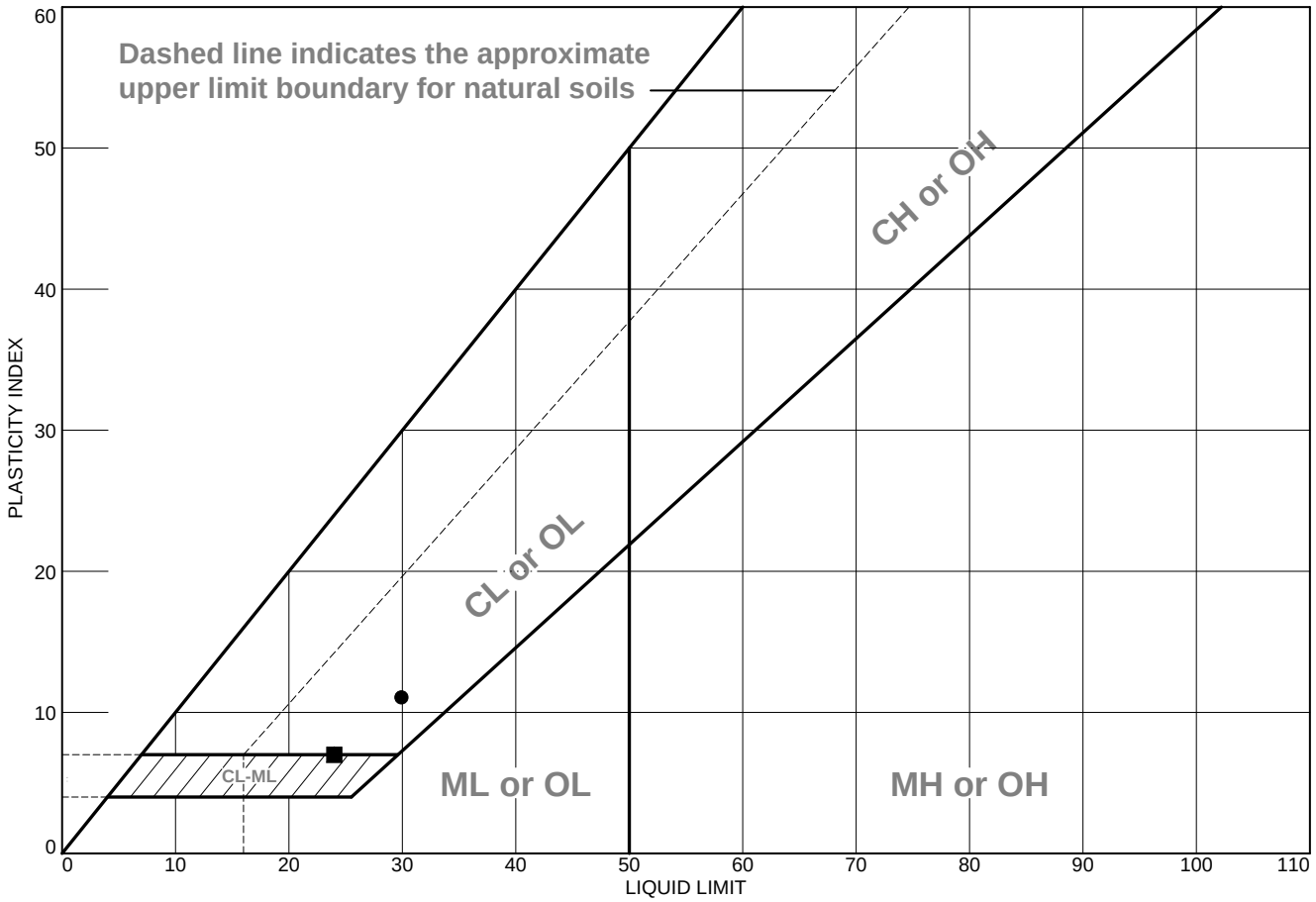
○Tested on July 27, 2021

Terrapex

Figure 3

Tested By: AO/AM

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	BH21-1, Sample 6	30	19	11			
■	BH21-5, Sample 4	24	17	7			
▲	BH21-7, Sample 5	24	17	7			

Project No. CA19009 **Client:** Palmer Environmental Consulting Group Inc. (PECG)

Project: PECG Prj No 2105901

●**Sample Number:** BH 21-1, Sample 8
■**Sample Number:** BH 21-5, Sample 4
▲**Sample Number:** BH 21-7, Sample 5

Remarks:
●Tested on July 27, 2021
■Tested on July 28, 2021
▲Tested on July 27, 2021

Terrapex

Figure 4

Tested By: AM **Checked By:** DM

Appendix C

General Requirements for Engineered Fill

GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows, however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.

2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.

3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and Palmer. Without this confirmation no responsibility for the performance of the structure can be accepted by Palmer. Survey drawing of the pre and post fill location and elevations will also be required.

4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by an engineer prior to placement of fill.

5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.

6. Full-time geotechnical inspection by approved geotechnical engineering personnel during placement of engineered fill is required. Work cannot commence or continue without the presence of the geotechnical engineering representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.

8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.

9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.

10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from geotechnical consultant prior to footing concrete placements. All excavations must be backfilled under full time supervision by approved geotechnical engineering personnel to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of geotechnical engineer.

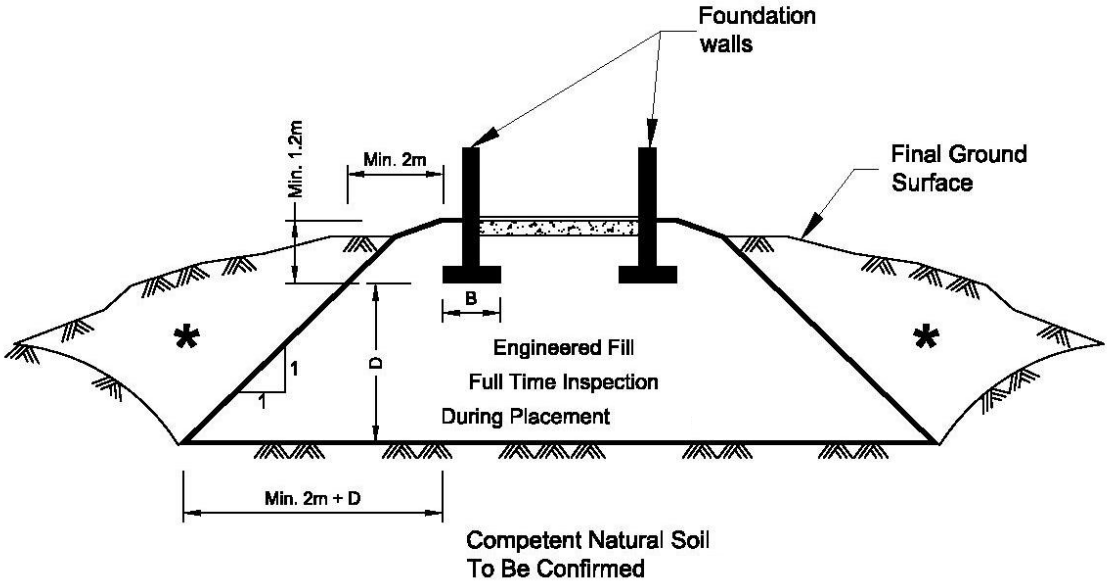
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.

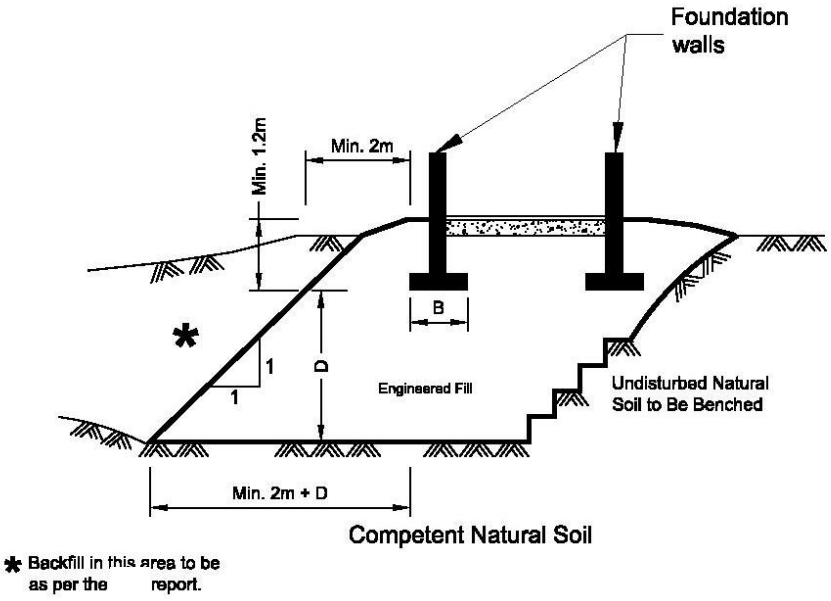
12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.

13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter

sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

14. These guidelines are to be read in conjunction with Palmer report attached.





* Backfill in this area to be as per the report.

Appendix D

Certificate of Analysis

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

Date Received: 23-JUL-21
Report Date: 04-AUG-21 08:59 (MT)
Version: FINAL

Client Phone: 647-795-8153

Certificate of Analysis

Lab Work Order #: L2617791

Project P.O. #: NOT SUBMITTED
Job Reference: 2105901
C of C Numbers:
Legal Site Desc:

Jennifer Barkshire-Paterson
Account Manager

Summary of Guideline Exceedances

ALS ID	Client ID	Grouping	Analyte	Result	Guideline Limit	Unit
Guideline						
Ontario Regulation 153/04 - April 15, 2011 Standards - T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use						
(No parameter exceedances)						
Ontario Regulation 153/04 - April 15, 2011 Standards - T3-Soil-Res/Park/Inst. Property Use (Coarse)						
(No parameter exceedances)						

Physical Tests - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2617791-1 / Sample Date: 13-JUL-21 / Sample ID: BH21-3 SS2	Lab ID: L2617791-2 / Sample Date: 13-JUL-21 / Sample ID: BH21-5 SS2	Lab ID: L2617791-3 / Sample Date: 13-JUL-21 / Sample ID: BH21-8 SS2
Conductivity	mS/cm	0.57	0.7	0.171	0.136	0.146
% Moisture	%	-	-	15.6	18.4	12.9
pH	pH units	-	-	7.76	7.75	7.82

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T3-Soil-Res/Park/Inst. Property Use (Coarse)

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.

Cyanides - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID: L2617791-1 / Sample Date: 13-JUL-21 / Sample ID: BH21-3 SS2	Lab ID: L2617791-2 / Sample Date: 13-JUL-21 / Sample ID: BH21-5 SS2	Lab ID: L2617791-3 / Sample Date: 13-JUL-21 / Sample ID: BH21-8 SS2
Cyanide, Weak Acid Diss	ug/g	0.051	0.051	<0.050	<0.050	<0.050

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T3-Soil-Res/Park/Inst. Property Use (Coarse)

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

Saturated Paste Extractables - SOIL

			Lab ID	L2617791-1	L2617791-2	L2617791-3
			Sample Date	13-JUL-21	13-JUL-21	13-JUL-21
			Sample ID	BH21-3 SS2	BH21-5 SS2	BH21-8 SS2
Analyte	**Unit**	**Guide Limits #1**	**#2**			
SAR	SAR	2.4	5	0.15	0.41	0.12
Calcium (Ca)	mg/L	-	-	19.1	12.4	14.9
Magnesium (Mg)	mg/L	-	-	3.60	2.38	2.17
Sodium (Na)	mg/L	-	-	2.71	6.04	1.83

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T3-Soil-Res/Park/Inst. Property Use (Coarse)

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.

Metals - SOIL

Analyte	Unit	Guide Limits #1	Guide Limits #2	Lab ID	Sample Date	Sample ID
				L2617791-1	13-JUL-21	BH21-3 SS2
				L2617791-2	13-JUL-21	BH21-5 SS2
				L2617791-3	13-JUL-21	BH21-8 SS2
Antimony (Sb)	ug/g	1.3	7.5	<1.0	<1.0	<1.0
Arsenic (As)	ug/g	18	18	5.8	6.4	4.2
Barium (Ba)	ug/g	220	390	38.7	42.3	25.5
Beryllium (Be)	ug/g	2.5	4	0.68	0.74	<0.50
Boron (B)	ug/g	36	120	22.2	23.0	11.2
Boron (B), Hot Water Ext.	ug/g	36	1.5	<0.10	<0.10	<0.10
Cadmium (Cd)	ug/g	1.2	1.2	<0.50	<0.50	<0.50
Chromium (Cr)	ug/g	70	160	20.2	24.4	13.0
Cobalt (Co)	ug/g	21	22	10.7	12.3	6.1
Copper (Cu)	ug/g	92	140	21.3	23.8	15.8
Lead (Pb)	ug/g	120	120	6.0	6.9	4.7
Mercury (Hg)	ug/g	0.27	0.27	0.0085	0.0062	0.0054
Molybdenum (Mo)	ug/g	2	6.9	<1.0	<1.0	<1.0
Nickel (Ni)	ug/g	82	100	23.2	25.4	12.8
Selenium (Se)	ug/g	1.5	2.4	<1.0	<1.0	<1.0
Silver (Ag)	ug/g	0.5	20	<0.20	<0.20	<0.20
Thallium (Tl)	ug/g	1	1	<0.50	<0.50	<0.50
Uranium (U)	ug/g	2.5	23	<1.0	<1.0	<1.0
Vanadium (V)	ug/g	86	86	28.1	35.7	20.5
Zinc (Zn)	ug/g	290	340	42.3	47.9	24.2

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T3-Soil-Res/Park/Inst. Property Use (Coarse)

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

Speciated Metals - SOIL

		Guide Limits				
Lab ID				L2617791-1	L2617791-2	L2617791-3
Sample Date				13-JUL-21	13-JUL-21	13-JUL-21
Sample ID				BH21-3 SS2	BH21-5 SS2	BH21-8 SS2
Analyte	**Unit**	**#1**	**#2**			
Chromium, Hexavalent	ug/g	0.66	8	<0.20	<0.20	<0.20

Guide Limit #1: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use
Guide Limit #2: T3-Soil-Res/Park/Inst. Property Use (Coarse)

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.

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**
B-HWS-R511-WT	Soil	Boron-HWE-O.Reg 153/04 (July 2011)	HW EXTR, EPA 6010B

A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

CN-WAD-R511-WT	Soil	Cyanide (WAD)-O.Reg 153/04 (July 2011)	MOE 3015/APHA 4500CN I-WAD

The sample is extracted with a strong base for 16 hours, and then filtered. The filtrate is then distilled where the cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

CR-CR6-IC-WT	Soil	Hexavalent Chromium in Soil	SW846 3060A/7199

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 7199, published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution.

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).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity 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).

HG-200.2-CVAA-WT	Soil	Mercury in Soil by CVAAS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

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).

MET-200.2-CCMS-WT	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020B (mod)

Soil/sediment is dried, disaggregated, and sieved (2 mm). For tests intended to support Ontario regulations, the <2mm fraction is ground to pass through a 0.355 mm sieve. Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS.

Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.

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), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference**

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

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).

SAR-R511-WT	Soil	SAR-O.Reg 153/04 (July 2011)	SW846 6010C

A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.

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 and as of November 30, 2020), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

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

Chain of Custody Numbers:

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

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 wwt - 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

Workorder: L2617791 Report Date: 04-AUG-21

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Ted Pan

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
B-HWS-R511-WT	**Soil**							
Batch R5535411								
WG3587089-4 DUP		**L2620450-1**						
Boron (B), Hot Water Ext.		0.37	0.36		ug/g	3.3	30	30-JUL-21
WG3587089-2 IRM		**WT SAR4**						
Boron (B), Hot Water Ext.			101.2		%		70-130	30-JUL-21
WG3587089-3 LCS								
Boron (B), Hot Water Ext.			99.5		%		70-130	30-JUL-21
WG3587089-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	30-JUL-21
Batch R5536799								
WG3587091-4 DUP		**L2617753-10**						
Boron (B), Hot Water Ext.		<0.10	<0.10	RPD-NA	ug/g	N/A	30	30-JUL-21
WG3587091-2 IRM		**WT SAR4**						
Boron (B), Hot Water Ext.			100.1		%		70-130	30-JUL-21
WG3587091-3 LCS								
Boron (B), Hot Water Ext.			105.0		%		70-130	30-JUL-21
WG3587091-1 MB								
Boron (B), Hot Water Ext.			<0.10		ug/g		0.1	30-JUL-21
CN-WAD-R511-WT	**Soil**							
Batch R5529686								
WG3583019-3 DUP		**L2616025-1**						
Cyanide, Weak Acid Diss		<0.050	<0.050	RPD-NA	ug/g	N/A	35	26-JUL-21
WG3583019-2 LCS								
Cyanide, Weak Acid Diss			89.3		%		80-120	26-JUL-21
WG3583019-1 MB								
Cyanide, Weak Acid Diss			<0.050		ug/g		0.05	26-JUL-21
WG3583019-4 MS		**L2616025-1**						
Cyanide, Weak Acid Diss			97.0		%		70-130	26-JUL-21
CR-CR6-IC-WT	**Soil**							
Batch R5530948								
WG3583469-4 CRM		**WT-SQC012**						
Chromium, Hexavalent			93.5		%		70-130	27-JUL-21
WG3583469-3 DUP		**L2617791-2**						
Chromium, Hexavalent		<0.20	<0.20	RPD-NA	ug/g	N/A	35	27-JUL-21
WG3583469-2 LCS								
Chromium, Hexavalent			101.7		%		80-120	27-JUL-21
WG3583469-1 MB								
Chromium, Hexavalent			<0.20		ug/g		0.2	27-JUL-21

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Ted Pan

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-WT	**Soil**							
Batch R5541557								
WG3587093-4 DUP		**WG3587093-3**						
Conductivity		0.451	0.456		mS/cm	1.1	20	03-AUG-21
WG3587093-2 IRM		**WT SAR4**						
Conductivity			115.7		%		70-130	03-AUG-21
WG3589346-1 LCS								
Conductivity			95.7		%		90-110	03-AUG-21
WG3587093-1 MB								
Conductivity			<0.0040		mS/cm		0.004	03-AUG-21
HG-200.2-CVAA-WT	**Soil**							
Batch R5535535								
WG3587079-2 CRM		**WT-SS-2**						
Mercury (Hg)			100.9		%		70-130	30-JUL-21
WG3587079-6 DUP		**WG3587079-5**						
Mercury (Hg)		0.0062	0.0056		ug/g	9.8	40	30-JUL-21
WG3587079-3 LCS								
Mercury (Hg)			100.0		%		80-120	30-JUL-21
WG3587079-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	30-JUL-21
MET-200.2-CCMS-WT	**Soil**							
Batch R5537184								
WG3587079-2 CRM		**WT-SS-2**						
Antimony (Sb)			97.1		%		70-130	30-JUL-21
Arsenic (As)			107.1		%		70-130	30-JUL-21
Barium (Ba)			101.4		%		70-130	30-JUL-21
Beryllium (Be)			110.3		%		70-130	30-JUL-21
Boron (B)			10.1		mg/kg		3.5-13.5	30-JUL-21
Cadmium (Cd)			102.8		%		70-130	30-JUL-21
Chromium (Cr)			107.3		%		70-130	30-JUL-21
Cobalt (Co)			103.9		%		70-130	30-JUL-21
Copper (Cu)			97.6		%		70-130	30-JUL-21
Lead (Pb)			97.2		%		70-130	30-JUL-21
Molybdenum (Mo)			102.2		%		70-130	30-JUL-21
Nickel (Ni)			101.4		%		70-130	30-JUL-21
Selenium (Se)			0.12		mg/kg		0-0.34	30-JUL-21
Silver (Ag)			101.7		%		70-130	30-JUL-21
Thallium (Tl)			0.074		mg/kg		0.029-0.129	30-JUL-21

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Ted Pan

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5537184								
WG3587079-2 CRM		**WT-SS-2**						
Uranium (U)			93.3		%		70-130	30-JUL-21
Vanadium (V)			107.7		%		70-130	30-JUL-21
Zinc (Zn)			99.0		%		70-130	30-JUL-21
WG3587079-6 DUP		**WG3587079-5**						
Antimony (Sb)		0.14	0.15		ug/g	9.2	30	30-JUL-21
Arsenic (As)		6.41	6.00		ug/g	6.6	30	30-JUL-21
Barium (Ba)		42.3	39.1		ug/g	8.1	40	30-JUL-21
Beryllium (Be)		0.74	0.65		ug/g	13	30	30-JUL-21
Boron (B)		23.0	20.8		ug/g	10	30	30-JUL-21
Cadmium (Cd)		0.050	0.045		ug/g	10	30	30-JUL-21
Chromium (Cr)		24.4	21.8		ug/g	11	30	30-JUL-21
Cobalt (Co)		12.3	11.0		ug/g	11	30	30-JUL-21
Copper (Cu)		23.8	21.6		ug/g	9.6	30	30-JUL-21
Lead (Pb)		6.87	6.26		ug/g	9.3	40	30-JUL-21
Molybdenum (Mo)		0.27	0.24		ug/g	10	40	30-JUL-21
Nickel (Ni)		25.4	22.6		ug/g	12	30	30-JUL-21
Selenium (Se)		<0.20	<0.20	RPD-NA	ug/g	N/A	30	30-JUL-21
Silver (Ag)		<0.10	<0.10	RPD-NA	ug/g	N/A	40	30-JUL-21
Thallium (Tl)		0.109	0.103		ug/g	5.4	30	30-JUL-21
Uranium (U)		0.592	0.538		ug/g	9.6	30	30-JUL-21
Vanadium (V)		35.7	32.5		ug/g	9.5	30	30-JUL-21
Zinc (Zn)		47.9	43.8		ug/g	8.8	30	30-JUL-21
WG3587079-4 LCS								
Antimony (Sb)			112.1		%		80-120	30-JUL-21
Arsenic (As)			110.7		%		80-120	30-JUL-21
Barium (Ba)			110.2		%		80-120	30-JUL-21
Beryllium (Be)			111.1		%		80-120	30-JUL-21
Boron (B)			104.8		%		80-120	30-JUL-21
Cadmium (Cd)			105.0		%		80-120	30-JUL-21
Chromium (Cr)			109.1		%		80-120	30-JUL-21
Cobalt (Co)			108.8		%		80-120	30-JUL-21
Copper (Cu)			105.4		%		80-120	30-JUL-21
Lead (Pb)			104.4		%		80-120	30-JUL-21

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Ted Pan

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-CCMS-WT	**Soil**							
Batch R5537184								
WG3587079-4 LCS								
Molybdenum (Mo)			108.5		%		80-120	30-JUL-21
Nickel (Ni)			106.1		%		80-120	30-JUL-21
Selenium (Se)			107.7		%		80-120	30-JUL-21
Silver (Ag)			102.3		%		80-120	30-JUL-21
Thallium (Tl)			103.3		%		80-120	30-JUL-21
Uranium (U)			99.3		%		80-120	30-JUL-21
Vanadium (V)			111.0		%		80-120	30-JUL-21
Zinc (Zn)			110.8		%		80-120	30-JUL-21
WG3587079-1 MB								
Antimony (Sb)			<0.10		mg/kg		0.1	30-JUL-21
Arsenic (As)			<0.10		mg/kg		0.1	30-JUL-21
Barium (Ba)			<0.50		mg/kg		0.5	30-JUL-21
Beryllium (Be)			<0.10		mg/kg		0.1	30-JUL-21
Boron (B)			<5.0		mg/kg		5	30-JUL-21
Cadmium (Cd)			<0.020		mg/kg		0.02	30-JUL-21
Chromium (Cr)			<0.50		mg/kg		0.5	30-JUL-21
Cobalt (Co)			<0.10		mg/kg		0.1	30-JUL-21
Copper (Cu)			<0.50		mg/kg		0.5	30-JUL-21
Lead (Pb)			<0.50		mg/kg		0.5	30-JUL-21
Molybdenum (Mo)			<0.10		mg/kg		0.1	30-JUL-21
Nickel (Ni)			<0.50		mg/kg		0.5	30-JUL-21
Selenium (Se)			<0.20		mg/kg		0.2	30-JUL-21
Silver (Ag)			<0.10		mg/kg		0.1	30-JUL-21
Thallium (Tl)			<0.050		mg/kg		0.05	30-JUL-21
Uranium (U)			<0.050		mg/kg		0.05	30-JUL-21
Vanadium (V)			<0.20		mg/kg		0.2	30-JUL-21
Zinc (Zn)			<2.0		mg/kg		2	30-JUL-21
MOISTURE-WT	**Soil**							
Batch R5529572								
WG3582627-3 DUP		**L2617885-1**						
% Moisture		16.8	15.6		%	7.6	20	24-JUL-21
WG3582627-2 LCS								
% Moisture			99.6		%		90-110	24-JUL-21
WG3582627-1 MB								

Quality Control Report

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Ted Pan

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-WT	**Soil**							
Batch R5529572								
WG3582627-1 MB								
% Moisture			<0.25		%		0.25	24-JUL-21
PH-WT	**Soil**							
Batch R5531024								
WG3584172-1 DUP		**L2617677-3**						
pH		8.26	8.29	J	pH units	0.03	0.3	28-JUL-21
WG3585812-1 LCS								
pH			6.96		pH units		6.9-7.1	28-JUL-21
SAR-R511-WT	**Soil**							
Batch R5536821								
WG3587093-4 DUP		**WG3587093-3**						
Calcium (Ca)		34.7	36.0		mg/L	3.7	30	30-JUL-21
Sodium (Na)		22.4	24.2		mg/L	7.7	30	30-JUL-21
Magnesium (Mg)		5.78	6.04		mg/L	4.4	30	30-JUL-21
WG3587093-2 IRM		**WT SAR4**						
Calcium (Ca)			105.4		%		70-130	30-JUL-21
Sodium (Na)			96.7		%		70-130	30-JUL-21
Magnesium (Mg)			105.1		%		70-130	30-JUL-21
WG3587093-5 LCS								
Calcium (Ca)			109.0		%		80-120	30-JUL-21
Sodium (Na)			113.8		%		80-120	30-JUL-21
Magnesium (Mg)			109.4		%		80-120	30-JUL-21
WG3587093-1 MB								
Calcium (Ca)			<0.50		mg/L		0.5	30-JUL-21
Sodium (Na)			<0.50		mg/L		0.5	30-JUL-21
Magnesium (Mg)			<0.50		mg/L		0.5	30-JUL-21

Quality Control Report

Workorder: L2617791 Report Date: 04-AUG-21

Client: PALMER ENVIRONMENTAL CONSULTING GROUP INC. (Richmond Hill)
74 Berkeley Street
Toronto ON M5V 1E3
Contact: Ted Pan

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.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

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.

Chain of Custody

L2617791-COFC

COC Number: 21 -

Page 1 of 1

www.alsglobal.com

Report To	Contact and company name below will appear on the final report
Company:	Palmer
Contact:	Ted Pan
Phone:	647-863-6076
	Company address below will appear on the final report
Street:	74 Berkeley St
City/Province:	Toronto, ON
Postal Code:	M5A 2W7
Invoice To	Same as Report To ☒ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☒ NO
Company:	
Contact:	

Project Information

ALS Account # / Quote #:	
Job #:	Z105901
PO / AFE:	AP
LSD:	
ALS Lab Work Order # (ALS use only):	L2617791

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: ted.pan@peq.ca

Email 2: sarah.sipak@peq.ca

Email 3:

Invoice Recipients

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax:

Email 2:

Oil and Gas Required Fields (client use)

AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

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 for non-routine tests.

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm am/pm

For all tests with rush TATs requested, please contact your AM to confirm availability.

AFFIX ALS BARCODE LABEL HERE (ALS use only)

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (ALS use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Metals & Inorganics	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH21-3 SS2	13-Jul-21	AM	Soil	1	X			
	BH21-5 SS2	13-Jul-21	AM	Soil	1	X			
	BH21-8 SS2	13-Jul-21	AM	Soil	1	X			

Drinking Water (DW) Samples[1] (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)

O. Reg 153 Table 1 & 3

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					FINAL COOLER TEMPERATURES °C				
					4.6				

SHIPMENT RELEASE (client use)

Released by:	Date:	Time:
Ted Pan	July 23, 2021	8:30am

INITIAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:

FINAL SHIPMENT RECEPTION (ALS use only)

Received by:	Date:	Time:
	4/23/21	1057

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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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**.