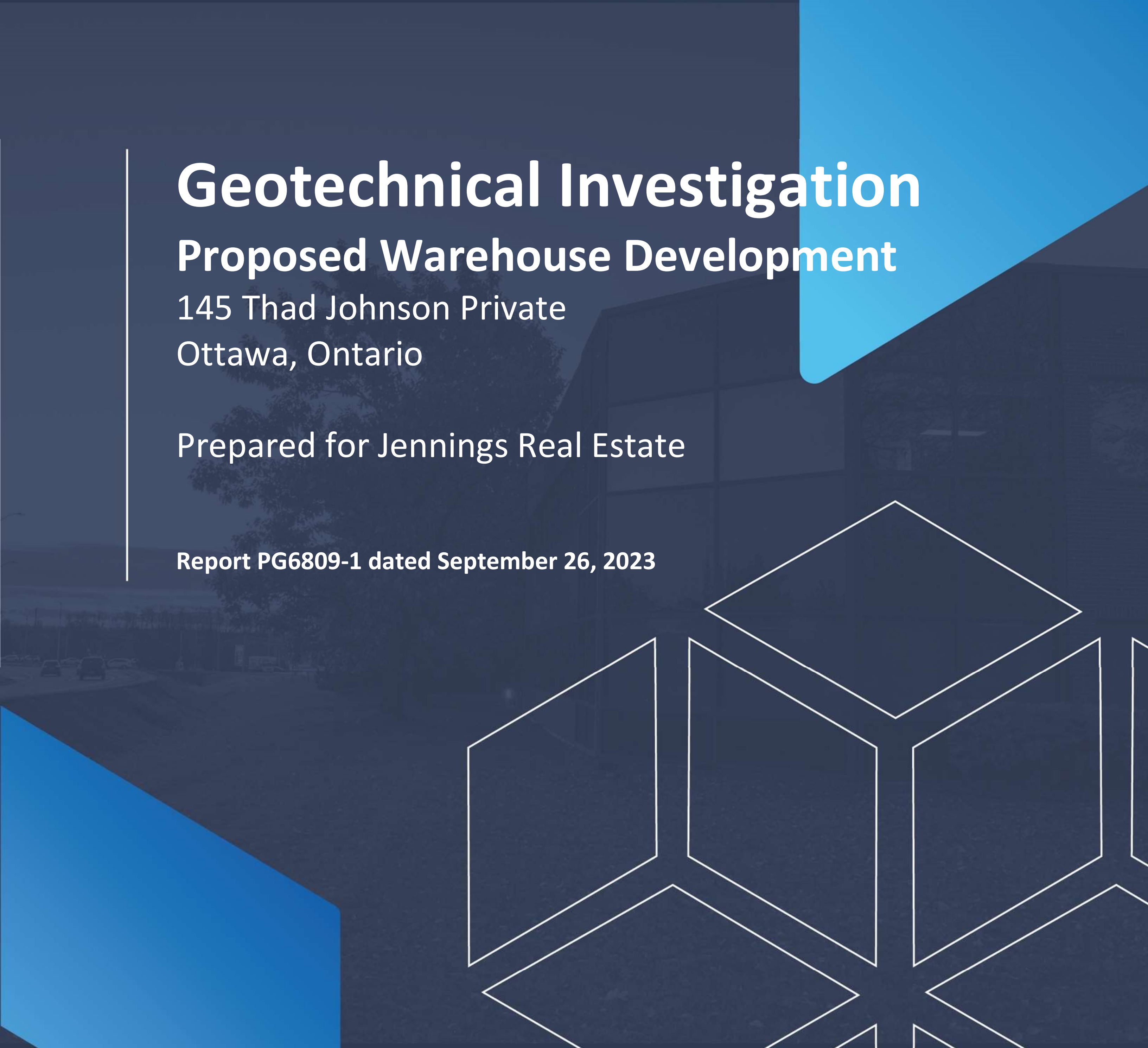


Geotechnical Investigation

Proposed Warehouse Development

145 Thad Johnson Private
Ottawa, Ontario

Prepared for Jennings Real Estate

Report PG6809-1 dated September 26, 2023

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Jennings Real Estate to conduct a geotechnical investigation for the proposed warehouse development to be located at 145 Thad Johnson Private in the City of Ottawa (reference should be made to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the geotechnical investigation were to:

☐ Determine the subsoil and groundwater conditions at this site by means of boreholes.

☐ Provide geotechnical recommendations pertaining to design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

Investigating for the presence or potential presence of contamination on the subject property was not part of the scope of work of the present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

Based on the available conceptual plan, it is understood that the proposed development will consist of an approximate 4,000 m^2 slab-on-grade warehouse building to be located in the northern portion of the site. Further, it is understood that the remainder of the site will generally be occupied by vehicle parking areas, access roads and loading areas with landscaped margins.

It is also expected that the subject site will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out from September 5 to 6, 2023, and consisted of advancing a total of 7 boreholes to a maximum depth of 6.7 m below existing ground surface. The borehole locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground utilities and site features. The approximate borehole locations are shown on Drawing PG6809-1 – Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a low clearance auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The testing procedure consisted of augering and excavating to the required depth at the selected location and sampling the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split spoon (SS) sampler. All samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags.

All samples were transported to our laboratory for further examination and classification. The depths at which the auger and split spoon samples were recovered from the boreholes are shown as AU, and SS, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The overburden thickness was evaluated by completing dynamic cone penetration test (DCPT) completed at borehole BH 2-23. The DCPT testing consisted of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data Sheets in Appendix 1 of this report.

Groundwater

Groundwater monitoring wells were installed in boreholes BH 2-23, BH 6-23 and BH 7-23 to permit monitoring of the groundwater levels following the completion of drilling. Additionally, standpipe piezometers were installed in all other boreholes. The groundwater level readings were obtained after a suitable stabilization period subsequent to the completion of the field investigation.

3.2 Field Survey

The borehole locations, and ground surface elevation at each borehole location, were surveyed by Paterson using a handheld GPS and referenced to a geodetic datum. The locations of the boreholes, and the ground surface elevations at each borehole location, are presented on Drawing PG6809-1 – Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. All samples will be stored in the laboratory for a period of one (1) month after issuance of this report. They will then be discarded unless we are directed otherwise.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity, and the pH of the samples. The results are presented in Appendix 1 and are discussed further in Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site primarily consists of a vacant, grass covered lot with the exception of a gravel surfaced access lane near the western boundary of the site. At the time of the current investigation, boulders and fill piles covered with vegetation were observed to be present along the eastern portion of the site.

Based on available historical aerial photographs, the subject site was located in the vicinity of a quarrying operation in the 1960's. The quarry seems to have been infilled and levelled off during the period between 1976 and 1991. Historical aerial photographs of the subject site and its surroundings are provided on Figures 2, 3 and 4 in Appendix 2.

The site is bordered by the Airport Parkway to the north, industrial buildings to the east and south, and the airport runway to the west. The ground surface across the subject site slopes downward from north to south from an approximate geodetic elevation of 117 m to an approximate geodetic elevation of 115 m.

4.2 Subsurface Profile

Generally, the subsoil profile encountered at the borehole locations consists of topsoil overlying a fill layer. The fill layer was generally observed to consist of brown silty sand with gravel, cobbles and crushed stone extending to approximate depths of 0.8 m to 2.3 m.

A deposit of compact to very dense, brown sand with varying amounts of silt, gravel, cobbles, boulders was encountered underlying the fill material at all boreholes and extended to the maximum depth of the boreholes. Intermittent layers of compact, brown sandy silt were observed within the sand deposit at borehole BH 5-23.

Practical refusal to the DCPT was encountered at an approximate depth of 7.5 m at borehole BH 2-23.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole location.

Bedrock

Based on available geological mapping, bedrock in the area of the subject site consists of dolomite of the Oxford Formation. The overburden drift thickness is estimated to be between 5 and 15 m depth.

4.3 Groundwater

Monitoring wells and piezometers were installed at all boreholes. However, the groundwater level was observed to be below the invert elevation of the monitoring wells and piezometers on September 15, 2023, when an attempt to measure the groundwater elevation was made.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

Long-term groundwater levels can also be estimated based on the observed color, moisture levels and consistency of the recovered soil samples. Based on these observations, the long-term groundwater level is anticipated to be a depth greater than **5 m** below the existing ground surface.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is recommended that the proposed structure be founded on conventional spread footings placed on the undisturbed, compact to dense sand bearing surface, or on the existing fill surface which is prepared in accordance with the "Subgrade Improvement Program for Foundations" procedure provided in Section 5.2.

The above and other considerations are discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and any fill containing significant amounts of deleterious or organic materials, should be stripped from under any buildings and other settlement sensitive structures. The existing fill material, where free of significant amounts of organic material and reviewed and approved by Paterson Group at the time of construction, can be left in place. Care should be taken not to disturb adequate bearing soils below the founding level during site preparation activities.

Any soft areas should be removed and backfilled with OPSS Granular B Type II, with a maximum particle size of 50 mm and compacted to 98% of the material's SPMDD.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the proposed building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath exterior parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Subgrade Improvement Program for Foundations

The following subgrade improvement program is recommended for areas where fill, free of significant amounts of deleterious materials, is encountered at the underside of footing elevation for the proposed building.

- ☐ The bearing surface at design underside of footing level should be sub-excavated at least 500 mm below footing level, extending at least 1 m beyond the outside face of the footing.

- ☐ The footing subgrade should be proof-compacted with a vibratory drum roller or large vibratory plate compactor. Any poor performing areas should be removed and replaced with an OPSS Granular B Type II material placed in maximum 300 mm loose lifts and compacted by a vibratory drum roller making several passes and witnessed by the geotechnical consultant.

- ☐ The sub-excavated area should be in-filled up to design underside of footing elevation with engineered fill, such as OPSS Granular B Type II, placed in maximum 300 mm loose lifts and compacted to at least 98% of the material’s SPMDD by a vibratory drum roller making several passes and witnessed by Paterson.

5.3 Foundation Design

Bearing Resistance Values

Footings placed on an undisturbed, compact to dense sand bearing surface, or on an approved existing fill subgrade which is prepared in accordance with the “Subgrade Improvement Programs for Foundations” procedure above, can be designed can be designed using a bearing resistance value at serviceability limit states (SLS) of **200 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **300 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed prior to the placement of concrete for footings.

Footings placed on an undisturbed soil bearing surface and designed using the bearing resistance values at SLS provided above will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Above the groundwater level, adequate lateral support is provided to the in-situ bearing medium soils when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered at this site. Due to the density of the sand and the depth of the long-term groundwater level, soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab on Grade Construction

With the removal of all topsoil and fill, containing significant amounts of deleterious or organic materials, the native soil and/or approved fill is considered to be an acceptable subgrade surface on which to commence backfilling for slab on grade construction.

Where the subgrade consists of existing fill, a vibratory drum roller should complete several passes over the subgrade surface. The proof-compaction program should be witnessed and approved by Paterson. Any poor performing areas should be removed and reinstated with an engineered fill such as OPSS Granular A, Granular B Type II with a maximum particle size of 50 mm. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

It is recommended that the upper 200 mm sub-floor fill consists of OPSS Granular A crushed stone. All backfill materials within the footprint of the proposed building should be placed in a maximum of 300 mm thick loose layers and compacted to at least 98% of the SPMDD.

5.6 Pavement Design

For design purposes, the pavement structures presented in the following tables are recommended for the design of car only parking areas, access lanes and heavy truck parking and loading areas.

Table 1 - Recommended Pavement Structure - Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course** – HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type **I** or **II** material placed over in situ soil or fill.	

Table 2 - Recommended Pavement Structure - Access Lanes and Heavy Truck Parking/Loading Areas

Thickness (mm)	Material Description
40	**Wear Course** – HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course** – HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type **I** or **II** material placed over in situ soil or fill.	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the material’s SPMDD using suitable vibratory equipment.

6.0 Design and Construction Precautions

6.1 Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free draining, non-frost susceptible granular materials. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, can be used for this purpose.

Excavated on-site fill and/or silty sand to sandy silt could also be re-used for backfilling the exterior sides of the foundation walls. However, this material would need to be maintained in an unfrozen state and at a suitable moisture content for compaction if it is to be re-used on-site.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover, or an equivalent combination of soil cover and foundation insulation, should be provided in this regard.

Exterior unheated footings, such as isolated piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure, and require additional protection, such as soil cover of 2.1 m, or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

Temporary Side Slopes

The temporary excavation side slopes anticipated should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertake by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should maintain safe working distance from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent material specifications and standard detail drawings from the department of public works and services, infrastructure services branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 98% of the SPMDD.

It should generally be possible to re-use the moist (not wet) site-generated fill above the cover material if the excavation and filling operations are carried out in dry weather conditions.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material’s SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Groundwater Control for Building Construction

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level. Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (GU – General Use cement) would be appropriate for this site. The chloride content and pH of the sample indicate that they are not a significant factor in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a slightly aggressive corrosive environment.

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

☐ Review of the final design details, from a geotechnical perspective.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Sampling and testing of the concrete and fill materials used.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to backfilling.

☐ Field density tests to determine the level of compaction achieved.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

All excess soil must be handled as per ***Ontario Regulation 406/19: On-Site and Excess Soil Management*****.**

8.0 Statement of Limitations

The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Jennings Real Estate, or their agents, is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Sep. 26, 2023
K. A. PICKARD
100531344
PROVINCE OF ONTARIO

Scott Dennis

Kevin Pickard, P.Eng.

Scott S. Dennis, P.Eng.

Report Distribution:

❑ Jennings Real Estate (Email Copy)
❑ Paterson Group (1 Copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

145 Thad Johnson Private

DATUM: Geodetic **EASTING:** 371012.727 **NORTHING:** 5021071.597 **ELEVATION:** 115.95

PROJECT: Proposed Commercial Development

BORINGS BY: CME Low Clearance Drill

REMARKS:

DATE: September 5, 2023

FILE NO. PG6809

HOLE NO. BH 1-23

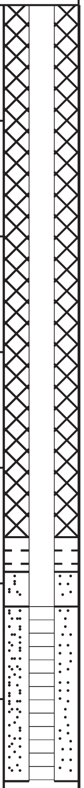
SAMPLE DESCRIPTION	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)
Ground Surface EL 115.95 m						0
TOPSOIL 0.08 m EL 115.87 m						
FILL: Brown silty sand with gravel 0.76 m EL 115.19 m	AU1	●				
FILL: Brown silty sand with gravel and crushed stone, occasional cobbles 2.29 m EL 113.66 m	SS2	▽	100	50+		1
	SS3	▽	33	50+		2
Dense to very dense, brown SAND with gravel, trace silt 6.71 m EL 109.24 m	SS4	▽	83	37		3
	SS5	▽	92	36		
	SS6	▽	75	38		4
	SS7	▽	75	50+		5
	SS8	▽	67	50+		6
	SS9	▽	67	50+		
End of Borehole (BH dry - Sep. 15, 2023)						7
						8
						9
						10

Remoulded Shear Strength (kPa): 0 25 50 75 100

Peak Shear Strength (kPa): 0 25 50 75 100

Pen. Resist. Blows/0.3m (50 mm Dia. Cone): 0 25 50 75 100

Piezometer Construction



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SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

145 Thad Johnson Private

DATUM: Geodetic **EASTING:** 371028.332 **NORTHING:** 5021043.283 **ELEVATION:** 115.75

PROJECT: Proposed Commercial Development

BORINGS BY: CME Low Clearance Drill

REMARKS:

DATE: September 5, 2023

FILE NO. PG6809

HOLE NO. BH 2-23

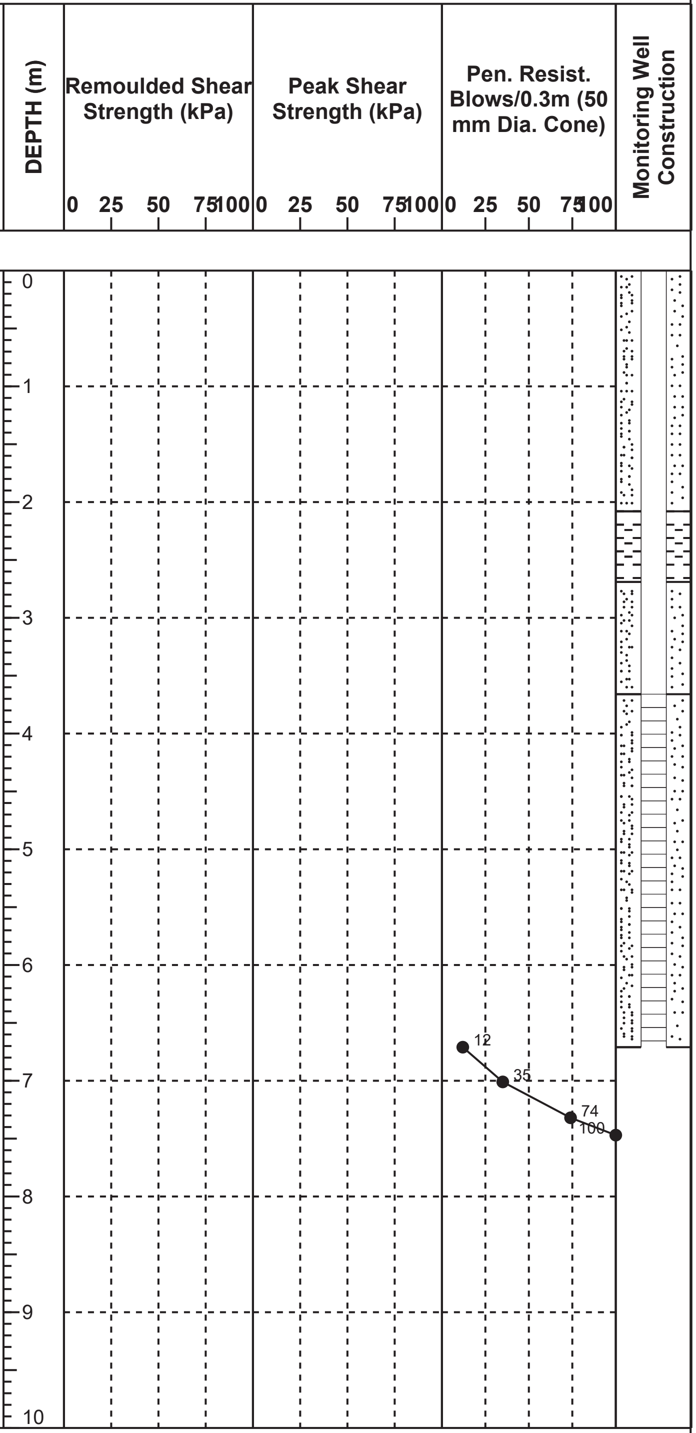
Ground Surface EL 115.75 m

SAMPLE DESCRIPTION	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)
TOPSOIL 0.08 m EL 115.67 m	AU1	●				0
FILL: Brown silty sand with gravel 0.76 m EL 114.99 m	SS2	▽	100	29		1
Compact to very dense, brown SAND with gravel, cobbles and boulders	SS3	▽	83	28		2
	SS4	▽	0	50+		
	SS5	▽	92	43		3
	SS6	▽	0	50+		4
	SS7	▽	75	34		5
	SS8	▽	100	50+		
6.71 m EL 109.04 m	SS9	▽	83	50+		6
Dynamic Cone Penetration Test commenced at 6.71m depth. 7.47 m EL 108.28 m						7

End of Borehole

Practical DCPT refusal at 7.47m depth.

(BH dry - Sep. 15, 2023)



PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

145 Thad Johnson Private

DATUM: Geodetic **EASTING:** 371064.998 **NORTHING:** 5021019.73 **ELEVATION:** 114.97

PROJECT: Proposed Commercial Development

BORINGS BY: CME Low Clearance Drill

REMARKS:

DATE: September 5, 2023

FILE NO. **PG6809**

HOLE NO. BH 3-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
Ground Surface EL 114.97 m							0				
TOPSOIL 0.05 m EL 114.92 m											
FILL: Brown silty sand with gravel		AU1	●								
		SS2	▽	100	28		1				
1.22 m EL 113.75 m											
Compact to very dense, brown SAND with gravel, cobbles and boulders		SS3	▽	75	12		2				
		SS4	▽	83	50+		3				
		SS5	▽	83	50+						
3.66 m EL 111.31 m											
End of Borehole							4				
(BH dry - Sep. 15, 2023)							5				
							6				
							7				
							8				
							9				
							10				

PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

145 Thad Johnson Private

DATUM: Geodetic **EASTING:** 370996.87 **NORTHING:** 5021014.186 **ELEVATION:** 116.53

PROJECT: Proposed Commercial Development

BORINGS BY: CME Low Clearance Drill

REMARKS:

DATE: September 5, 2023

FILE NO. **PG6809**

HOLE NO. BH 4-23

SAMPLE DESCRIPTION	Depth	Elevation
Ground Surface		EL 116.53 m
TOPSOIL	0.08 m	EL 116.45 m
FILL: Brown silty sand with gravel	1.17 m	EL 115.36 m
FILL: Brown sand with gravel and cobbles	1.45 m	EL 115.08 m
Dense to very dense, brown to grey SAND with gravel	6.71 m	EL 109.82 m
End of Borehole		
(BH dry - Sep. 15, 2023)		

SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %
AU1	●			
SS2	▽	100	43	
SS3	▽	92	34	
SS4	▽	100	37	
SS5	▽	100	31	
SS6	▽	100	36	
SS7	▽	100	50+	
SS8	▽	100	43	
SS9	▽	100	34	

STRATA PLOT

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Remoulded Shear Strength (kPa): 0 25 50 75 100

Peak Shear Strength (kPa): 0 25 50 75 100

Pen. Resist. Blows/0.3m (50 mm Dia. Cone): 0 25 50 75 100

Piezometer Construction

RSLog / Geotechnical Borehole - Geodetic / paterson-group / admin / September 26, 2023 12:03 PM

PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

145 Thad Johnson Private

DATUM: Geodetic **EASTING:** 370976.138 **NORTHING:** 5021033.368 **ELEVATION:** 116.89

PROJECT: Proposed Commercial Development

BORINGS BY: CME Low Clearance Drill

REMARKS:

DATE: September 6, 2023

FILE NO. **PG6809**

HOLE NO. BH 5-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
Ground Surface EL 116.89 m							0				
TOPSOIL 0.08 m EL 116.81 m											
FILL: Brown silty sand with gravel 1.45 m EL 115.44 m		AU1	●								
		SS2	▽	100	38		1				
Dense, brown SAND 2.21 m EL 114.68 m		SS3	▽	100	36						
Compact, brown SANDY SILT 2.8 m EL 114.09 m		SS4	▽	100	29		2				
Dense, brown SAND 3.73 m EL 113.16 m		SS5	▽	100	36		3				
Compact, brown SANDY SILT 4.5 m EL 112.39 m		SS6	▽	75	28		4				
Dense to compact, brown SAND 6.71 m EL 110.18 m		SS7	▽	75	42		5				
		SS8	▽	83	21						
		SS9	▽	96	20		6				
End of Borehole (BH dry - Sep. 15, 2023)							7				
							8				
							9				
							10				

RSLog / Geotechnical Borehole - Geodetic / paterson-group / admin / September 26, 2023 12:03 PM

PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

145 Thad Johnson Private

DATUM: Geodetic **EASTING:** 370952.526 **NORTHING:** 5020977.953 **ELEVATION:** 117.18

PROJECT: Proposed Commercial Development

BORINGS BY: CME Low Clearance Drill

REMARKS:

DATE: September 6, 2023

FILE NO. PG6809

HOLE NO. BH 6-23

SAMPLE DESCRIPTION	Depth / Elevation
Ground Surface	EL 117.18 m
Asphaltic concrete	0.05 m EL 117.13 m
FILL: Brown sand with gravel	1.17 m EL 116.01 m
Compact to dense, brown SAND	6.71 m EL 110.47 m
End of Borehole (BH dry - Sep. 15, 2023)	

SAMPLE No.	Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %
AU1	●			
SS2	▽	100	22	
SS3	▽	92	35	
SS4	▽	83	21	
SS5	▽	100	38	
SS6	▽	100	48	
SS7	▽	100	39	
SS8	▽	100	41	
SS9	▽	83	32	

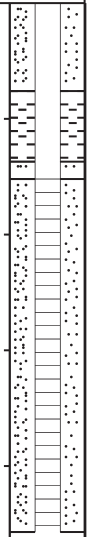
DEPTH (m): 0 1 2 3 4 5 6 7 8 9 10

Remoulded Shear Strength (kPa): 0 25 50 75 100

Peak Shear Strength (kPa): 0 25 50 75 100

Pen. Resist. Blows/0.3m (50 mm Dia. Cone): 0 25 50 75 100

Monitoring Well Construction



SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

145 Thad Johnson Private

DATUM: Geodetic **EASTING:** 371037.904 **NORTHING:** 5020991.438 **ELEVATION:** 115.08

PROJECT: Proposed Commercial Development

BORINGS BY: CME Low Clearance Drill

REMARKS:

DATE: September 6, 2023

FILE NO. **PG6809**

HOLE NO. BH 7-23

SAMPLE DESCRIPTION	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %
Ground Surface EL 115.08 m					
TOPSOIL 0.08 m EL 115 m	AU1	●			
FILL: Brown silty sand, trace gravel 0.76 m EL 114.32 m					
Compact to very dense, brown SAND with gravel, cobbles and boulders	SS2	▽	100	21	
	SS3	▽	100	29	
	SS4	▽	92	25	
	SS5	▽	67	21	
	SS6	▽	83	41	
	SS7	▽	55	50+	
	SS8	▽	55	50+	
	SS9	▽	4	50+	
6.71 m EL 108.37 m					
End of Borehole (BH dry - Sep. 15, 2023)					

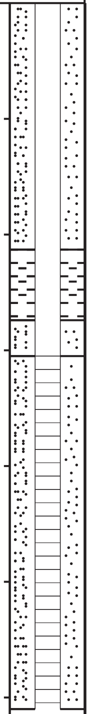
DEPTH (m) 0 1 2 3 4 5 6 7 8 9 10

Remoulded Shear Strength (kPa) 0 25 50 75 100

Peak Shear Strength (kPa) 0 25 50 75 100

Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100

Monitoring Well Construction



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<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

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC% - Natural water content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic Limit, % (water content above which soil behaves plastically)
PI - Plasticity Index, % (difference between LL and PL)

Dxx - Grain size at which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = $D60 / D10$

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

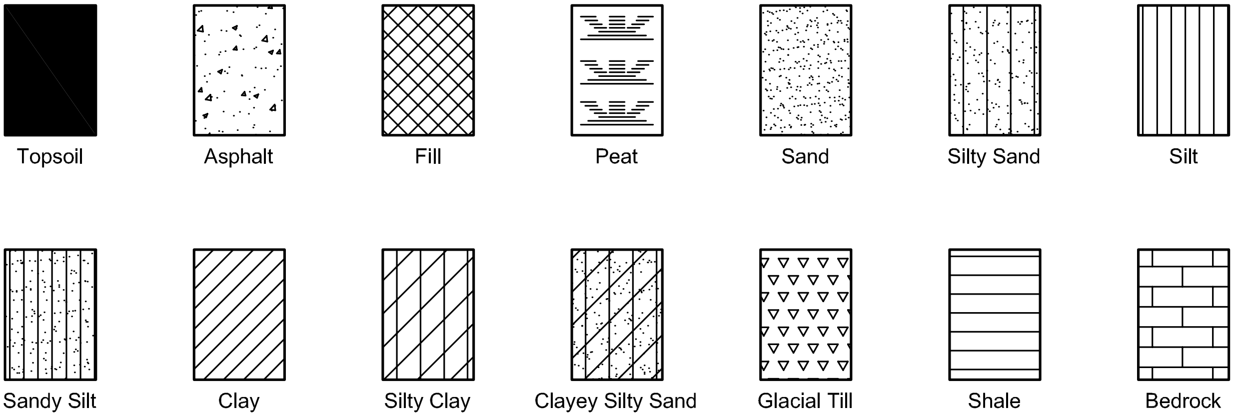
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

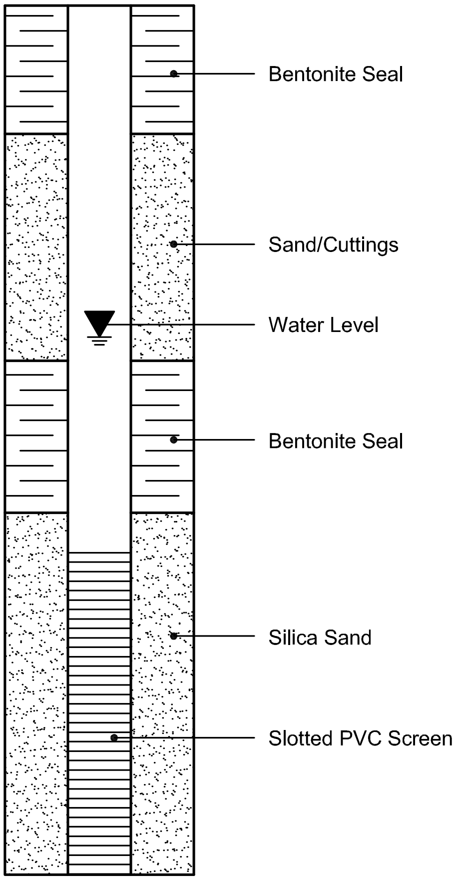
SYMBOLS AND TERMS (continued)

STRATA PLOT

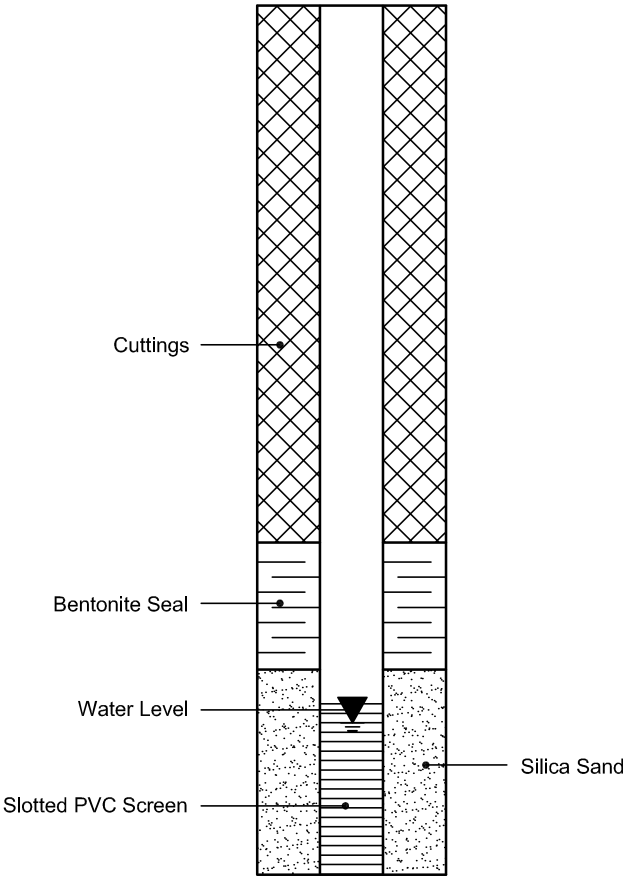


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 12-Sep-2023

Client: Paterson Group Consulting Engineers

Order Date: 7-Sep-2023

Client PO: 58328

Project Description: PG6809

	Client ID:	BH4-23 SS4	-	-	-	-	-
	Sample Date:	07-Sep-23 09:00	-	-	-		
	Sample ID:	2336352-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	93.0	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.91	-	-	-	-	-
Resistivity	0.1 Ohm.m	115	-	-	-	-	-
Anions							
Chloride	10 ug/g	<10	-	-	-	-	-
Sulphate	10 ug/g	15	-	-	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 – AERIAL PHOTOGRAPH – 1965

FIGURE 3 – AERIAL PHOTOGRAPH – 1976

FIGURE 4 – AERIAL PHOTOGRAPH – 1991

DRAWING PG6809-1 - TEST HOLE LOCATION PLAN

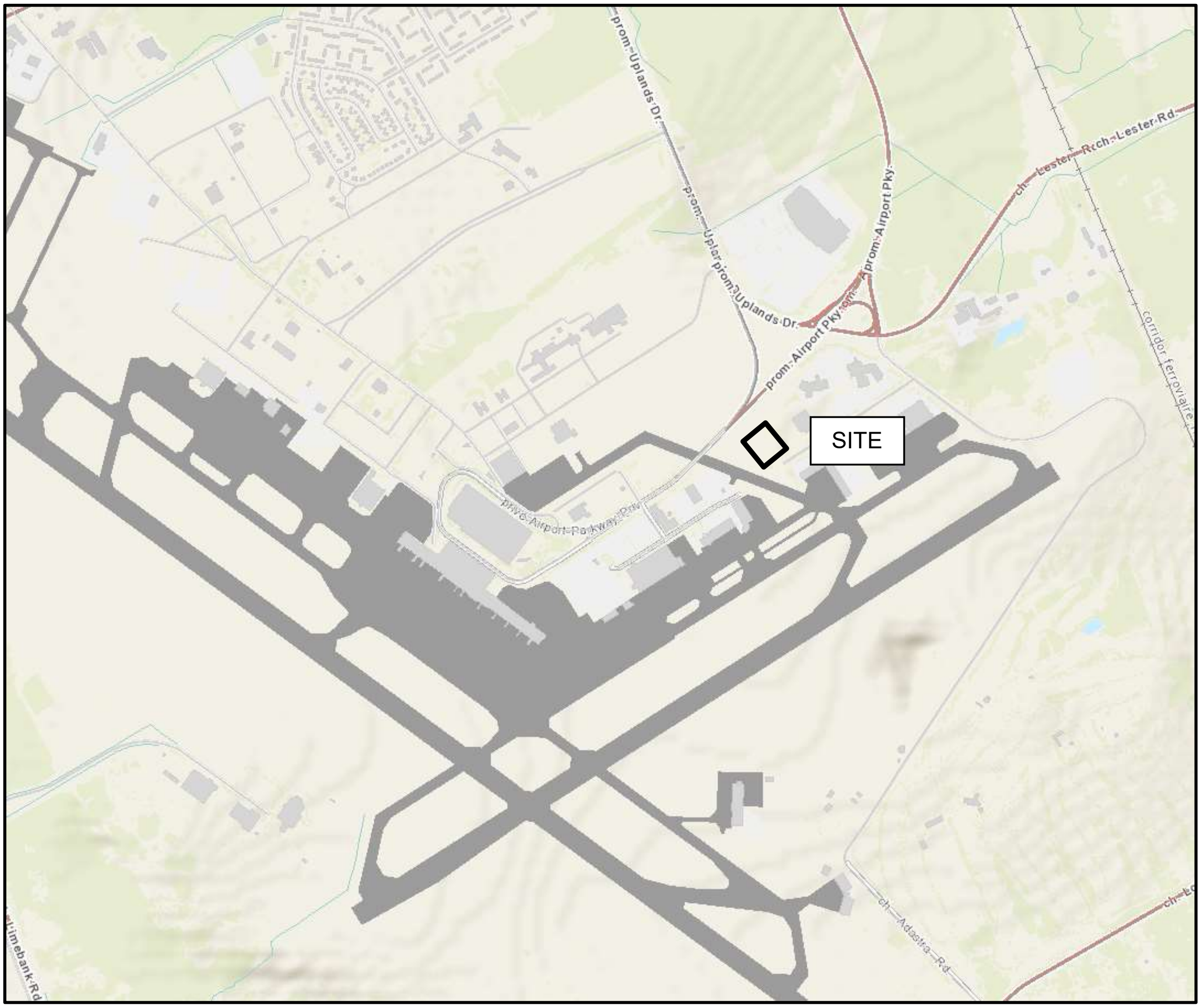


FIGURE 1

KEY PLAN

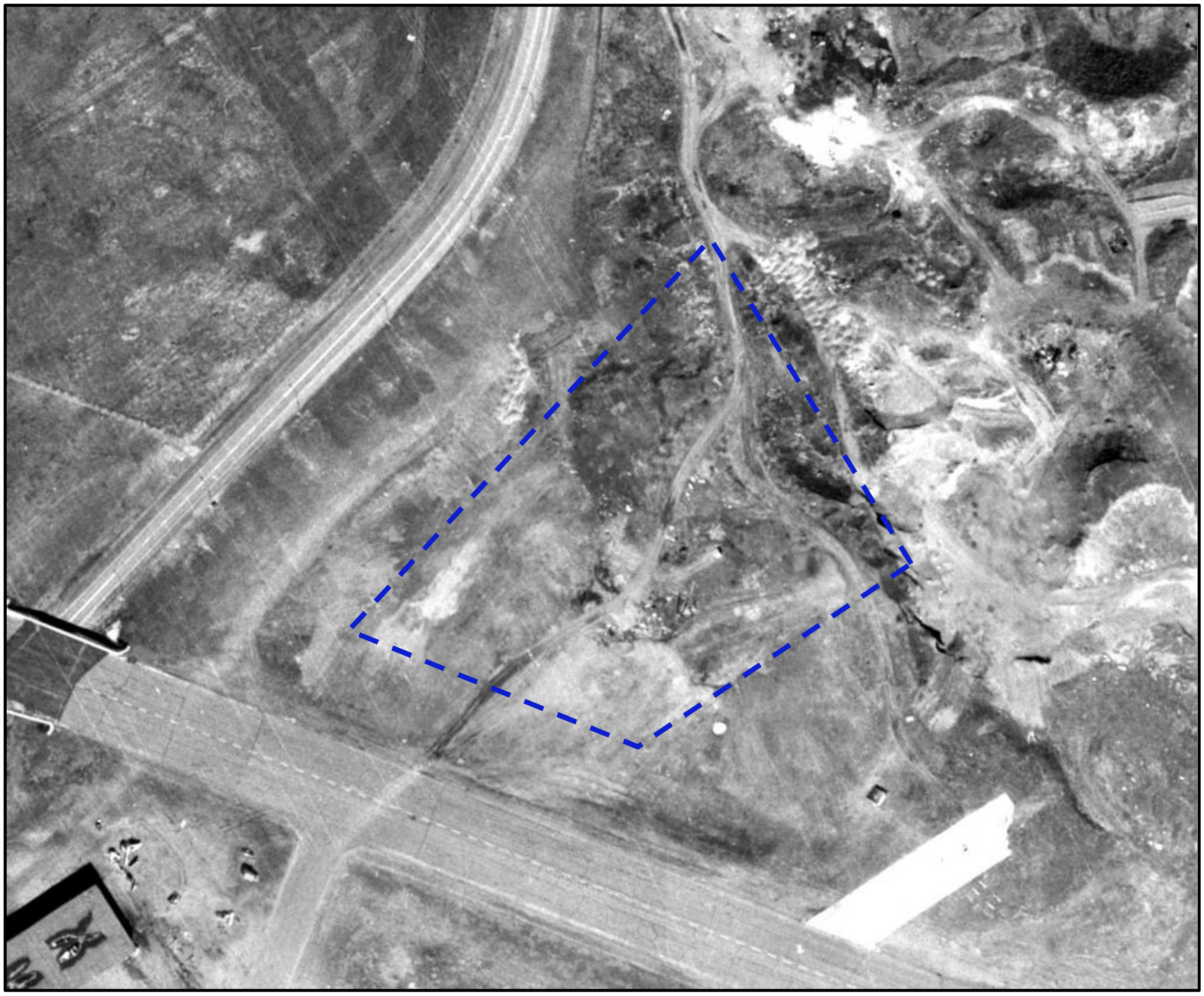


FIGURE 2

AERIAL PHOTOGRAPH - 1965

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FIGURE 3

AERIAL PHOTOGRAPH - 1976

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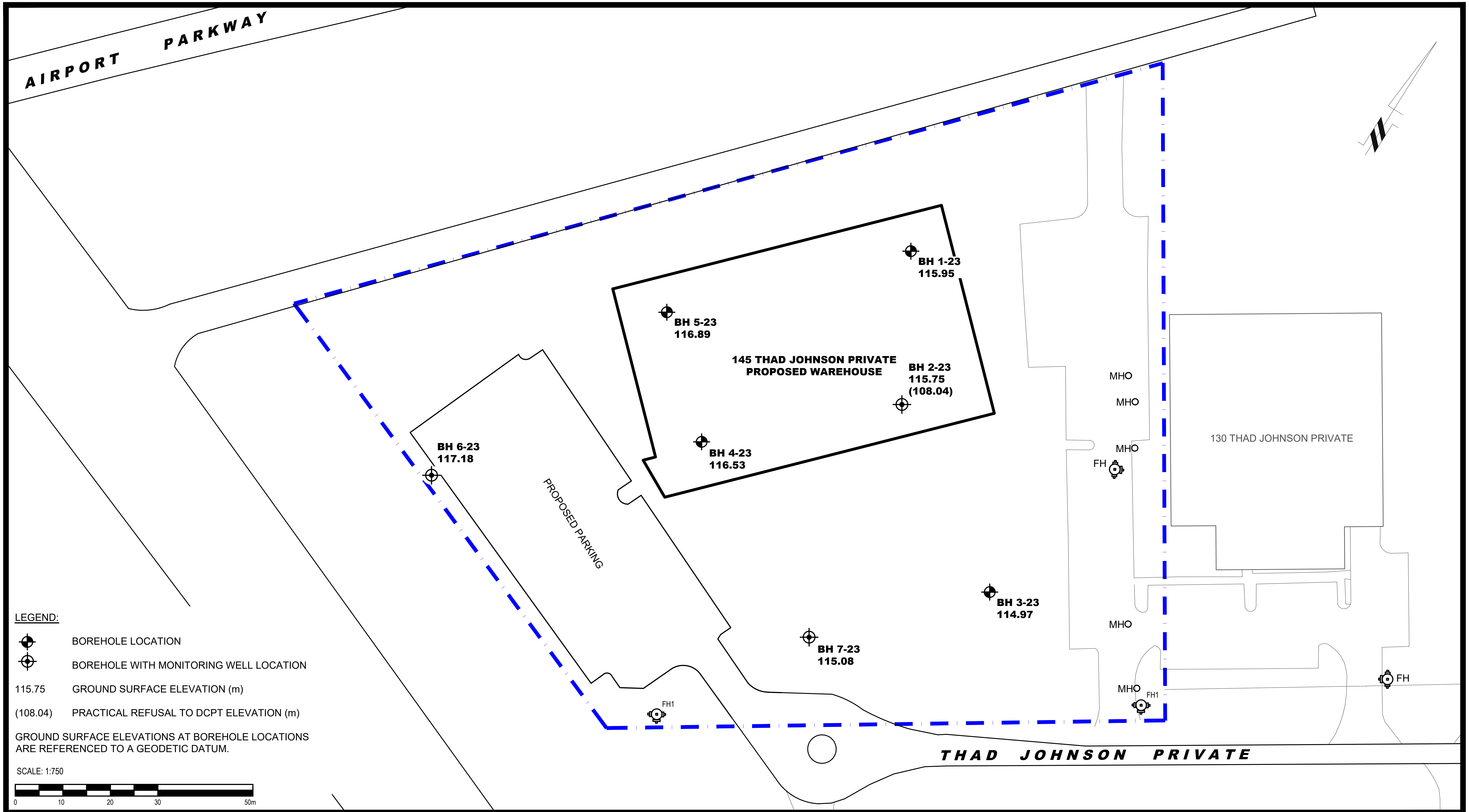
FIGURE 4

AERIAL PHOTOGRAPH - 1991

PATERSON GROUP



LEGEND:

⌖	BOREHOLE LOCATION
⌖	BOREHOLE WITH MONITORING WELL LOCATION
115.75	GROUND SURFACE ELEVATION (m)
(108.04)	PRACTICAL REFUSAL TO DCPT ELEVATION (m)

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:750

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

JENNINGS REAL ESTATE C/O WKJ DEVELOPMENT AND PROJECT MANAGEMENT
GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
145 THAD JOHNSON PRIVATE
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750
Date: 09/2023
Drawn by: GK
Report No.: PG6809-1
Checked by: KP
Dwg. No.: PG6809-1
Approved by: SD
Revision No.:

11x17

p:\autocad drawings\geotechnical\pg68xx\pg6809\pg6809-1 test hole location plan.dwg