Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Hydrogeological Review

Proposed Multi-Storey Building
36 Robinson Avenue
Ottawa, Ontario

Prepared For

Robinson Village LPIV Limited Partnership
c/o TC United Development

June 8, 2020

Report PG5231-REP.02

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Appendices

1.0 INTRODUCTION

Introduction

Paterson Group (Paterson) was commissioned by TC United Development on behalf of Robinson Village LPIV Limited Partnership to prepare a hydrogeological review for the proposed multi-storey building to be located at 36 Robinson Avenue in Ottawa, Ontario (refer to Figure 1.2 - Site Plan by others within Appendix 1).

Subsurface information was obtained from the field investigations carried out by Paterson and others to determine the subsoil and groundwater conditions at the site by means of test holes.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains the investigation findings and includes hydrogeological assessments pertaining to the proposed program as understood at the time of writing this report.

Proposed Project

It is our understanding that the proposed development will consist of a multi-storey building with three levels of underground parking. The P-3 level floor slab has been proposed at an elevation of 50.2 m. It is further understood that the proposed parking structure will occupy the entire subject site and the site will be municipally serviced.

The proposed development will incorporate a water suppression system that will reduce infiltration volumes and long term groundwater lowering at the post-construction stage. The water suppression system will consist of a horizontal concrete hydraulic barrier at the base of the excavation and a waterproofing membrane along the vertical surfaces. Any groundwater breaching the waterproofing system will be managed by the building sump pit system. Further details regarding the water suppression system have been included in geotechnical Paterson Report PG5231-1 - Revision 2 dated May 12, 2020.

2.0 SITE CONDITIONS

2.1 Surface Conditions

The subject site consists of 5 contiguous properties identified as 36 Robinson Avenue and is currently occupied by residential dwellings that will be demolished prior to re-development. The topography of the site is relatively flat and at grade with the surrounding roadways, with an approximate 1 m elevation difference sloping downwards towards the northeast. It is bordered to the northwest by Robinson Avenue, to the northeast and southeast by townhouse style residential dwellings followed by Robinson Avenue, and to the southwest by single residential dwellings.

According to available mapping, the subject site is located in the Ottawa Valley Clay Plains physiographic region.

Field Investigations

A geotechnical field investigation completed by Paterson was carried out on February 21, 2020. At that time, a total of 6 test pits were excavated to a maximum depth of 6.2 m below ground surface (bgs). Previous subsoil and hydrogeological investigations completed by others in 2019 have also been included as part of the current hydrogeological review. The previous investigations consisted of 12 boreholes extending to a maximum depth of 16.6 m bgs. The test hole locations were distributed in a manner to provide general coverage of the subject site taking into consideration site features as well as evaluate any environmental concerns. The borehole locations of the field investigations are presented on Drawing PG5231-1 and Figure 3.1 by others, included in Appendix 2.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Borehole Log Records by others and the Soil Profile and Test Data sheets in Appendix 2 of this report.

Surface Water

The subject site is located within the Rideau River-Falls subwatershed. The only surface water feature identified within 500 m of the subject site is the Rideau River. Given the meandering nature of the watercourse, the Rideau River is located approximately 80 m to the north, 110 m to the east and 350 m to the south.

Groundwater

Groundwater monitoring wells were installed in select boreholes by others to permit the monitoring of the groundwater levels at the subject site. Observations of groundwater infiltration were also noted in the open hole excavations by Paterson. Groundwater information is discussed in Sections 3 of this report and details are noted on the Borehole Log Records by others and Soil Profile and Test Data sheets presented in Appendix 2 of this report.

2.2 Subsurface Profile

The subsurface profile at the subject site is generally comprised of fill material followed by a sandy silt/silty sand and/or clayey silt layers. The above noted layers are underlain by a glacial till deposit extending to the bedrock surface. Practical refusal to excavation was encountered at select test pit locations between 5.8 and 6.2 m bgs, while bedrock was encountered between 5.3 and 7.8 m bgs.

Reference should be made to the soil profile records and test hole locations completed by Paterson and others included in Appendix 2 for the details of the soil profiles encountered at each borehole location.

Based on surficial mapping prepared by the Ontario Geological Survey, the subject site is located in an area where surficial geology consists of a fluvial deposit comprised of gravel, sand, silt and clay deposited on modern flood plains.

Fill Material

A fill layer was encountered in all test holes at ground surface or underlying the asphaltic concrete. The fill material consisted of varying amounts of silty sand, clay, gravel, organics and construction debris. The fill material extended to a maximum depth of 3.7 m bgs.

Clayey Silt

Generally, the loose to dense clayey silt was encountered beneath the fill material in select boreholes and extended to a maximum depth of 3.8 m bgs.

Silty Sand

A loose to dense grey to brown silty sand layer with some clay and gravel was encountered in all boreholes underlying the fill material and/or clayey silt and extended to a maximum depth of 7.1 m bgs.

Sandy Silt

A very loose to very dense grey sandy silt layer with some clay and trace gravel was encountered in select boreholes underlying the fill material and/or silty sand and extended to a maximum depth of 5.3 m bgs.

Glacial Till

Generally, the compact to very dense glacial till deposit was noted underlying the silty sand and/or sandy silt in select boreholes. The glacial till deposit consists of clayey silt to silty sand matrix with varying amounts gravel with occasional cobbles and boulders and it extends to a maximum depth of 7.8 m bgs.

Bedrock

Based on coring results completed by others, shale bedrock was encountered between 5.3 and 7.8 m bgs and was cored to a maximum depth of 16.6 m bgs. The recovery values ranged from 50 to 100%, while the RQD values generally varied between 0 and 100%. Based on these results the quality of the bedrock ranges from very poor to excellent.

Based on available geological mapping, the subject site is located in an area where the bedrock consists of shale of the Carlsbad Formation with an overburden thickness between 5 and 10 m.

3.0 HYDROGEOLOGY

Subsequent to the subsurface investigations completed at the subject site, groundwater levels were measured at the borehole locations by Paterson and others and ranged from 1 to 4.8 m bgs. However, groundwater levels may have been influenced by surface water infiltrating the backfilled boreholes. Groundwater infiltration was also observed by Paterson during the excavation of the test pits across the subject site and varied between 5.4 and 5.7 m bgs. It should be noted that long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, a grey silty sand/sandy silt was generally encountered between 3 to 4 m below ground surface and is expected to be the approximate long-term groundwater table. It should also be noted that groundwater levels can fluctuate both seasonally and in conjunction with precipitation events. Therefore, the groundwater levels could vary at the time of construction. Groundwater level measurements have been summarized in Table 1 included in Appendix 3.

On a conceptual scale, hydrogeological/hydrologic conditions at the subject site suggest that water may infiltrate the open excavation as surface water infiltration during precipitation events and through groundwater flow within the overburden and bedrock at depth.

The excavation footprint related to the proposed multi-storey building at the subject site is expected to encompass an area of approximately 1,800 m^2. Therefore, the potential exists for a low amount of surface water to intercept the excavation footprint directly during significant precipitation events.

In terms of groundwater flow, the building excavation is expected to intercept the silty sand/sandy silt, glacial till and bedrock within the anticipated saturated depth of excavation. The potential exists for a low to moderate amount of groundwater inflow through the overburden and bedrock. The volume of groundwater that infiltrates through the overburden and bedrock will depend on the variability of the soil and the extent of weathering/fracturing in the bedrock across the subject site.

Based on the groundwater levels at the borehole locations, the local groundwater flow direction generally trends in a northerly direction. The regional groundwater flow direction is expected to trend northeast towards the Rideau River and following regional topography. It should be noted that groundwater levels can fluctuate based on precipitation events and seasonal variations. Therefore, groundwater levels and flow directions may vary at the time of construction.

3.1 Estimated Water Taking Rates

The potential sources of water taking at the subject site have been identified as the excavation footprint of the proposed building during the construction phase as well as long-term groundwater infiltration at post-construction.

The hydraulic conductivity values of the silty sand and bedrock were determined based on single well response tests (rising head test) completed by others at the subject site. Based on the testing, the hydraulic conductivity of the silty sand is 1.5×10^{-7} m/sec, while bedrock varied from 5.1×10^{-8} to 1.5×10^{-6} m/sec and is dependant on the quality of the bedrock. Hydraulic conductivity results from the single well response tests completed by others have been included in Appendix 3.

To determine surface water infiltration into the excavation footprint, an intensity duration frequency (IDF) curve from the Ministry of Transportation - Ontario (MTO) was obtained. The IDF curve is the graphical representation of the probability that a given average rainfall intensity will occur. For the purposes of this project, a 5 year storm event with a one hour duration was chosen as the design storm. This provides a potential rainfall intensity of 2.63×10^{-2} m of precipitation into the excavation footprint. Various duration storm events with their associated rainfall intensities are presented in the IDF Curve in Appendix 3.

The infiltration rates provided for the following source was calculated using the Dupuit Forchheimer method:

$$Q = \pi K((h_0^2 - h_p^2)/\ln(R/r))$$

- ❏ K = hydraulic conductivity (m/sec)
- ❏ h_0 = thickness of the aquifer (m)
- ❏ h_p = thickness of the aquifer from the base of the excavation to the base of the aquifer (m)
- ❏ R = effective drawdown radius for the excavation (m)
- ❏ r = equivalent radius of the excavation (m)

A sample groundwater infiltration calculation is provided in Appendix 3 of this report.

Building Excavation Footprint (Construction Dewatering)

The strata at the proposed building location consists of sandy silt/silty sand followed by glacial till and very poor to excellent bedrock within the anticipated saturated depth of excavation. The maximum depth of excavation is expected to be approximately 10 m bgs to accommodate the horizontal concrete hydraulic barrier at the base of the excavation and sump pit system. Calculations are based on an excavation sizing of 1,800 m^2 and a saturated depth of excavation of 8 m, using a conservative groundwater level measurement of 2 m bgs. Using the above noted values and a conservative hydraulic conductivity of 1.5 x 10^{-6} m/sec, the steady state volume of groundwater anticipated is approximately **125,000 L/day**, and does not account for the initial groundwater inflow into the excavation or unforseen circumstances.

A factor of safety between 2 and 3 should be applied to the calculated infiltration rates to account for variability in the overburden material, quality of bedrock and any unforseen circumstances that may arise during construction activities.

With respect to the potential for surface water inflow into the excavation footprint, the proposed multi-storey building is adjacent to developed land on all sides. It is therefore expected that the majority of surface water inflow into the excavation footprint will be caused by precipitation directly onto the footprint rather than runoff from other sources. Given an excavation footprint with a sizing of 1,800 m^2 and a precipitation depth of 2.63 x 10^{-2} m, a total volume of approximately 50,000 L of surface water can be expected during a 5 year - 1 hour duration precipitation event. It is expected that the contractor will direct surface water away from open excavations whenever possible.

Post-Construction (Long-Term Dewatering)

Long-term groundwater infiltration breaching the water suppression system at post-construction will be managed by the building sump pit system. Provided the proposed groundwater infiltration control system is properly installed and approved by the geotechnical engineer at the time of construction, a conservative 1 m drawdown in the groundwater table at the subject site could be expected. The steady state volume of groundwater anticipated post-construction is approximately **10,000 to 20,000 L/day**.

3.2 Estimated Radius of Influence

A series of calculations were carried out on theoretical radii of influence for the likely duration of extended pumping during the excavation of the building and post-construction. These calculations were completed based on Sichardt (1992) using the equation:

$R = r_e + 3000*\Delta h(k^{0.5})$

- R = radius of influence (m)
- r_e = equivalent radius of excavation (m)
- Δh = thickness of drawdown within the aquifer (m)
- k = hydraulic conductivity (m/sec)

For the purposes of completing the calculations, the following assumptions were made:

- r_e = 28 m (building excavation); 4 m (post-construction)
- k = 1.5×10^{-6} to 5.1×10^{-8} m/sec, based upon single well response tests.
- Δh = 7 to 9 m (building excavation); 0.5 to 1.5 (post-construction), to review potential minimum/maximum variable conditions.

Using the above equation and assumptions, a radius of influence of approximately **5 to 33 m** will develop as a steady state condition, extending from the edge of the excavation, during the construction of the proposed building. It's expected that recharging from precipitation events and with a reasonable foundation construction schedule, **the radius of influence will be approximately 10 to 15 m**.

With the water suppression system in place, it is expected that a radius of influence of approximately **0.5 to 5.5 m** will develop as a steady state condition, extending from the edge of the building, at post-construction.

3.3 Water Discharge

The discharge point for the pumped water from the excavation sump is expected to be to the existing City of Ottawa sewer system via a sewer connection. As such, it will be subject to the City of Ottawa Sewer Use Bylaws and a permit will be required to discharge the water to the sewer system.

It is expected that BMP's as recommended by the City of Ottawa - Sewer Use Program (SUP) document (attached within Appendix 5) or similar will be used to reduce sediment loading within the water prior to discharge to the sewer system. If the pumped water does not meet the SUP criteria, it must be retained on site until test results indicate compliance with the SUP criteria or remove the water through other means such as tanker trucks.

Given the size of the excavation for the proposed development, the volumes of surface water pumped during a 100 year storm event are not expected to exceed the capacity of the nearby City sewer system. Should volumes exceed the available capacity, it's expected that water will be stored on site temporarily and released at an acceptable rate or removed via tanker trucks. The approved SUP permit may provide further discharge restrictions.

Based upon the anticipated water takings being discharged to the City sewer system, it's Paterson's opinion that the water discharged will not cause negative impacts to the natural environment. As the discharged water is not being returned directly to the natural environment, there are no negative effects expected related to the temperature of the discharged water. The location and operation of the appropriate discharge measures are the responsibility of the contractor.

4.0 POTENTIAL IMPACTS

4.1 Adverse Effects on Adjacent Structures

The subsurface profile at the subject site is generally comprised fill material overlain by sandy silt/silty sand and/or clayey silt layers followed by glacial till and bedrock. The majority of the expected groundwater infiltration will be encountered within the sandy silty sand/sandy silt, glacial till and bedrock. The potential dewatering volumes due to groundwater infiltration into excavation footprints are anticipated to be low to moderate dependant on location across the site and majority composition of the materials at a given location. The structures in the surrounding area typically consist of low-rise residential dwellings and are expected to be founded on silty sand/sandy silt, glacial till or bedrock. The compressibility of the silty sand/sandy silt, glacial till and bedrock in the area as a result of dewatering is anticipated to be minimal. Furthermore, dewatering is expected to be short term in duration, given the nature of the proposed development. As such, any effects related to ground surface settlement due to the water taking activities are anticipated to be negligible.

It is not expected mitigation methods will be required related to potential adverse effects on structures or infrastructure adjacent to the excavations due to the short term nature of the construction, theoretical radius of influence and compressibility of the overburden. However, mitigation methods would consist of halting pumping and providing monitoring of the potential settlement to determine if the negative effects are related to the dewatering program. If the dewatering is causing the consolidation/settlement effects, then a revised dewatering program to reduce the taking of water or providing a water recharge system to reduce the consolidation effects would be necessary.

Due to the currently proposed construction activities at the subject site (demolition, hoe-ramming, controlled blasting, shoring installations), a pre-construction survey is recommended to be carried out for the structures immediately surrounding the site to document existing conditions. It is additionally recommended in the Paterson geotechnical Report PG5231-1 dated May 12, 2020.

4.2 Adverse Effects on Neighbouring Water Wells

A search of the Ontario Water Well Records database indicates there are a large number of wells within 500 m of the site as depicted in Figure 2.3 by others included in Appendix 1. However, these wells are predominantly monitoring well installations or abandoned wells. It should be noted that 2 groundwater supply wells were identified east of the Rideau River and located well outside the theoretical radius of influence.

Furthermore, the area surrounding the site is serviced by municipal water supplies. Therefore, dewatering activities at the site are therefore not expected to cause any interference to the water supply of surrounding properties or other negative impacts.

Municipal water is available in the immediate area. However, in the event that the taking of water is shown to cause negative impacts to the water supplies of unknown existing users/sources that were in use prior to construction, the owner shall take action to make available a supply of water equivalent in quality and quantity of their typical takings, or shall compensate those affected for reasonable costs for doing so, or shall reduce water taking amounts to alleviate the negative impacts. The owner shall provide temporary water supplies, to those affected, to meet their typical takings or compensate such persons for reasonable costs associated to do so until permanent restoration of the affected water supply or an equivalent source.

4.3 Soil, Surface Water and Groundwater

A search of the MECP Brownfields Environmental Site Registry was conducted as part of the assessment of the site, neighbouring properties and the general area. No Brownfield sites were located within 500 m of the subject site.

Following the completion of a Phase II Environmental Site Assessment (ESA) by others at the subject site, it was determined that all groundwater samples analysed for metals, VOCs, PHCs and PAHs were in compliance with MECP Table 3 standards. Fill material impacted with mercury concentrations as well as electrical conductivity and sodium adsorption ratio exceeding MECP Table 3 standards have been identified on the subject site. Native soil impacted with benzo(a)pyrene and fluoranthene concentrations as well as electrical conductivity was also encountered on the property. The site is not considered to be in compliance with the O.Reg. 153/04 criteria for the proposed land use and requires a soil remedial/removal program.

It is anticipated that the material on site will be disposed of as per the MECP policy, *Management of Excess Soil - A Guide for Best Management Practices* dated January, 2014.

With respect to nearby surface water bodies, the Rideau River is located approximately 80 m to the north, 110 m to the east and 350 m to the south from the subject site due to meandering nature of the watercourse. Given the location of the river, it's located well outside the theoretical radius of influence that will develop as a result of the water taking at the subject site. As such, adverse effects to surface water features resulting from dewatering activities at the subject site are expected to be negligible.

The groundwater that is pumped from the site excavation must be managed in an appropriate manner. The contractor will be required to implement a water management program to dispose of the pumped water. It is expected the groundwater will be discharged to the City of Ottawa sewer system in accordance with the City Sewer Use By-Laws. Dependant upon the results of the baseline test to be performed for the discharge permit application, the City of Ottawa will determine the appropriate discharge location (storm versus sanitary sewer), on-site treatment or if off-site disposal is required.

4.4 Adjacent Permits to Take Water

It is understood that Robinson Village LPIV Limited Partnership has an EASR in place for the proposed water taking at the subject site and is for construction dewatering with a maximum taking of 400,000 L/day.

A search of the MECP Permit to Take Water database provided no active PTTW within 500 m of the subject site. A search of the MECP Environmental Activity and Sector Registry (EASR) database also provided no additional registries within 500 m of the subject site.

Given there are no active PTTW within 500 m of the subject site, the risk of cumulative impacts resulting from multiple PTTW in close proximity to each other is considered negligible.

5.0 STATEMENT OF LIMITATIONS

The recommendations provided in this report are in accordance with our present understanding of the project.

A hydrogeological review of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

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 Robinson Village LPIV Limited Partnership, TC United Development, or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Nicholas Zulinski, P.Geo., géo.

Carlos P. Da Silva, P.Eng., ing., QP_{ESA}

APPENDIX 1

Figure 1.2 - Site Plan (by Others)

Figure 2.3 - MECP Water Well Records (by Others)

Source: Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation, Date Unknown

0 5 10 15
Meters
Coordinate System:
NAD 1983 UTM Zone 18N

N

GHD

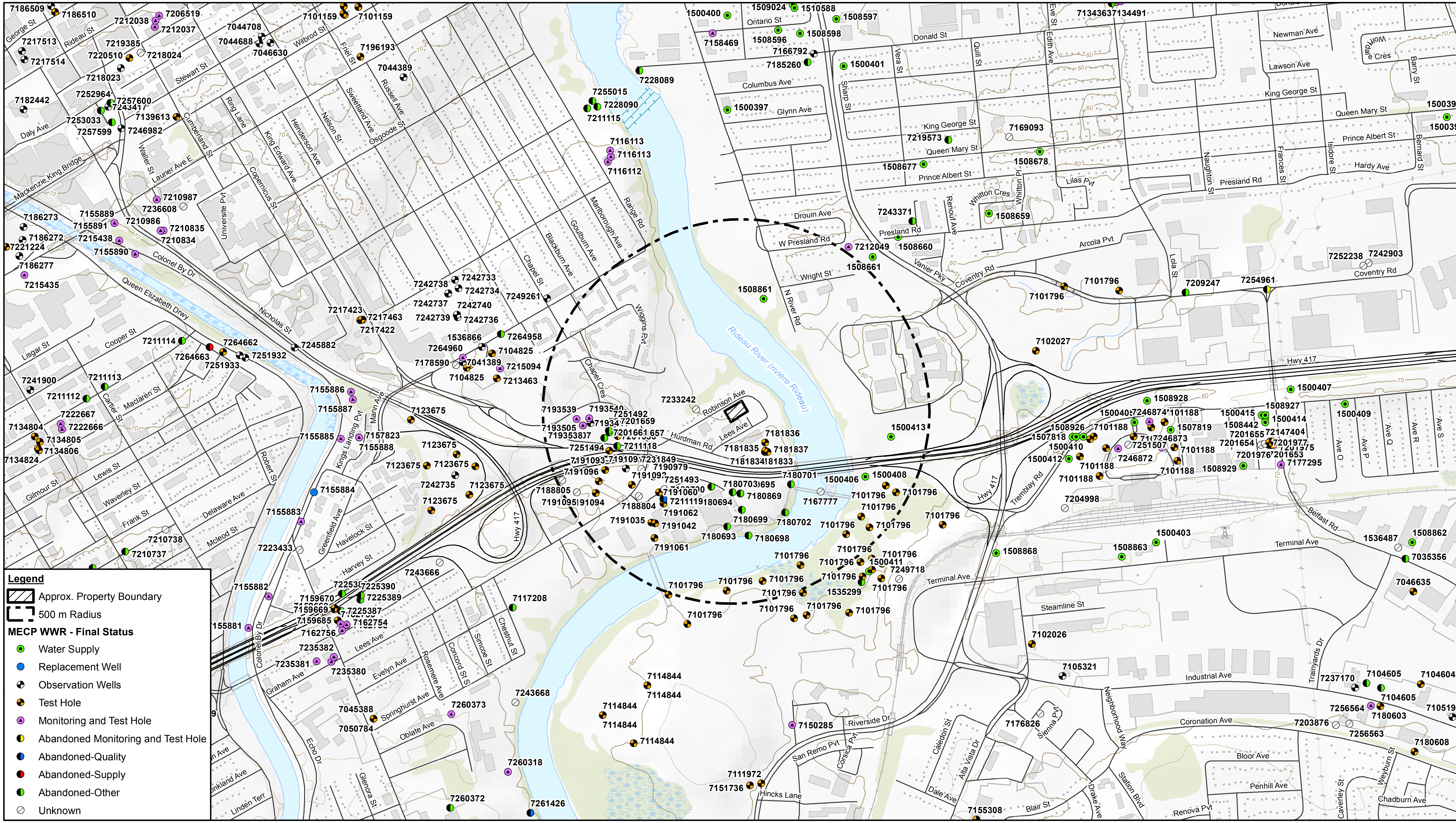
ROBINSON VILLAGE LPIV LIMITED PARTNERSHIP
36 ROBINSON AVENUE, OTTAWA, ONTARIO
HYDROGEOLOGICAL ASSESSMENT

SITE PLAN

11186719-A1
Dec 20, 2019

FIGURE 1.2

GIS File: Q:\GIS\PROJECTS\11186000s\11186719\Layouts\PRES001\11186719-A1(PRES001)GIS-OT001.mxd



Source: MNRF NRVIS, 2019. Produced by GHD under licence from Ontario Ministry of Natural Resources and Forestry, © Queen's Printer 2019; WWIS, 2017. Ontario Ministry of the Environment, Conservation and Parks. (Accessed January 2017).

0 100 200 300
1:10,000 Meters

Coordinate System:
NAD 1983 UTM Zone 18N

N

GHD

ROBINSON VILLAGE LIMITED PARTNERSHIP
36 ROBINSON AVENUE, OTTAWA, ONTARIO
HYDROGEOLOGICAL ASSESSMENT

11186719-E2
Feb 11, 2019

MECP WATER WELL RECORDS

FIGURE 2.3

GIS File: Q:\GIS\PROJECTS\11186000s\11186719\Layouts\002\11186719-E2(002)GIS-OT005.mxd

APPENDIX 2

PG5231 - Soil Profile and Test Data

Borehole Log Records (by Others)

PG5231 - Test Hole Location Plan

Figure 3.1 - Investigative Locations (by Others)

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
36 Robinson Avenue
Ottawa, Ontario

DATUM Approximate elevations obtained from others.

FILE NO. PG5231

REMARKS

HOLE NO. TP 1-20

BORINGS BY Hydraulic Shovel **DATE** 2020 February 21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	59.40
FILL: Brown silty sand, trace gravel, organics and debris						1	58.40
1.40		G	1				
GLACIAL TILL: Brown silty sand, occasional cobbles and obulders, some clay, trace gravel		G	2			2	57.40
- grey by 3.2 m depth						3	56.40
		G	3			4	55.40
						5	54.40
6.20						6	53.40
End of Test Pit Refusal to excavation on bedrock surface @ 6.2m depth (TP dry upon completion)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %
20 40 60 80

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
36 Robinson Avenue
Ottawa, Ontario

DATUM Approximate elevations obtained from others.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 February 21

FILE NO. PG5231

HOLE NO. TP 2-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	58.55		
FILL: Brown silty sand, trace organics, gravel and debris						1	57.55		
		G	1						
2.00						2	56.55		
GLACIAL TILL: Brown sandy silt, some clay, trace gravel, occasional cobbles and boulders		G	2						
- grey by 2.9m depth						3	55.55		
		G	3						
						4	54.55		
						5	53.55		∇
5.90									
End of Test Pit Refusal to excavation on bedrock surface @ 5.9m depth (Open hole GWL @ 5.4m depth)									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
36 Robinson Avenue
Ottawa, Ontario

DATUM Approximate elevations obtained from others.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 February 21

FILE NO. PG5231

HOLE NO. TP 3-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	58.60		
FILL: Brown silty sand, trace gravel, organics and brick						1	57.60		
		G	1						
2.00						2	56.60		
GLACIAL TILL: Brown silty clay, some sand and gravel		G	2						
2.30									
End of Test Pit									
(TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
36 Robinson Avenue
Ottawa, Ontario

DATUM Approximate elevations obtained from others.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 February 21

FILE NO. PG5231

HOLE NO. TP 4-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	58.30		
FILL: Brown silty sand, trace gravel, organics and debris						1	57.30		
		G	1						
2.10						2	56.30		
GLACIAL TILL: Brown clayey silt, some sand, trace gravel		G	2						
2.30 End of Test Pit									
(TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
36 Robinson Avenue
Ottawa, Ontario

DATUM Approximate elevations obtained from others.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 February 21

FILE NO. PG5231

HOLE NO. TP 5-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	58.95		
FILL: Brown silty sand, trace gravel, organics and debris						1	57.95		
		G	1						
2.00						2	56.95		
GLACIAL TILL: Brown clayey silt, some sand and gravel		G	2						
2.20									
End of Test Pit (TP dry upon completion)									

Shear Strength (kPa): 20, 40, 60, 80, 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
36 Robinson Avenue
Ottawa, Ontario

DATUM Approximate elevations obtained from others.

REMARKS

BORINGS BY Hydraulic Shovel

DATE 2020 February 21

FILE NO. PG5231

HOLE NO. TP 6-20

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	58.90
FILL: Brown silty sand, trace gravel and debris						1	57.90
1.50							
GLACIAL TILL: Brown clayey silt, some sand and gravel		G	1			2	56.90
2.40							
GLACIAL TILL: Grey sandy silt, some clay, trace gravel		G	2			3	55.90
						4	54.90
						5	53.90
5.80		G	3				
End of Test Pit Refusal to excavation on bedrock surface @ 5.8m depth (Open hole GWL @ 5.74m depth)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

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

SYMBOLS AND TERMS (continued)

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

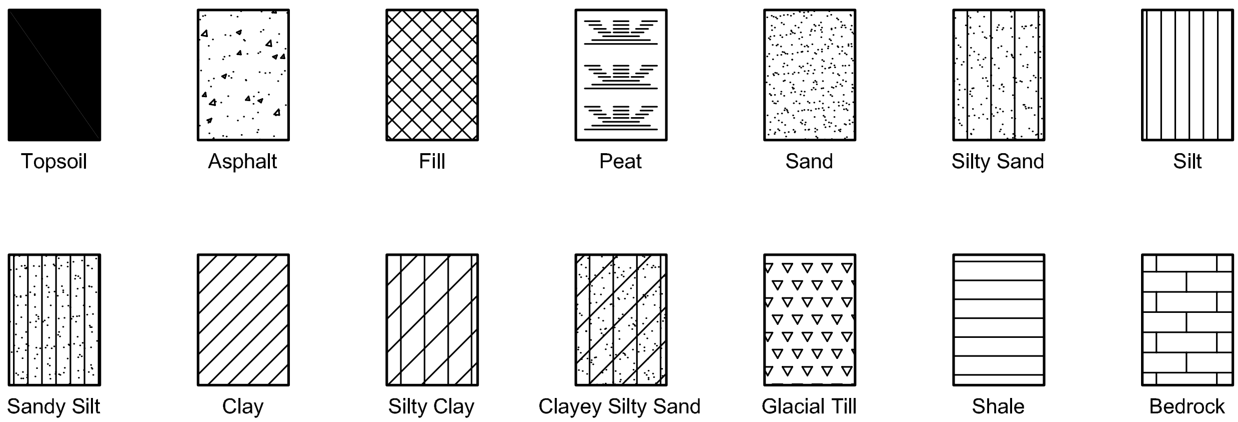
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

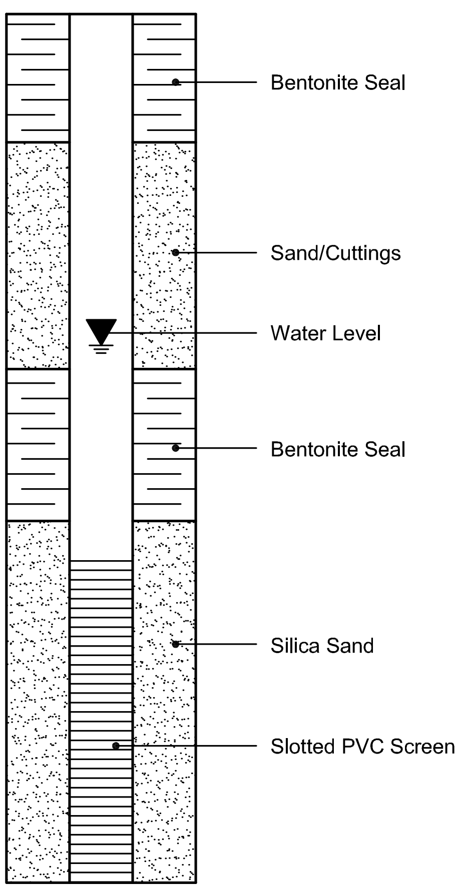
SYMBOLS AND TERMS (continued)

STRATA PLOT

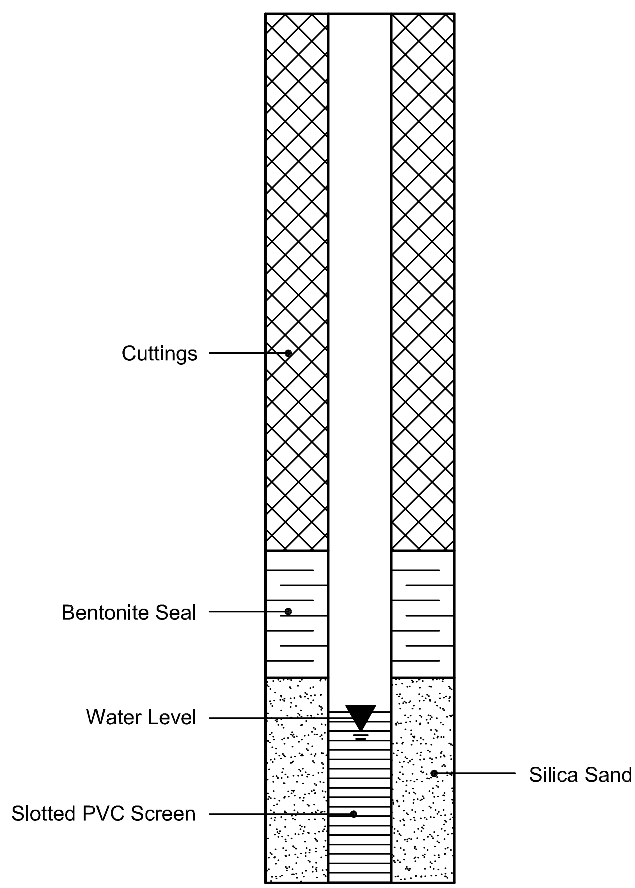


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



REFERENCE No.: 11186719 ENCLOSURE No.: 1

BOREHOLE LOG

BOREHOLE No.: BH1

ELEVATION: 58.30 m

Page: 1 of 1

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: R. Vanden Tillaart CHECKED BY: B. Vazhbakht

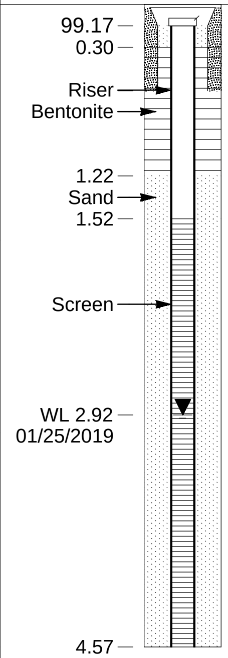
DATE (START): 21 January 2019 DATE (FINISH): 21 January 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- ▼ Water Level
- ○ Water content (%)
- ⊢⊣ Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

Depth BGS (meters)	Elevation (m)	DESCRIPTION OF SOIL AND BEDROCK
0.00	58.30	GROUND SURFACE
0.0 – 1.7		**FILL** - Silty sand, some clay, trace gravel, brown, moist, loose Upper 0.6 m frozen
1.7	56.6	**SILTY SAND**- some clay, some gravel, brown, moist to saturated, compact to dense
3.0	55.3	**SANDY SILT**- some clay, trace gravel, grey, saturated, compact
4.6	53.7	Borehole terminated at 4.6 mbgs

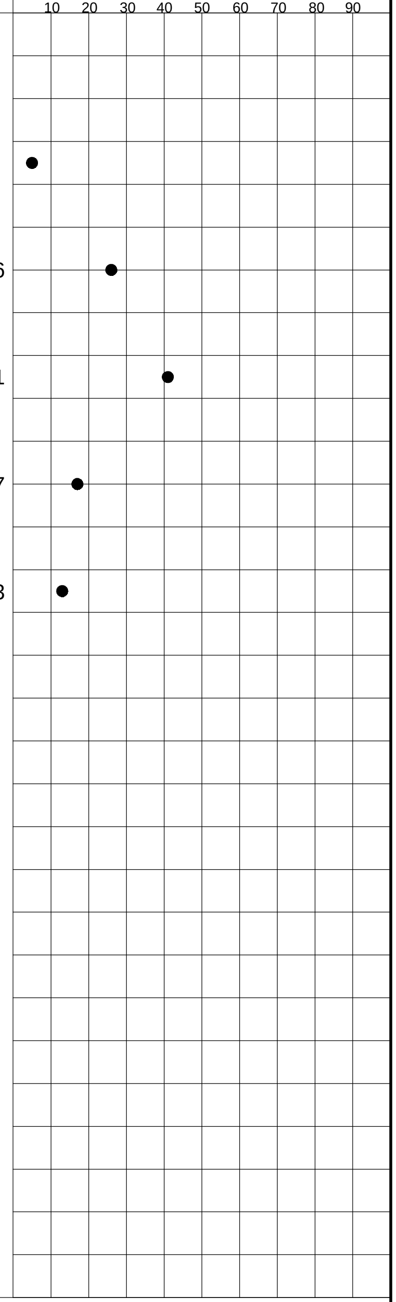
MONITOR WELL



SAMPLE DATA

Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
SS1	25	11	5
SS2	63	25	26
SS3	100	11	41
SS4	100	12	17
SS5	71	9	13

SCALE FOR TEST RESULTS: 50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90



NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

BOREHOLE LOG 11186719-A1-BOREHOLE LOGS.GPJ INSPEC_SOL.GDT 16/12/19

REFERENCE No.: 11186719 ENCLOSURE No.: 2

BOREHOLE No.: BH2

ELEVATION: 58.60 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: R. Vanden Tillaart CHECKED BY: B. Vazhbakht

DATE (START): 21 January 2019 DATE (FINISH): 21 January 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

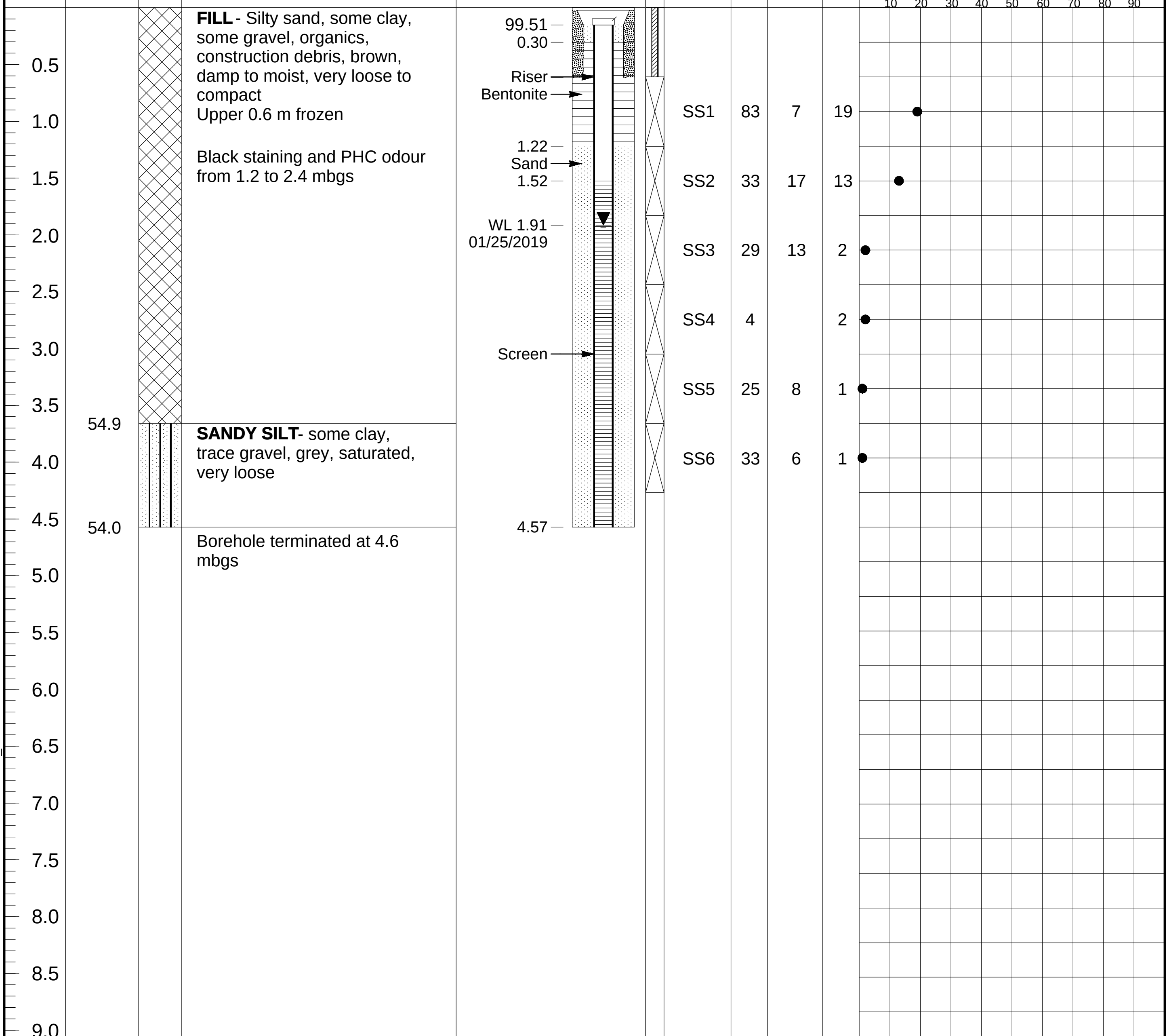
Depth BGS (meters)	Elevation (m)	Description of Soil and Bedrock
0.0	58.60	GROUND SURFACE
0.0 – 3.65		**FILL** - Silty sand, some clay, some gravel, organics, construction debris, brown, damp to moist, very loose to compact Upper 0.6 m frozen Black staining and PHC odour from 1.2 to 2.4 mbgs
3.65 – 4.57	54.9	**SANDY SILT**- some clay, trace gravel, grey, saturated, very loose
4.57	54.0	Borehole terminated at 4.6 mbgs

Monitor Well: 99.51; 0.30; Riser; Bentonite; 1.22; Sand; 1.52; WL 1.91 01/25/2019; Screen; 4.57

Sample Data

Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
SS1	83	7	19
SS2	33	17	13
SS3	29	13	2
SS4	4		2
SS5	25	8	1
SS6	33	6	1

SCALE FOR TEST RESULTS: 50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90



NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

BOREHOLE LOG 11186719-A1-BOREHOLE LOGS.GPJ INSPEC_SOL.GDT 16/12/19

REFERENCE No.: 11186719 ENCLOSURE No.: 3

BOREHOLE LOG

BOREHOLE No.: BH3
ELEVATION: 59.40 m

Page: 1 of 1

CLIENT: TC United Group
PROJECT: Geotechnical Investigation
LOCATION: 36 Robinson Avenue
DESCRIBED BY: R. Vanden Tillaart CHECKED BY: B. Vazhbakht
DATE (START): 22 January 2019 DATE (FINISH): 22 January 2019

LEGEND
- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

Depth BGS (meters)	Elevation (m)	Description of Soil and Bedrock	Monitor Well	Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
0	59.40	GROUND SURFACE					
0–2.3		**FILL** - Silty sand, some gravel, brown, moist, very loose to compact. Upper 0.6 m frozen	100.24; 0.30; Riser; Bentonite				
1.0			1.22; Sand; 1.52	SS1	67	28	13
2.0			Screen	SS2	4		3
2.3	57.1	**SILTY SAND**- some clay, some gravel, grey to brown, saturated, loose to compact		SS3	58	42	17
3.0			WL 2.97 01/25/2019				
3.5				SS4	58	26	8
4.0				SS5	71		16
4.6	54.8	Borehole terminated at 4.6 mbgs	4.57				

SCALE FOR TEST RESULTS: 50kPa, 100kPa, 150kPa, 200kPa; 10, 20, 30, 40, 50, 60, 70, 80, 90

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719 ENCLOSURE No.: 4

BOREHOLE No.: **BH4**

ELEVATION: 58.70 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: R. Vanden Tillaart CHECKED BY: B. Vazhbakht

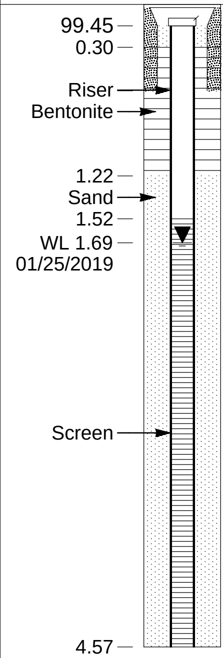
DATE (START): 22 January 2019 DATE (FINISH): 22 January 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

Depth BGS (meters)	Elevation (m)	Description of Soil and Bedrock
0.00	58.70	GROUND SURFACE
0.00–2.0		**FILL** - Silty sand, some gravel, brown, moist, very loose to loose Black staining, PHC odour at 1.5 mbgs
2.0	56.7	**SILTY SAND**- some gravel, some clay, grey to brown, moist to saturated, compact
4.6	54.1	Borehole terminated at 4.6 mbgs

Monitor Well:



Sample Data:

State	Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
SS	SS1	4		5
SS	SS2	54	19	3
SS	SS3	63	28	22
SS	SS4	58	17	10
SS	SS5	88	14	16

SCALE FOR TEST RESULTS: 50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90

Depth scale: 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719 ENCLOSURE No.: 5

BOREHOLE LOG

BOREHOLE No.: BH5

ELEVATION: 58.30 m

Page: 1 of 1

CLIENT: TC United Group
PROJECT: Geotechnical Investigation
LOCATION: 36 Robinson Avenue
DESCRIBED BY: S. Wheeler CHECKED BY: B. Vazhbakht
DATE (START): 17 December 2018 DATE (FINISH): 17 December 2018

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

STRATIGRAPHY

Depth BGS (meters)	Elevation (m)	DESCRIPTION OF SOIL AND BEDROCK
	58.30	GROUND SURFACE
0.0		**FILL** - Silty sand, some clay, some gravel, possible cobbles, organics, rootlets, brown and grey, moist, very loose to compact
	55.7	**SILTY SAND** - some clay, some gravel, brown, moist, very loose to compact
	53.7	**SANDY SILT** - some clay, trace gravel, grey, saturated, very loose to very dense Coarse sand layer encountered at 5.2 mbgs Spoon refusal encountered at 5.3 mbgs
	53.0	
	52.7	**SHALE** - highly weathered and fractured, black Auger refusal encountered at 5.6 mbgs
		SHALE - very poor becoming good quality, black 0.1 m thick mud seam encountered at 6.1 mbgs
	51.0	Borehole terminated at 7.3 mbgs

MONITOR WELL

- 99.14
- 0.61
- Cuttings
- WL 2.59 01/03/2019
- Riser
- 5.18
- Bentonite
- 5.79
- Sand
- 6.10
- Screen
- 7.32

SAMPLE DATA

Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
SS1	71		26
SS2	71		17
SS3	54		3
SS4	54		20
SS5	71		15
SS6	4		5
SS7	92		3
SS8	100		50+
RC1	100		0
RC2	100		81

SCALE FOR TEST RESULTS: 50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

BOREHOLE LOG

BOREHOLE No.: BH6
ELEVATION: 59.40 m

CLIENT: TC United Group
PROJECT: Geotechnical Investigation
LOCATION: 36 Robinson Avenue
DESCRIBED BY: S. Wheeler CHECKED BY: B. Vazhbakht
DATE (START): 17 December 2018 DATE (FINISH): 17 December 2018

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

Depth BGS (meters)	Elevation (m)	Description of Soil and Bedrock	Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
0.0	59.40	GROUND SURFACE				
		FILL - Silty sand, some clay, trace gravel, dark brown, moist, loose to very dense, possible cobbles	SS1	58		4
			SS2	33		50+
			SS3	75		21
	57.1	**SILTY SAND**- some clay becoming clayey, trace to some gravel, grey and brown, saturated, loose to compact	SS4	83		11
			SS5	88		13
			SS6	0		9
			SS7	83		10
			SS8	100		9
			SS9	100		22
		Spoon refusal encounterd at 7.1 mbgs Auger refusal encountered at 7.2 mbgs	SS10	33		50+
	52.3	**SHALE**- black, highly weathered and fractured				
	52.2	**SHALE**- black, excellent quality	RC1	100		92
			RC2	100		96
	50.6	Borehole terminated at 8.9 mbgs				

SCALE FOR TEST RESULTS: 50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90

NOTES:
Monitoring well could not be installed due to the existence of a saturated sand layer.
Borehole backfilled with sand, bentonite and auger cuttings.
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719 ENCLOSURE No.: 7

GHD

BOREHOLE No.: BH7

ELEVATION: 59.10 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: D.Cooper CHECKED BY: B. Vazhbakht

DATE (START): 18 November 2019 DATE (FINISH): 18 November 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- ▼ Water Level
- ○ Water content (%)
- ├─┤ Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE FOR TEST RESULTS: 50kPa, 100kPa, 150kPa, 200kPa; 10, 20, 30, 40, 50, 60, 70, 80, 90

STRATIGRAPHY

Depth BGS (meters)	Elevation (m)	DESCRIPTION OF SOIL AND BEDROCK
	59.10	GROUND SURFACE
0.0	59.10	**FILL** - Sandy SILT, pockets of clayey silt, possible cobbles/boulders, trace gravel, brown, moist, loose to compact
	56.8	**CLAYEY SILT**- some sand, brown, moist, loose to compact
	55.3	**SILTY SAND**- trace to some clay, grey, moist to wet, loose
	53.8	**CLAYEY SILT (TILL)**- some sand and gravel, grey, wet, very stiff to hard
	51.3	**SHALE**- dark grey, fresh, high strength, poor quality, laminated at 35°, with some calcite healed defects, two noted dominant defect sets, set 1 comprises partings every 0.1-0.2 m at 35°, clean, planar and smooth to rough, set 2 comprises joints every 0.1- 9.02 m - 9.11 m, becoming highly weathered, entire rock mass fractured 9.6m, becoming very poor quality 9.8m, becoming with completely fractured, highly weathered zones, up to 0.05 m thick, at approximately 0.1 m spacings 11.6 m, rock mass entirely fractured, highly weathered, with zones of silty sandy gravel
	46.9	

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0

MONITOR WELL

- 0.46
- Backfill
- Riser
- 7.82
- Bentonite
- 9.01
- 9.14
- Sand
- Screen
- 12.19

SAMPLE DATA

Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
SS1	42		16
SS2	63		7
SS3	67		37
SS4	33		7
SS5	75		14
SS6	71		18
SS7	75		23
SS8	42		13
SS9	83		36
SS10	54		53
SS11	75		R
SS12	100		R
RC13	100		37
RC14	84		21
RC15	100		0

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719 ENCLOSURE No.: 8

BOREHOLE LOG

BOREHOLE No.: **BH8**

ELEVATION: 58.60 m

Page: 1 of 1

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: D.Cooper CHECKED BY: B. Vazhbakht

DATE (START): 18 November 2019 DATE (FINISH): 18 November 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE FOR TEST RESULTS: 50kPa, 100kPa, 150kPa, 200kPa; 10, 20, 30, 40, 50, 60, 70, 80, 90

Depth BGS (meters)	Elevation (m)	DESCRIPTION OF SOIL AND BEDROCK
0.0	58.60	GROUND SURFACE
0.0		**FILL** - Silty sand, with some gravel, presence of brick fragments, organic pockets, brown, moist, loose to compact
	56.3	**CLAYEY SILT**- some gravel and sand, brown, saturated, compact to dense
	54.8	**SANDY SILT**- some gravel, trace of clay, grey, saturated, loose to compact
	53.3	**SANDY GRAVEL**- some silt, grey, saturated, compact to very dense; becoming glacial till
	52.3	**SHALE**- dark grey, laminated at 0-5°, fresh, medium to high strength, fair quality, only defect set comprises partings at 0-5°
		8.01 m, becoming excellent quality
		9.65 m, becoming fair quality
		11.2 m, becoming excellent quality
	46.5	

MONITOR WELL: 0.46, Backfill, Riser, 6.27, Bentonite, 8.92, 9.07, Sand, Screen, 12.12

SAMPLE DATA

Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
SS1	96		13
SS2	92		9
SS3	63		14
SS4	46		38
SS5	71		16
SS6	83		14
SS7	79		7
SS8	25		22
SS9	100		R
RC10	100		57
RC11	100		100
RC12	92		70
RC13	100		100

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719 ENCLOSURE No.: 9

BOREHOLE No.: BH9
ELEVATION: 59.10 m

BOREHOLE LOG

CLIENT: TC United Group
PROJECT: Geotechnical Investigation
LOCATION: 36 Robinson Avenue
DESCRIBED BY: D.Cooper CHECKED BY: B. Vazhbakht
DATE (START): 9 December 2019 DATE (FINISH): 9 December 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE FOR TEST RESULTS: 50kPa, 100kPa, 150kPa, 200kPa; 10, 20, 30, 40, 50, 60, 70, 80, 90

Depth BGS (meters)	Elevation (m)	DESCRIPTION OF SOIL AND BEDROCK	Monitor Well	Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
	59.10	GROUND SURFACE					
0.0		Augered to practical refusal with no sampling	Sand; Riser				
7.40	51.7	**SHALE**- Highly weathered and fractured, dark grey to black, fresh with completely weathered zones, thinly laminated at 20-30°. Dominant defects are partings at approximately 50 mm spacing Approximately 50mm seam of crushed rock	7.40 Bentonite	RC1	87		9
				RC2	100		50
		Abundantly fractured, fresh with completely weathered crushed seams	11.10 Sand 11.81	RC3	92		14
		Fresh, laminated at approximately 30°. Dominant defects every 50 to 100 mm are partings, occasional calcite coatings, minor crushed seams (<5 mm) comprising of silty clayey sand every 300 mm. becoming more fractured	Screen	RC4	100		44

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719

ENCLOSURE No.: 9

BOREHOLE No.: BH9

ELEVATION: 59.10 m

BOREHOLE LOG

Page: 2 of 2

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: D.Cooper

CHECKED BY: B. Vazhbakht

DATE (START): 9 December 2019

DATE (FINISH): 9 December 2019

LEGEND

- ☒ SS Split Spoon
- GS Auger Sample
- ▨ ST Shelby Tube
- ▼ Water Level
- ○ Water content (%)
- ├─┤ Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE: Depth BGS	SCALE: Elevation (m)	STRATIGRAPHY: Stratigraphy	STRATIGRAPHY: DESCRIPTION OF SOIL AND BEDROCK	MONITOR WELL	SAMPLE DATA: State	SAMPLE DATA: Type and Number	SAMPLE DATA: Recovery	SAMPLE DATA: OVC	SAMPLE DATA: Penetration Index / RQD	SCALE FOR TEST RESULTS (50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90)
meters	59.10		GROUND SURFACE				%	ppm	N	
15.0 – 16.0			Approximately 50 mm crushed seams encountered at 14.6 and 14.8 mbgs comprising of silty clayey gravel Crushed seams approximately every 100mm	16.38		RC5	84		30	
						RC6	88		29	
	42.5		Borehole terminated at 16.6 mbgs							
17.0 – 28.0										

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

BOREHOLE LOG 11186719-A1-BOREHOLE LOGS.GPJ INSPEC_SOL.GDT 16/12/19

REFERENCE No.: 11186719 ENCLOSURE No.: 10

BOREHOLE No.: BH10

ELEVATION: 59.20 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: D.Cooper CHECKED BY: B. Vazhbakht

DATE (START): 10 December 2019 DATE (FINISH): 10 December 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

Depth BGS (meters)	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
	59.20		GROUND SURFACE					
0.0–6.0			Augered to practical refusal with no sampling					
6.0	53.1		**BOULDER**					
	52.9		**SHALE**- dark grey, fresh, highly fractured, occasional seams of crushed rock comprising of silty clayey sand, laminated at 0 to 10°		RC1	50		8
			Vertical joint, planar, calcite coated encounterd from 8.2 to 8.9 mbgs		RC2	83		9
			Thinly laminated at 5 to 10°					
			5 mm crushed seam of sandy gravel encountered at 9.8 mbgs		RC3	100		67
			13 mm crushed seam of sandy gravel seam encountered at 9.9 mbgs					
			Subvertical joint, clean, planar, rough to smooth encountered at 10.1 mbgs		RC4	100		89
			Occasional joint at 45° every 300 mm, clean, rough to smooth					
					RC5	79		94
13.5	45.7		Borehole terminated at 13.5 mbgs					

Depth scale: 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 14.0

SCALE FOR TEST RESULTS: 50kPa 100kPa 150kPa 200kPa; 10 20 30 40 50 60 70 80 90

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719 ENCLOSURE No.: 11

GHD	**BOREHOLE No.:** **BH11** **ELEVATION:** 59.20 m	**BOREHOLE LOG** Page: 1 of 1

CLIENT: TC United Group
PROJECT: Geotechnical Investigation
LOCATION: 36 Robinson Avenue
DESCRIBED BY: D.Cooper CHECKED BY: B. Vazhbakht
DATE (START): 10 December 2019 DATE (FINISH): 10 December 2019

LEGEND

- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

SCALE		STRATIGRAPHY		SAMPLE DATA					
Depth BGS	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery	OVC	Penetration Index / RQD	SCALE FOR TEST RESULTS 50kPa 100kPa 150kPa 200kPa / 10 20 30 40 50 60 70 80 90
meters	59.20		GROUND SURFACE			%	ppm	N	
			Augered to practical refusal with no sampling	GS					
1.0									
2.0									
3.0									
4.0									
5.0	53.8		**LIMESTONE**		RC1	70		75	
6.0	53.1		**SHALE**- dark grey, fresh, thinly laminated at 0 to 5°. Defects comprisined of partings in line with bedding, clean, rough to smooth		RC2	67		44	
7.0									
8.0					RC3	100		94	
9.0			Weathered/crusehd seam comprising of silty sand with some clay encountered at 8.8 mbgs Approximately 70° joint, smooth, clean to rough encountered at 8.9 mbgs Approximately 45° joint, smooth, clean to rough encountered at 9.3 mbgs						
10.0					RC4	100		98	
11.0					RC5	93		82	
12.0	47.3		Borehole terminated at 11.9 mbgs						
13.0									
14.0									

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing

REFERENCE No.: 11186719 ENCLOSURE No.: 12

BOREHOLE No.: BH12

ELEVATION: 59.10 m

BOREHOLE LOG

Page: 1 of 1

CLIENT: TC United Group

PROJECT: Geotechnical Investigation

LOCATION: 36 Robinson Avenue

DESCRIBED BY: D.Cooper CHECKED BY: B. Vazhbakht

DATE (START): 9 December 2019 DATE (FINISH): 9 December 2019

LEGEND

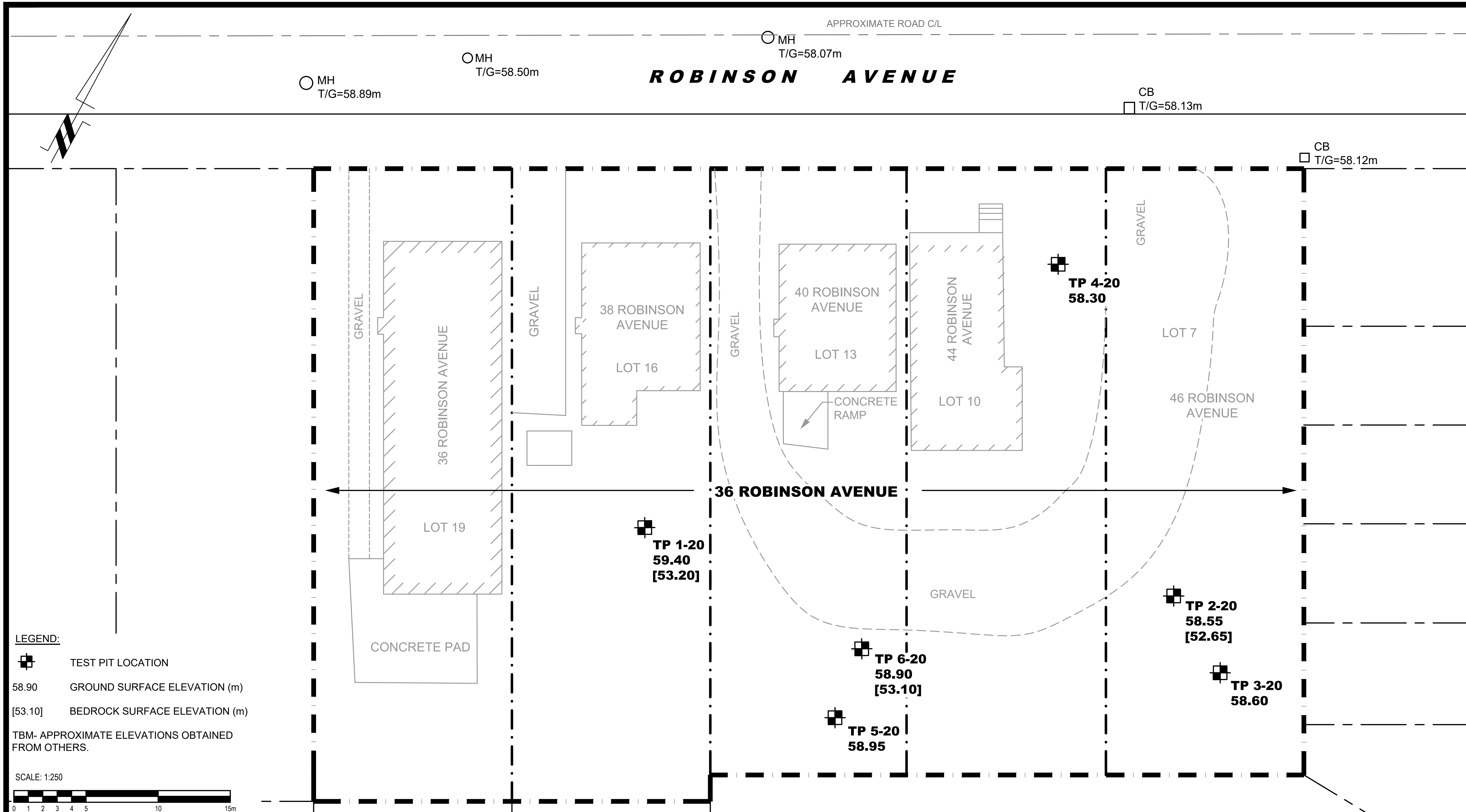
- SS Split Spoon
- GS Auger Sample
- ST Shelby Tube
- Water Level
- ○ Water content (%)
- Atterberg limits (%)
- ● N Penetration Index based on Split Spoon sample
- • N Penetration Index based on Dynamic Cone sample
- △ Cu Shear Strength based on Field Vane
- □ Cu Shear Strength based on Lab Vane
- S Sensitivity Value of Soil
- ▲ Shear Strength based on Pocket Penetrometer

Depth BGS (meters)	Elevation (m)	Description of Soil and Bedrock	Monitor Well	State	Type and Number	Recovery (%)	OVC (ppm)	Penetration Index / RQD (N)
	59.10	GROUND SURFACE						
	59.0	**CONCRETE**	0.10					
0.5		**FILL** - Sandy SILT, pockets of clayey silt, possible cobbles/boulders, trace gravel, brown, moist, loose to compact		SS	SS1	33		10
1.0			Riser	SS	SS2	41		12
2.0			1.98	SS	SS3	30		27
	56.8	**CLAYEY SILT** - some sand, brown, moist, loose to compact	Bentonite					
2.5			2.59; Sand; 2.90	SS	SS4	57		17
3.5				SS	SS5	25		17
	55.3	**SILTY SAND** - trace to some clay, grey, moist to wet, loose						
4.0				SS	SS6	66		13
4.5			Screen					
5.0				SS	SS7	51		3
	53.8	**CLAYEY SILT (TILL)** - some sand and gravel, grey, wet, very stiff to hard						
5.5				SS	SS8	49		13
	53.2		5.94					

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0

SCALE FOR TEST RESULTS: 50kPa, 100kPa, 150kPa, 200kPa; 10, 20, 30, 40, 50, 60, 70, 80, 90

NOTES:
mbgs: meters below ground surface
Elevations are approximate based on shoring drawing



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NO.	REVISIONS	DATE	INITIAL

TCU DEVELOPMENTS

GEOTECHNICAL INVESTIGATION
36 ROBINSON AVENUE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:250	Date: 03/2020
Drawn by: YA	Report No.: PG5231-1
Checked by: DL	Dwg. No.: PG5231-1
Approved by: CDS	Revision No.:

p:\autocad drawings\geotechnical\pg52xx\pg5231\pg5231-test hole location plan.dwg

Source: Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation, Date Unknown

0 5 10 15

Meters

Coordinate System:
NAD 1983 UTM Zone 18N

N

GHD

ROBINSON VILLAGE LPIV LIMITED PARTNERSHIP
36 ROBINSON AVENUE, OTTAWA, ONTARIO
HYDROGEOLOGICAL INVESTIGATION

11186719-E2
Dec 11, 2019

INVESTIGATIVE LOCATIONS

FIGURE 3.1

GIS File: Q:\GIS\PROJECTS\11186000s\11186719\Layouts\001\11186719-A1(001)GIS-OT006.mxd

APPENDIX 3

MTO IDF Curves

Sample Calculations - Dupuit Forchheimer

Hydraulic Conductivity Results (by Others)

Table 1 - Summary of Groundwater Level Readings

Ontario IDF CURVE LOOKUP

Active coordinate

45° 25' 15" N, 75° 39' 45" W (45.420833,-75.662500)

Retrieved: Thu, 04 Jun 2020 21:09:21 GMT

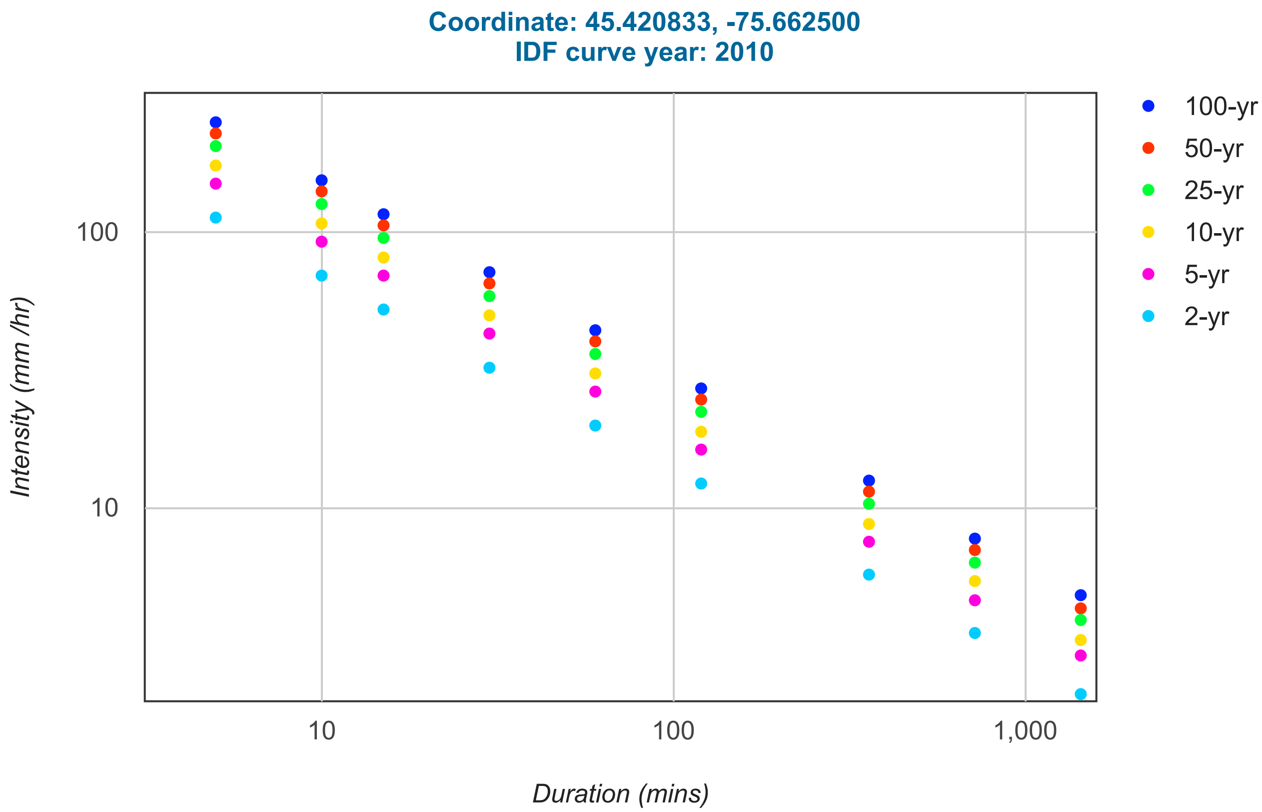
Location summary

These are the locations in the selection.

IDF Curve: 45° 25' 15" N, 75° 39' 45" W (45.420833,-75.662500)

Results

An IDF curve was found.



Coefficient summary

IDF Curve: 45° 25' 15" N, 75° 39' 45" W (45.420833,-75.662500)

Retrieved: Thu, 04 Jun 2020 21:09:21 GMT

Data year: 2010
IDF curve year: 2010

Return period	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
A	19.8	26.3	30.6	36.0	40.0	43.9
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

Statistics

Rainfall intensity (mm hr^{-1})

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	112.5	69.3	52.2	32.1	19.8	12.2	5.7	3.5	2.1
5-yr	149.4	92.0	69.3	42.7	26.3	16.2	7.5	4.6	2.9
10-yr	173.8	107.1	80.6	49.7	30.6	18.8	8.7	5.4	3.3
25-yr	204.5	126.0	94.9	58.4	36.0	22.2	10.3	6.3	3.9
50-yr	227.2	140.0	105.4	64.9	40.0	24.6	11.4	7.0	4.3
100-yr	249.4	153.6	115.7	71.3	43.9	27.0	12.5	7.7	4.8

Rainfall depth (mm)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	9.4	11.5	13.0	16.1	19.8	24.4	34.0	41.8	51.5
5-yr	12.4	15.3	17.3	21.3	26.3	32.4	45.1	55.6	68.5
10-yr	14.5	17.8	20.2	24.8	30.6	37.7	52.5	64.6	79.6
25-yr	17.0	21.0	23.7	29.2	36.0	44.4	61.7	76.1	93.7
50-yr	18.9	23.3	26.4	32.5	40.0	49.3	68.6	84.5	104.1
100-yr	20.8	25.6	28.9	35.6	43.9	54.1	75.3	92.7	114.3

Terms of Use

Estimated Groundwater Inflow

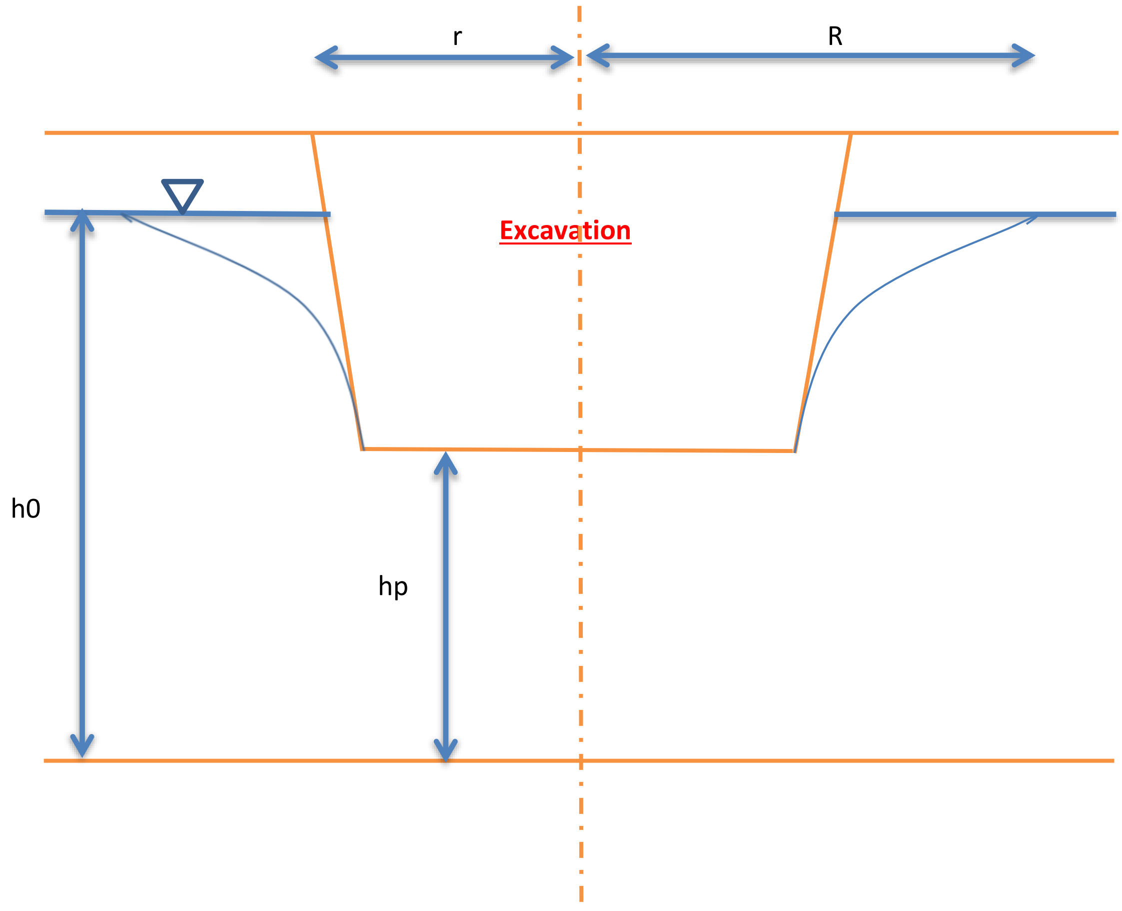
Robinson Village LPIV Limited Partnership - 36 Robinson Avenue - Building Excavation Footprint

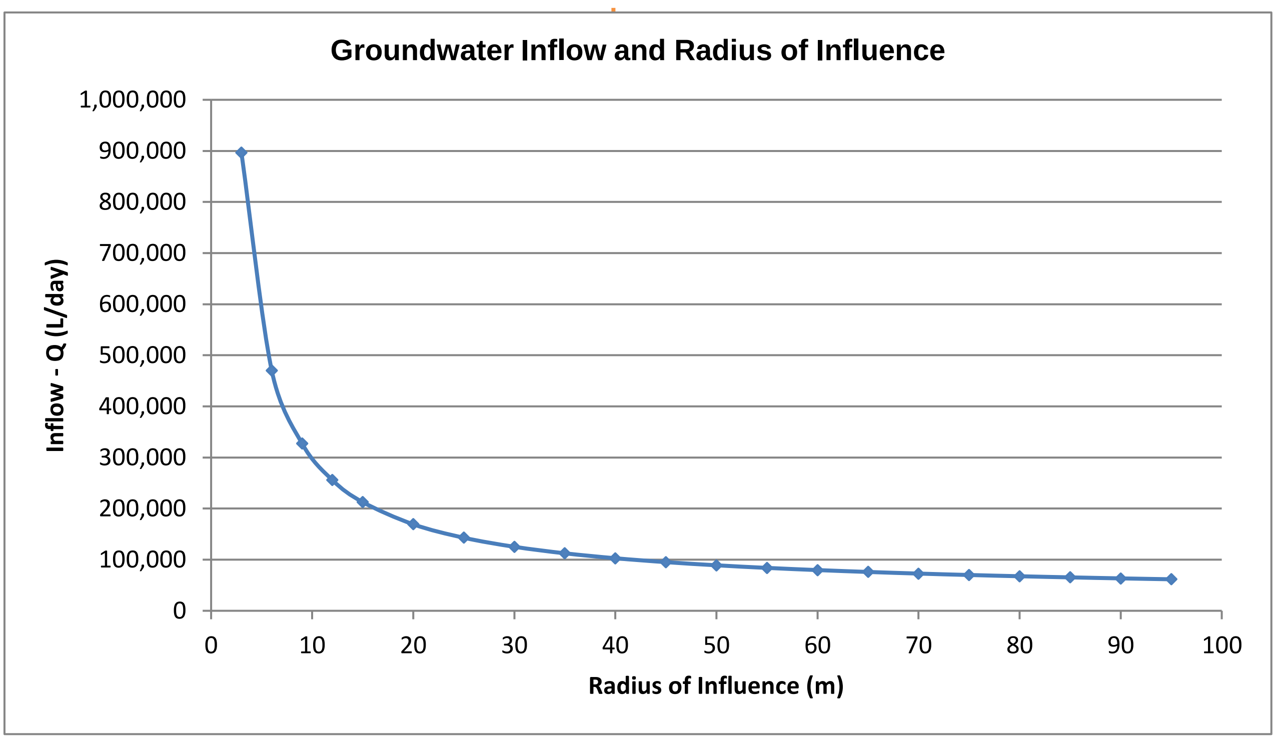
Dupuit-Forchheimer Equation **$Q = \pi K((h_0^2 - h_p^2)/\ln(R/r))$**

Equivalent Radius of Excavation = A+B=Pi*r

K (m/sec) =	1.50E-06			
h0 (m) =	18	Excavation Width (A) =	55	m
hp (m) =	10	Excavation Length (B) =	33	m
r (m) =	28.01	Perimeter Length =	176	m
		Equivalent Radius (r) =	28.01	m

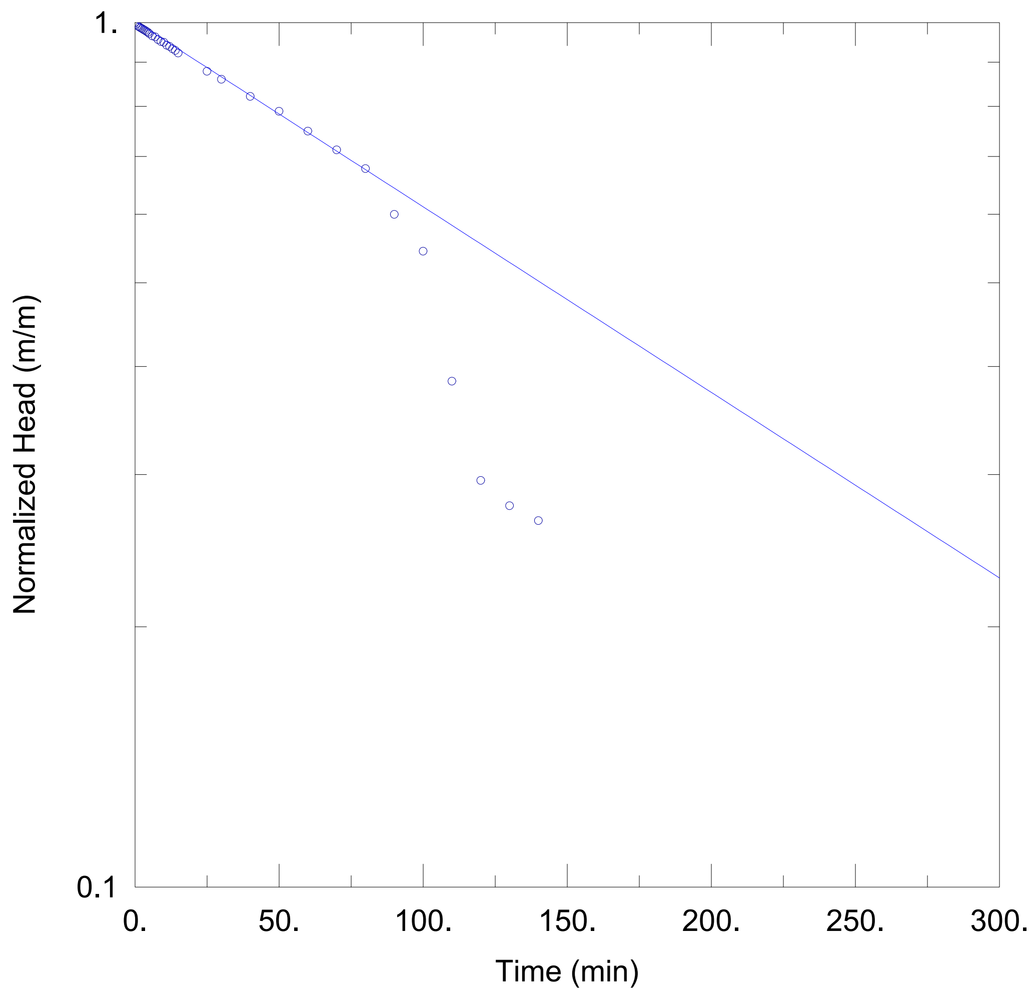
R	Distance to edge of excavation	Q (m^3/s)	Q (m^3/day)	Q (L/day)
31.01	3.00	0.0104	896	896,386
34.01	6.00	0.0054	470	469,906
37.01	9.00	0.0038	327	327,339
40.01	12.00	0.0030	256	255,786
43.01	15.00	0.0025	213	212,663
48.01	20.00	0.0020	169	169,259
53.01	25.00	0.0017	143	142,972
58.01	**30.00**	**0.0014**	**125**	**125,272**
63.01	35.00	0.0013	112	112,497
68.01	40.00	0.0012	103	102,813
73.01	45.00	0.0011	95	95,199
78.01	50.00	0.0010	89	89,043
83.01	55.00	0.0010	84	83,951
88.01	60.00	0.0009	80	79,662
93.01	65.00	0.0009	76	75,994
98.01	70.00	0.0008	73	72,817
103.01	75.00	0.0008	70	70,035
108.01	80.00	0.0008	68	67,575
113.01	85.00	0.0008	65	65,383
118.01	90.00	0.0007	63	63,415
123.01	95.00	0.0007	62	61,637


r
R
Excavation
h0
hp


Groundwater Inflow and Radius of Influence
Inflow - Q (L/day)
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
0
10
20
30
40
50
60
70
80
90
100
Radius of Influence (m)

BH4 Rising Test

Prepared By: GHD	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Ave, Ottawa



Data Set: \...\BH4 Rising.aqt
Date: 02/15/19 Time: 12:22:14

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.519E-5 cm/sec y0 = 2.145 m

AQUIFER DATA

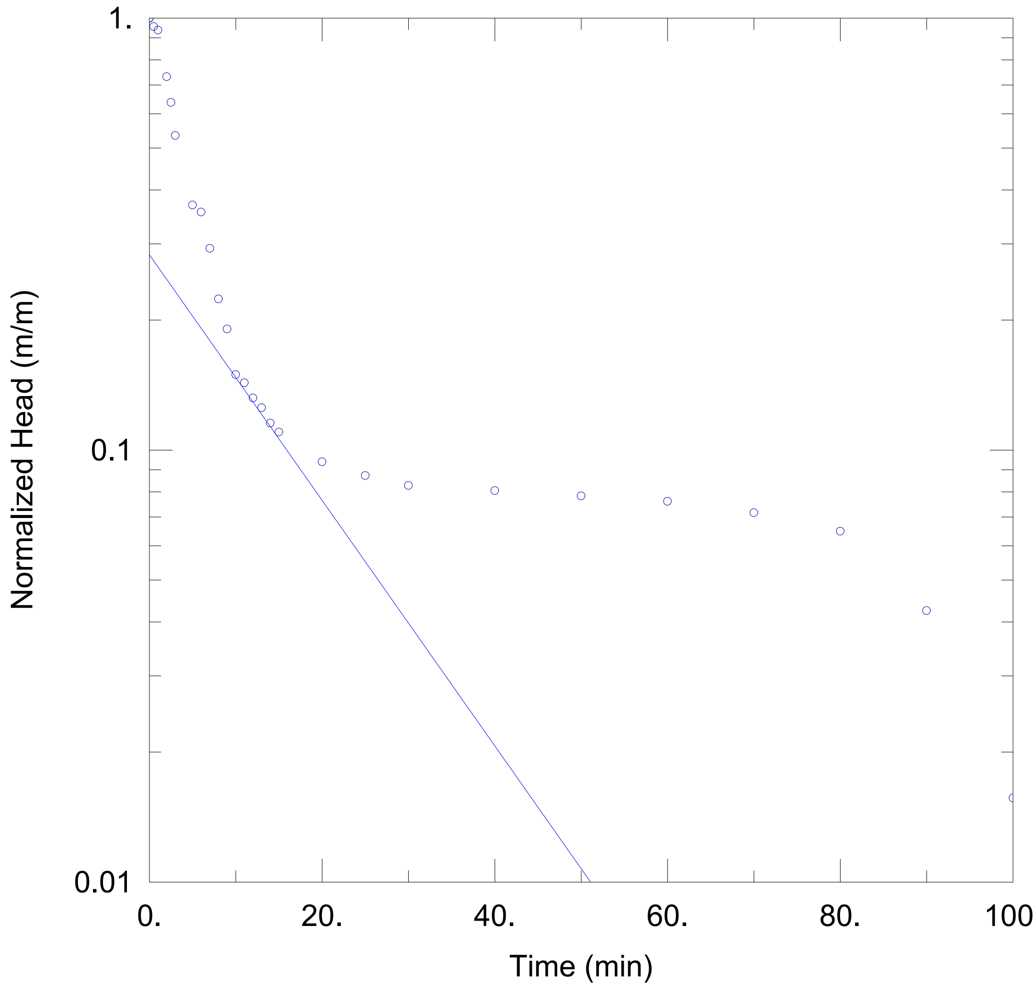
Saturated Thickness: 2.4 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH4)

Initial Displacement: 2.137 m
Static Water Column Height: 2.4 m
Total Well Penetration Depth: 2.4 m
Screen Length: 2.4 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH5 Rising Test

Prepared By: GHD	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Ave, Ottawa



Data Set: \...\BH5 Rising.aqt
Date: 02/15/19 Time: 12:23:07

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0001028 cm/sec y0 = 0.6329 m

AQUIFER DATA

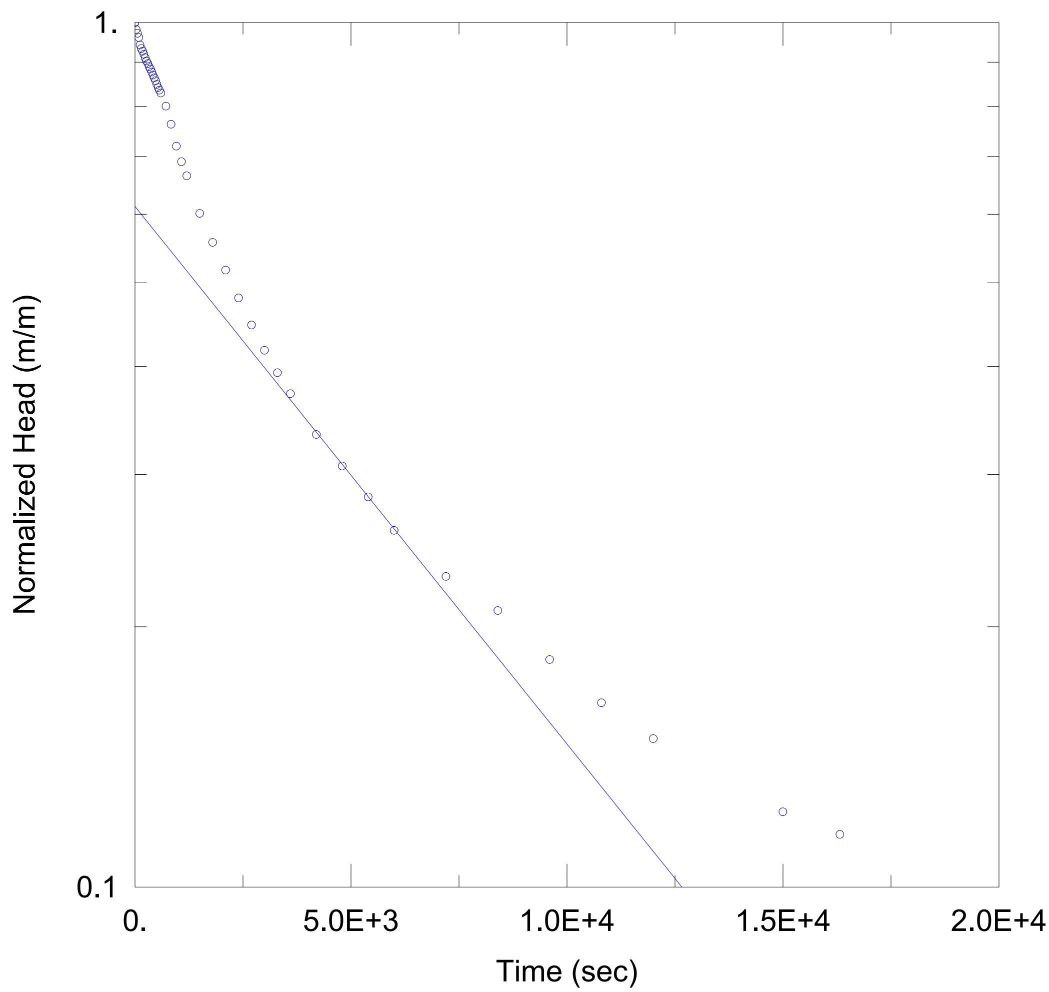
Saturated Thickness: 4.56 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH5)

Initial Displacement: 2.235 m
Static Water Column Height: 4.56 m
Total Well Penetration Depth: 4.56 m
Screen Length: 1.22 m
Casing Radius: 0.01588 m
Well Radius: 0.04 m
Gravel Pack Porosity: 0.32

BH7 Rising Head Test

Prepared By: GHD Limited	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Avenue, Sandy Hill



Data Set: C:\Users\mmckerrall\Desktop\11186719\BH7 Rising Head Test Bouwer-IAQUIFER DATA
Date: 12/04/19 Time: 14:47:04

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.803E-5 cm/sec y0 = 4.313 m

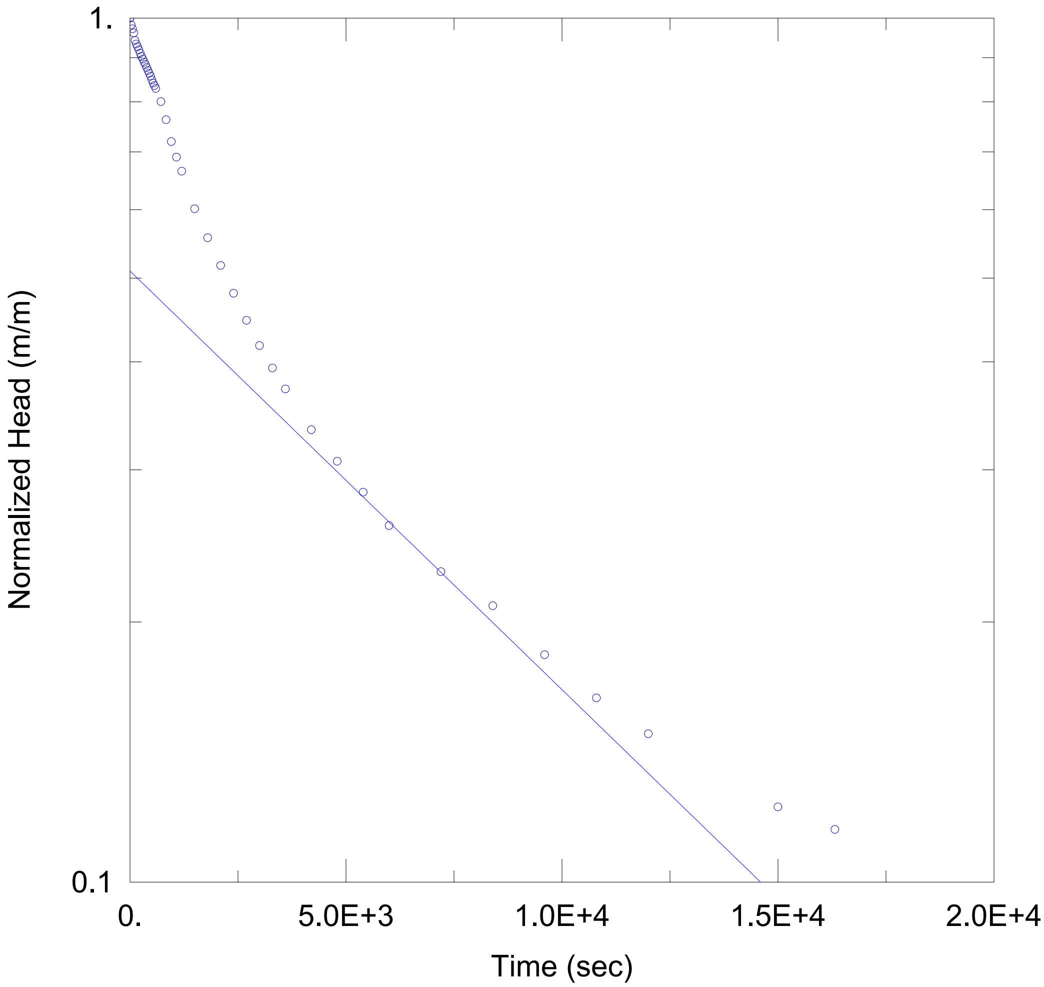
Saturated Thickness: 8.61 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH7)

Initial Displacement: 7.04 m
Static Water Column Height: 8.61 m
Total Well Penetration Depth: 8.61 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH7 Rising Head Test

Prepared By: GHD Limited	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Avenue, Sandy Hill



Data Set: C:\Users\mmckerrall\Desktop\11186719\BH7 Rising Head Test HvorslevAQUIFER DATA
Date: 12/04/19 Time: 14:47:19

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 2.803E-5 cm/sec y0 = 3.588 m

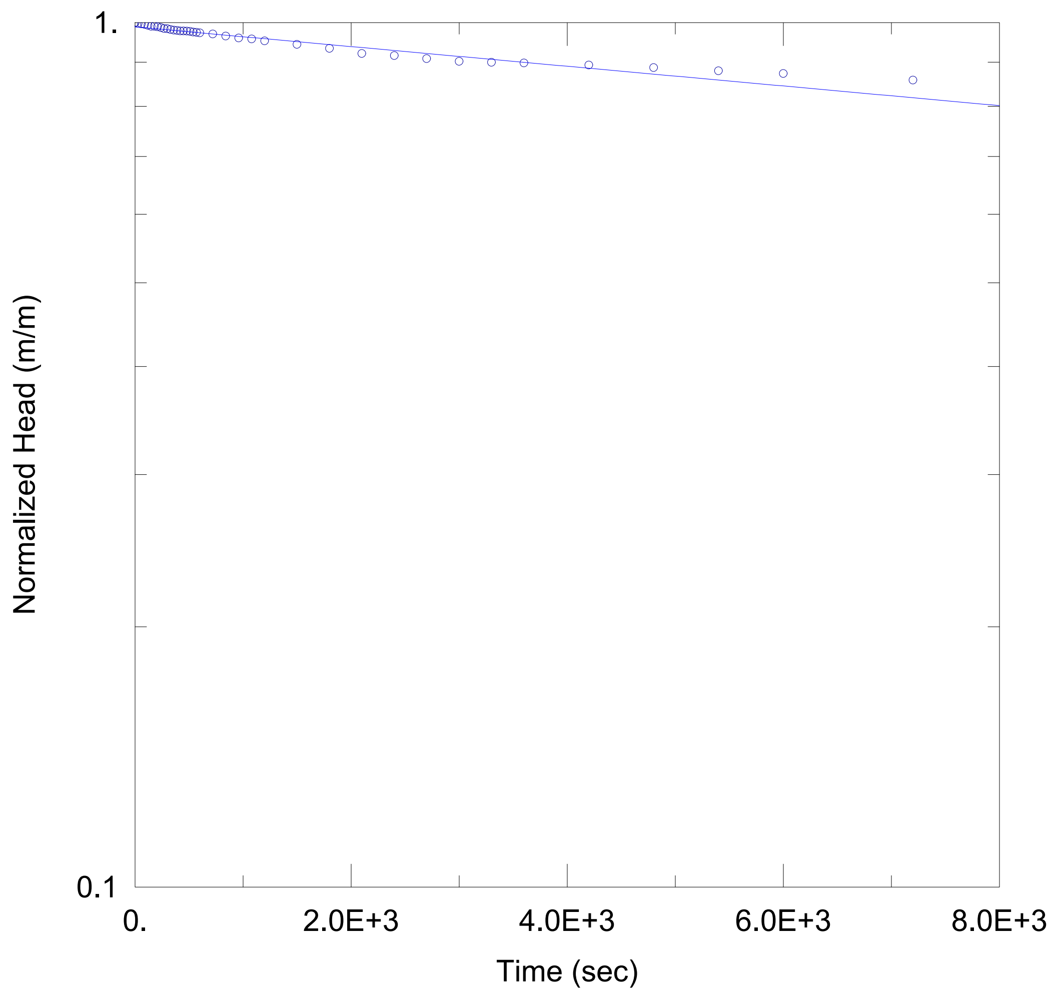
Saturated Thickness: 8.61 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH7)

Initial Displacement: 7.04 m
Static Water Column Height: 8.61 m
Total Well Penetration Depth: 8.61 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH8 Rising Head Test

Prepared By: GHD Limited	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Avenue, Sandy Hill



Data Set: C:\Users\mmckerrall\Desktop\11186719\BH8 Rising Head Test Bouwer-IAQUIFER DATA

Date: 12/04/19 Time: 14:47:50

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 5.141E-6 cm/sec y0 = 7.859 m

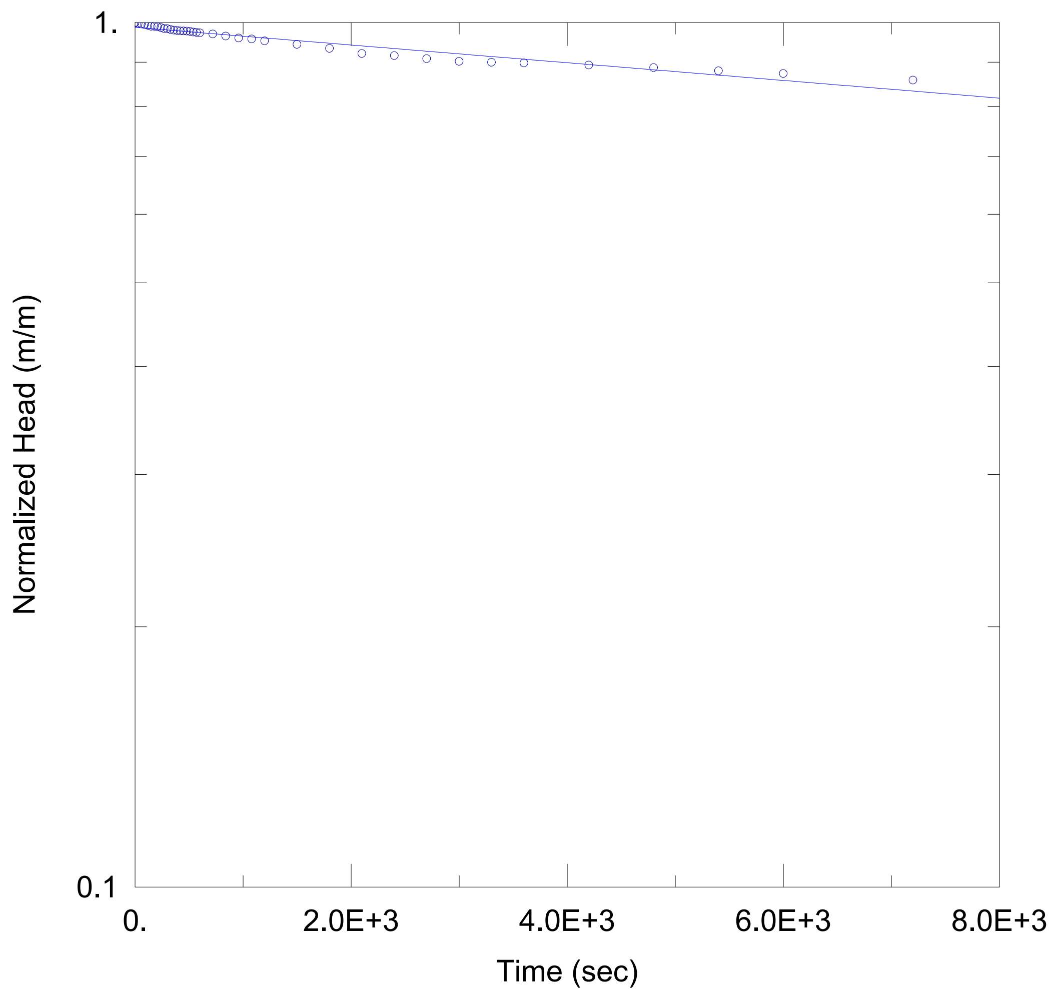
Saturated Thickness: 8.7 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH8)

Initial Displacement: 7.95 m
Static Water Column Height: 8.7 m
Total Well Penetration Depth: 8.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH8 Rising Head Test

Prepared By: GHD Limited	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Avenue, Sandy Hill



Data Set: C:\Users\mmckerrall\Desktop\11186719\BH8 Rising Head Test HvorslevAQUIFER DATA
Date: 12/04/19 Time: 14:48:10

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 5.924E-6 cm/sec y0 = 7.85 m

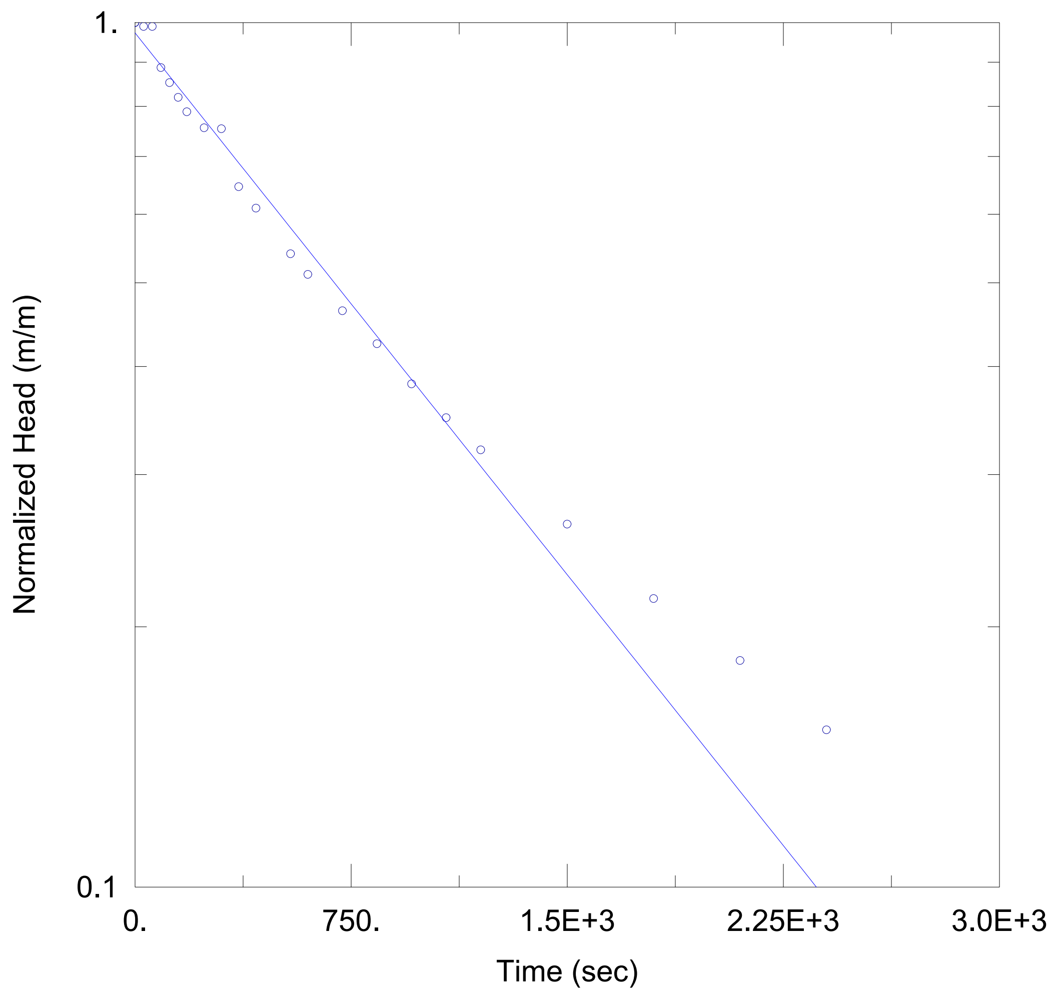
Saturated Thickness: 8.7 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH8)

Initial Displacement: 7.95 m
Static Water Column Height: 8.7 m
Total Well Penetration Depth: 8.7 m
Screen Length: 3.05 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH9 Rising Head Test

Prepared By: GHD Limited	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Avenue



Data Set: C:\...\11186719-BH9 Rising Head Test Bouwer-Rice.aqt
Date: 12/16/19 Time: 15:30:03

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 9.875E-5 cm/sec y0 = 4.737 m

AQUIFER DATA

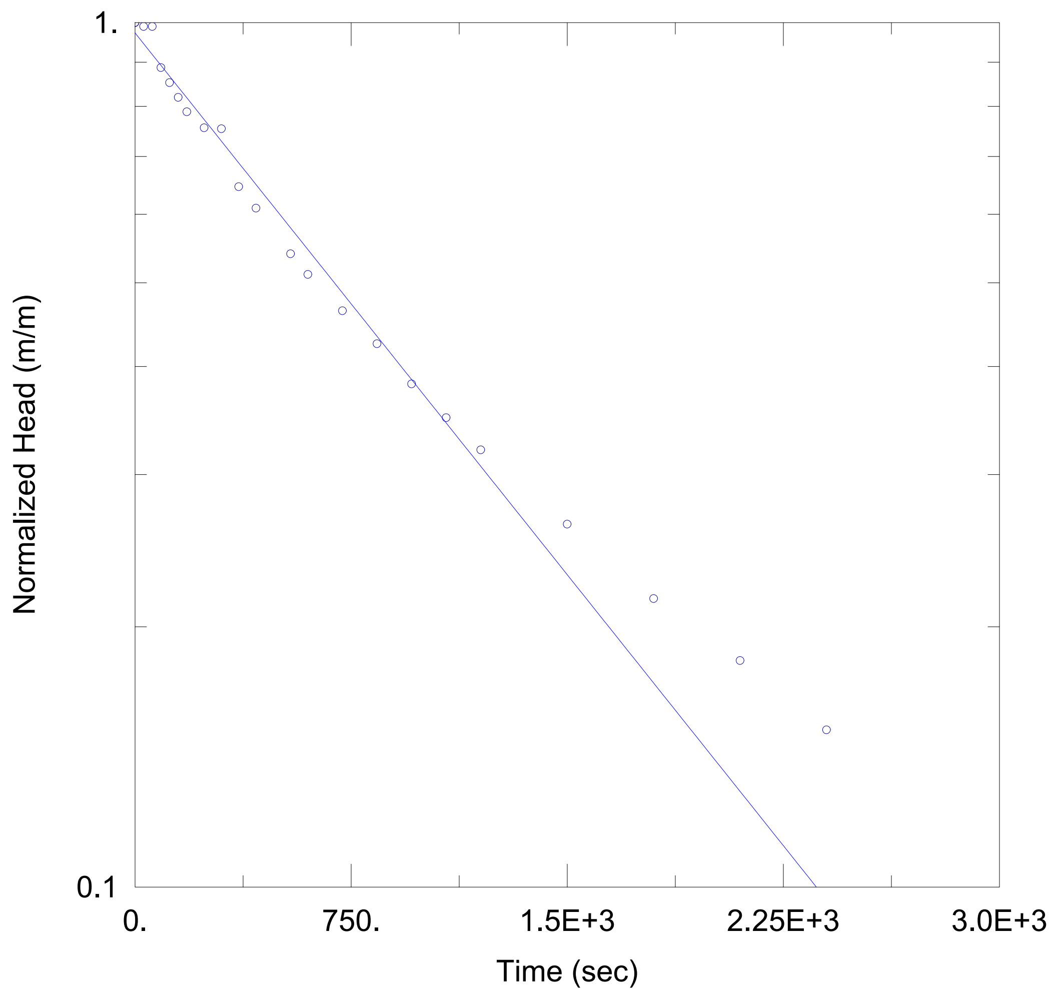
Saturated Thickness: 12.05 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH9)

Initial Displacement: 4.87 m
Static Water Column Height: 12.05 m
Total Well Penetration Depth: 4.57 m
Screen Length: 4.57 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH9 Rising Head Test

Prepared By:	Prepared For:
GHD Limited	TC United Group
Project:	**Location:**
11186719	36 Robinson Avenue



Data Set: C:\...\11186719-BH9 Rising Head Test Hvorslev.aqt
Date: 12/16/19 Time: 15:30:32

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001499 cm/sec y0 = 4.737 m

AQUIFER DATA

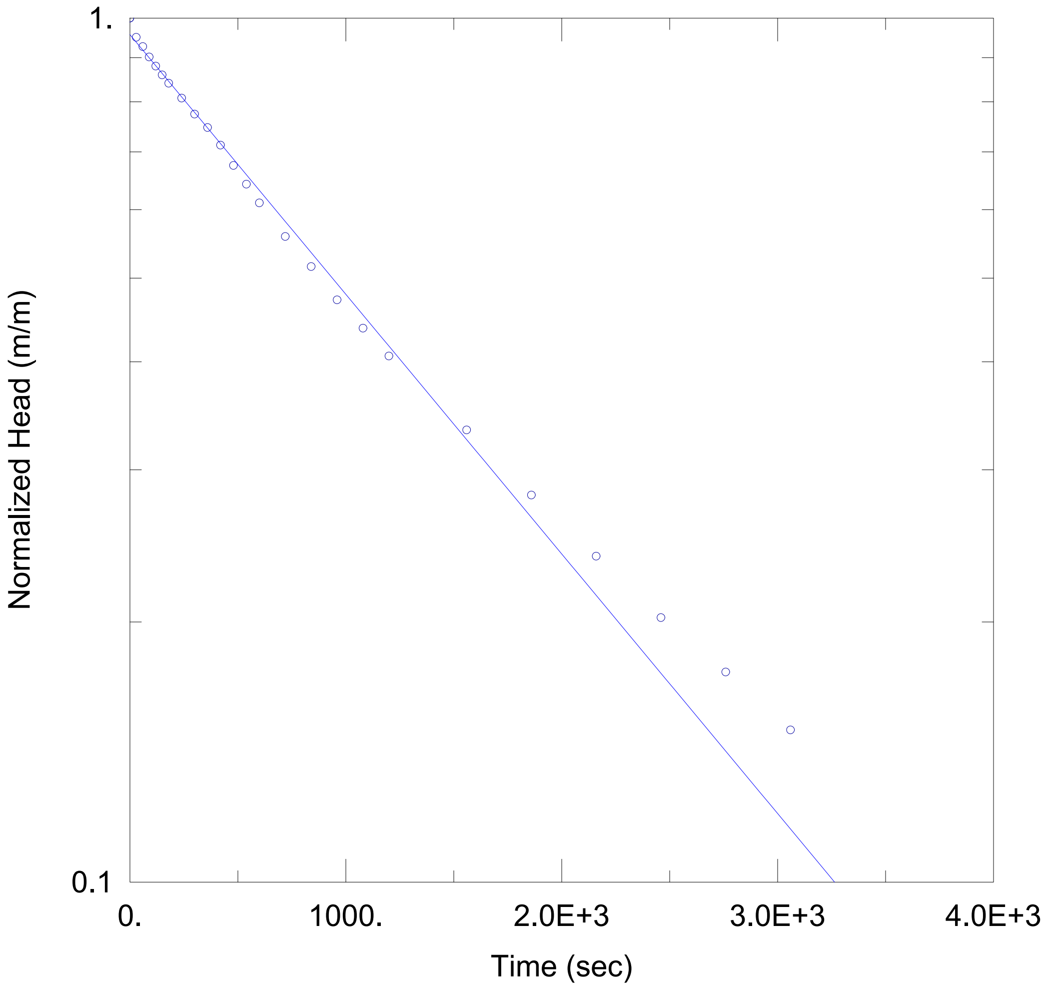
Saturated Thickness: 12.05 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH9)

Initial Displacement: 4.87 m
Static Water Column Height: 12.05 m
Total Well Penetration Depth: 4.57 m
Screen Length: 4.57 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH9 Rising Head Test

Prepared By: GHD Limited	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Avenue



Data Set: C:\...\11186719-BH9 Rising Head Test 2 Bouwer-Rice.aqt
Date: 12/16/19 Time: 15:29:00

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 7.101E-5 cm/sec y0 = 6.123 m

AQUIFER DATA

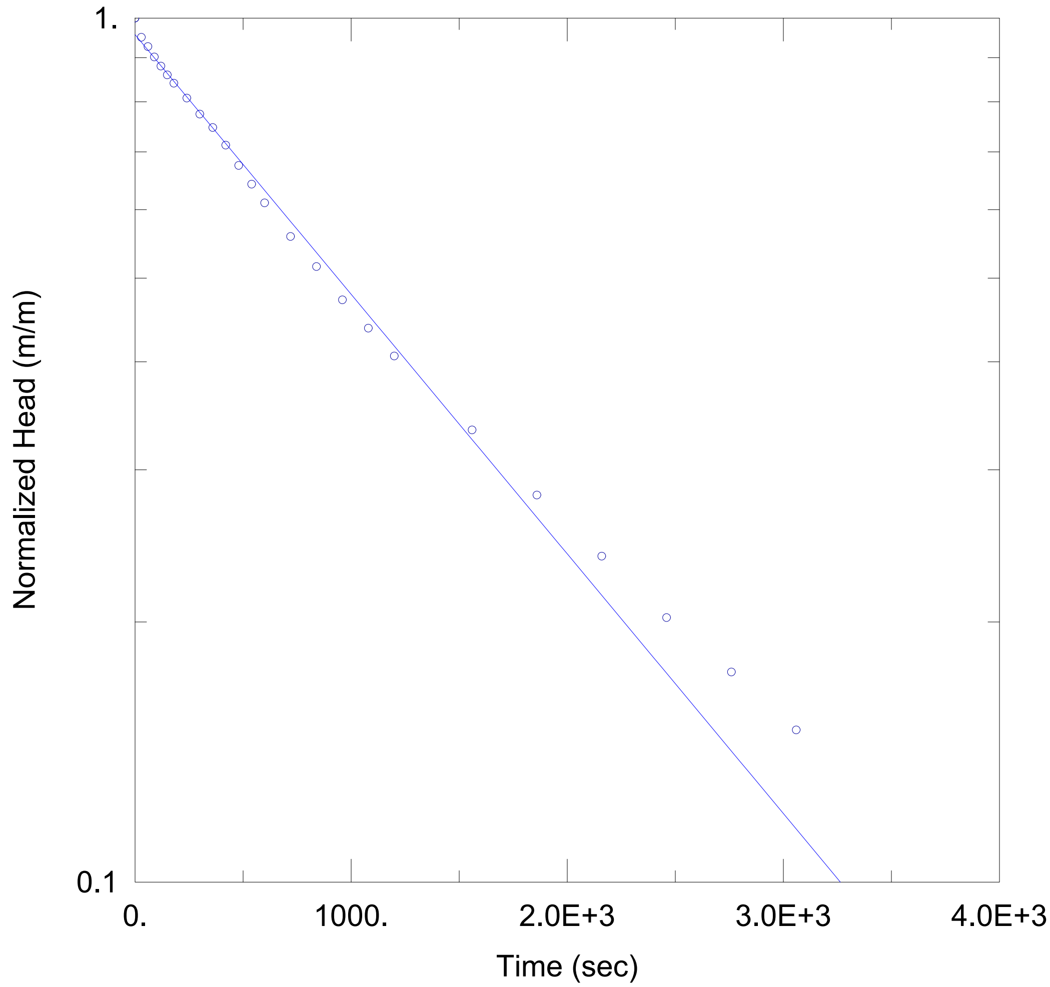
Saturated Thickness: 12.05 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH9)

Initial Displacement: 6.4 m
Static Water Column Height: 12.05 m
Total Well Penetration Depth: 4.57 m
Screen Length: 4.57 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

BH9 Rising Head Test

Prepared By: GHD Limited	Prepared For: TC United Group
Project: 11186719	Location: 36 Robinson Avenue



Data Set: C:\...\11186719-BH9 Rising Head Test 2 Hvorslev.aqt
Date: 12/16/19 Time: 15:29:40

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.0001078 cm/sec y0 = 6.123 m

AQUIFER DATA

Saturated Thickness: 12.05 m Anisotropy Ratio (Kz/Kr): 1.

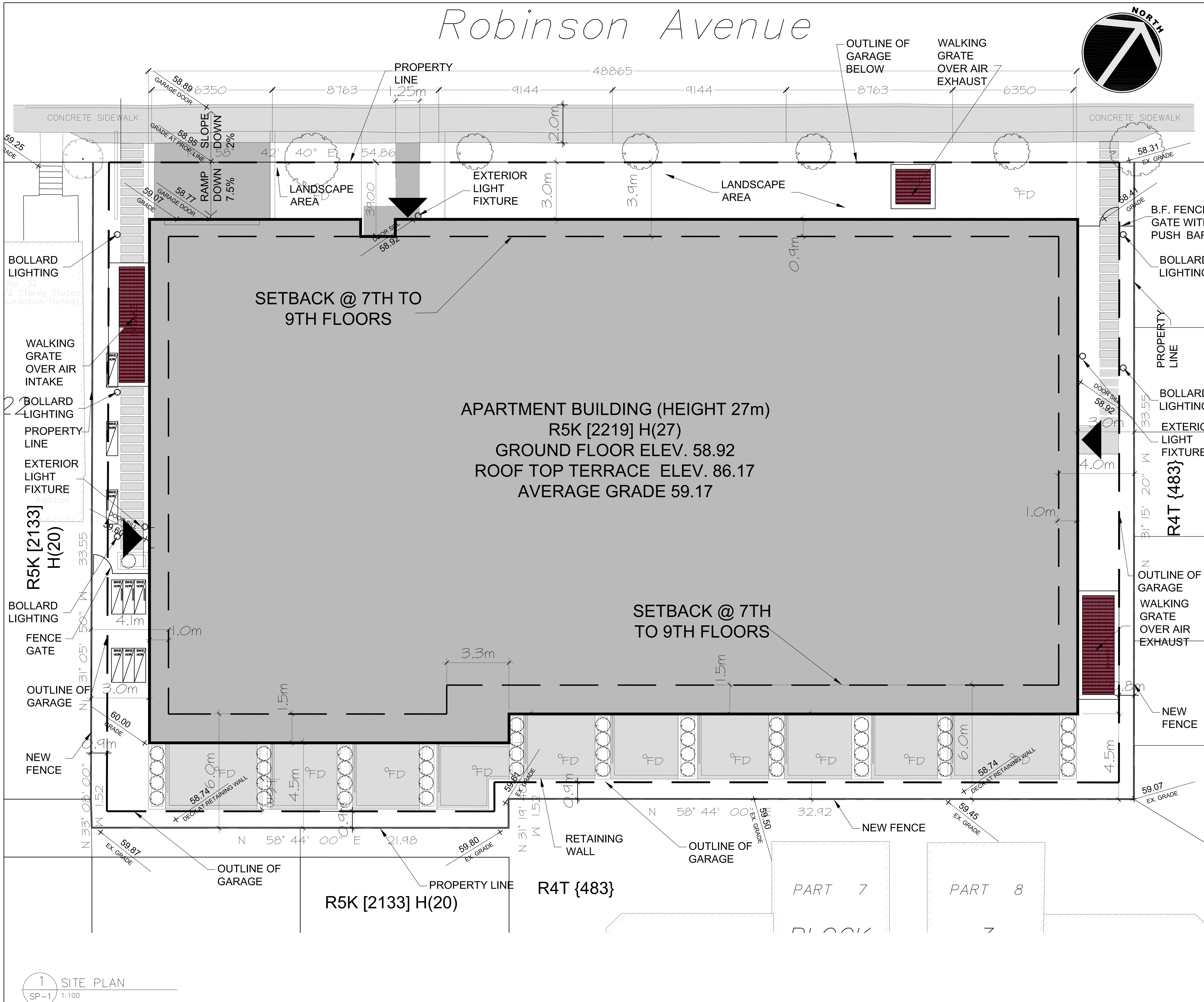
WELL DATA (BH9)

Initial Displacement: 6.4 m
Static Water Column Height: 12.05 m
Total Well Penetration Depth: 4.57 m
Screen Length: 4.57 m
Casing Radius: 0.0254 m
Well Radius: 0.1016 m
Gravel Pack Porosity: 0.32

Table 1 - Summary of Groundwater Level Readings (m bgs)										
	BH1	**BH2**	**BH3**	**BH4**	**BH5**	**BH6**	**BH7**	**BH8**	**BH9**	**Measured By**
Screen	Overburden	Overburden	Overburden	Overburden	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	
January 25, 2019	2.9	1.9	3	2.6	2.6	--	--	--	--	Others
February 1, 2019	--	--	--	3.1	2.8	--	--	--	--	Others
November 29, 2019	2.6	1.3	2.3	1	--	--	3.6	3.4		Others
December 13, 2019	2.8	1.5	2.5	1.2	--	--	4.6	3.4	4.7	Others
June 3, 2020	2.9	3.11	2.8	1.8	--	--	4.3	--	4.3	Paterson Group

APPENDIX 4

Hobin Architecture Inc. - Plan/Profile Drawings



1 SITE PLAN
SP-1 1:100

SITE DATA

SITE STATISTICS

GROSS FLOOR AREA 11,367m²

LOT COVERAGE	
TOTAL LOT AREA:	1,875m²
TOTAL GROSS BUILDING AREA:	1,299m²
TOTAL LOT COVERAGE	69%
TOTAL HARD LANDSCAPING AREA:	348m²
TOTAL LOT COVERAGE	18%
DRIVEWAY NOT INCLUDED	
TOTAL SOFT LANDSCAPING AREA:	246m²
TOTAL LOT COVERAGE	13%

PARKING (PARKING PROVISIONS 2008-250 SECTION 100-114)

USE	REQUIRED	PROVIDED
MID-RISE APT. UNITS 153	(153-12)x.5=71 Parking Space / Dwelling Unit	Parking 71
Visitor Parking PARKING SPACES	(153-12)x.1=14 Visitor Parking Spaces/Dwelling **Total Required= 85**	Visitor Parking 14 **Total Provided = 87 (35 Reduced, 52 Standard Dimensions)**
BICYCLE PARKING	REQUIRED 0.5 x 153 UNITS = 77 SPACES	PROVIDED 77 SPACES PROVIDED 51 HORIZ. & 17 VERT. SPACES 9 OUTDOOR SPACES 77 SPACES TOTAL

SOLID WASTE STORAGE & DISPOSAL

APARTMENT REQUIRED:		APARTMENT PROVIDED:	
GARBAGE STORAGE COMPACTED	- 5x4 yd.	GARBAGE STORAGE COMPACTED	-5x4 yd.
FIBRE (PAPER) STORAGE	- 3x4 yd.	FIBRE (PAPER) STORAGE	- 3x4 yd.
G.M.P. STORAGE	- 1x3 yd.	G.M.P. STORAGE	- 1x3 yd.
GREEN WASTE STORAGE	- 4x240 L	GREEN WASTE STORAGE	- 4x240 L

SURVEY INFORMATION

PLAN OF SURVEY OF PART OF LANE (ADJACENT TO LOTS 15, 16, 18, 19, 21 AND 22) REGISTERED PLAN 190 CITY OF OTTAWA

GRAPHIC SCALE

1 : 100

1m 2m 3m 4m 5m 10m

SITE STATISTICS

PLANNED UNIT DEVELOPMENT ZONING MECHANISM

ZONING: R5K [2219] H(27)

DWELLING TYPE: MID RISE APARTMENT (153 UNITS)	REQUIRED	PROPOSED
MIN. WIDTH OF PRIVATE DRIVEWAY MIN. WIDTH OF DRIVE AISLE WIDTH	6.0m 6.0m	6.0m 6.0m
SETBACKS (AS PER ZONING MAP) FRONT YARD - NORTH INTERIOR SIDE YARD - EAST INTERIOR SIDE YARD - WEST REAR YARD - SOUTH	STOREY SETBACK REQUIRED 1 to 6 / 7 to 9 3.0m 4.0m 3.0m 4.0m 3.0m 4.0m 4.5m 6.0m	STOREY SETBACK PROVIDED 1 to 6 / 7 to 9 3.0m 4.0m 3.0m 4.0m 3.0m 4.0m 4.5m 6.0m
MIN. LOT WIDTH MIN. LOT AREA MAX. BUILDING HEIGHT MAX. FLOOR SPACE INDEX	15.0m 450m² 27m 2.0	54.83m 1,875m² 27m 1.48m
MIN. PERCENTAGE OF LANDSCAPED AREAS ABUTTING A STREET (m) OTHER CASES (m)	30% NO MIN. NO MIN.	31.68% NO MIN. NO MIN.
MIN. TOTAL AMENITY AREA (m²) APARTMENT OF 9 STOREYS AND 153 UNITS	6m² PER DWELLING 918m²	1,186m²
MIN. COMMUNAL AMENITY AREA (m²)	50% OF THE REQUIRED TOTAL AMENITY COMMUNAL	776.26m²
PERMITTED PROJECTIONS PROVISIONS IN THE CASE OF ANY YARDS	1.5m BUT NO CLOSER THAN 1m TO LOT LINE	1.5m BUT NO CLOSER THAN 1m TO LOT LINE
DRIVEWAY SLOPE FIRST 6 METRES DUE TO SLOPE GREATER AND 6% DRIVEWAY WILL NEED TO BE HEATED.	MAX 6%	7.5%

CONSULTANTS

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HOBIN ARCHITECTURE INC.
63 PAMILLA STREET,
OTTAWA, ON K1S 3K7

CONTACT:
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FAX. 613-265-2005

TRAFFIC PLANNING
CGH TRANSPORTATION
OTTAWA, ON

CONTACT:
ANDREW HARTE
TEL. 613-697-3797
EMAIL:
ANDREW.HARTE@CGHTRANSPORTATION.COM

GEOTECHNICAL
GHD.
179 COLONNADE ROAD #400,
OTTAWA, ON K2E 7J4

CONTACT:
BAHAREH VAZHBAKHT
TEL. 613-727-051

GEOTECHNICAL
PATERSON GROUP INC.
154 COLONNADE ROAD
OTTAWA, ON K2E 7J5

CONTACT:
CARLOS DASILVA
TEL. 613-226-7381

LANDSCAPE ARCHITECT
JAMES B. LENNOX & ASSOCIATES INC.
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OTTAWA, ON K1Z 7L6

CONTACT:
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DSEL
120 IBER RD, STITTSVILLE,
ON K2S 1E9

CONTACT:
STEVE MERRICK
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URBAN PLANNING
FOTENN
223 MCLEOD ST
OTTAWA, ON K2P 0Z8

CONTACT:
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SURVEYOR
ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 CONCOURSE GATE, SUITE 500
OTTAWA, ON K2E 7S6

CONTACT:
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TEL. 613-727-0850
FAX. 613-727-1079

SOUND & WIND
GRADIENT WIND ENGINEERING INC..
127 WALGREEN RD, CARP, ON K0A 1L0

CONTACT:
Joshua Foster
613-836-0934

no.	date	revision
17	20/04/24	REV. FOR SITE PLAN CONTROL
16	20/01/30	ISSUED FOR FOUNDATION PERMIT
15	20/01/28	REV. FOR SITE PLAN CONTROL
14	20/01/27	REV. FOR SITE PLAN CONTROL
13	19/12/16	REV. FOR SITE PLAN CONTROL
12	19/11/25	REV. FOR SITE PLAN CONTROL
11	19/11/22	ISSUED FOR REVIEW
10	19/11/15	REV. FOR SITE PLAN CONTROL
9	19/10/23	REV. FOR SITE PLAN CONTROL
8	19/08/12	REV. FOR SITE PLAN CONTROL
7	19/07/30	REV. FOR SITE PLAN CONTROL
6	19/03/07	ISSUED FOR SITE PLAN CONTROL
5	19/03/05	ISSUED FOR CONSULTANT REVIEW
4	19/02/28	ISSUED FOR CONSULTANT REVIEW
3	19/02/26	ISSUED FOR CONSULTANT REVIEW
2	19/02/25	ISSUED FOR CONSULTANT REVIEW
1	19/01/30	ISSUED FOR CONSULTANT REVIEW

It is the responsibility of the appropriate contractor to check and verify all dimensions on site and report all errors and/or omissions to the architect.

All contractors must comply with all pertinent codes and by-laws.

Do not scale drawings.

This drawing may not be used for construction until signed.

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hobinarc.com
HOBIN ARCHITECTURE

project title
ROBINSON VILLAGE APARTMENT BUILDING
36 ROBINSON AVENUE
OTTAWA, ONTARIO

drawing title
SITE PLAN

drawn	date	scale
KG	JAN, 10/2019	1:100

ONTARIO ASSOCIATION OF ARCHITECTS
BARRY J. HOBIN
LICENCE
3049

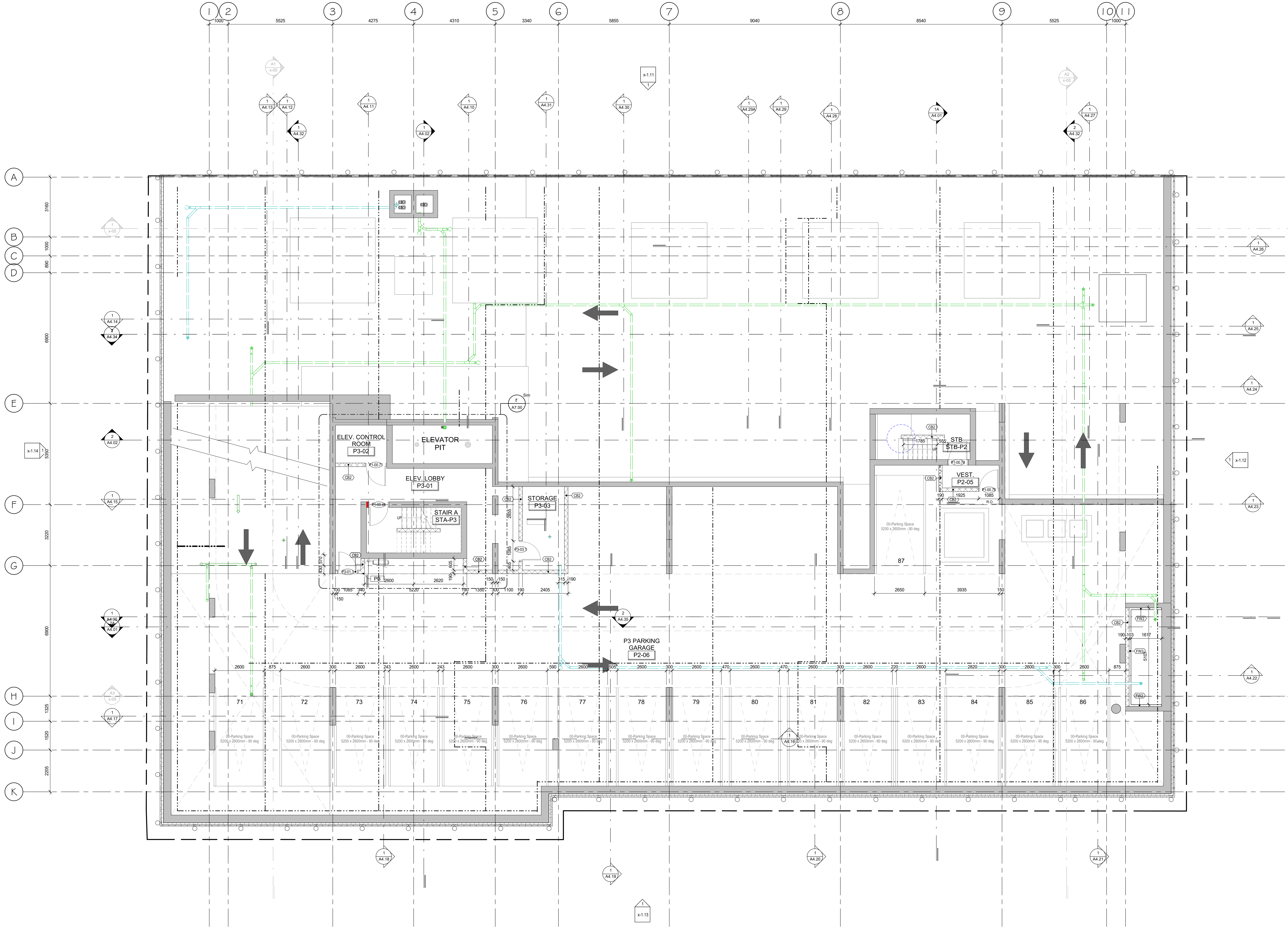
project
1834

drawing no.
SP-1

revision no.

D07-12-19-0044

17908



2 A2.01 0.3-BASEMETN-LEVEL-P3 Top Level
SCALE: 1 : 75

no.	date	revision
B	20.01.31	ISSUED FOR EXCAVATION & FOUNDATION PERMIT
A	19.11.22	ISSUED FOR REVIEW

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PROJECT
36 ROBINSON AVENUE

36 ROBINSON AVENUE

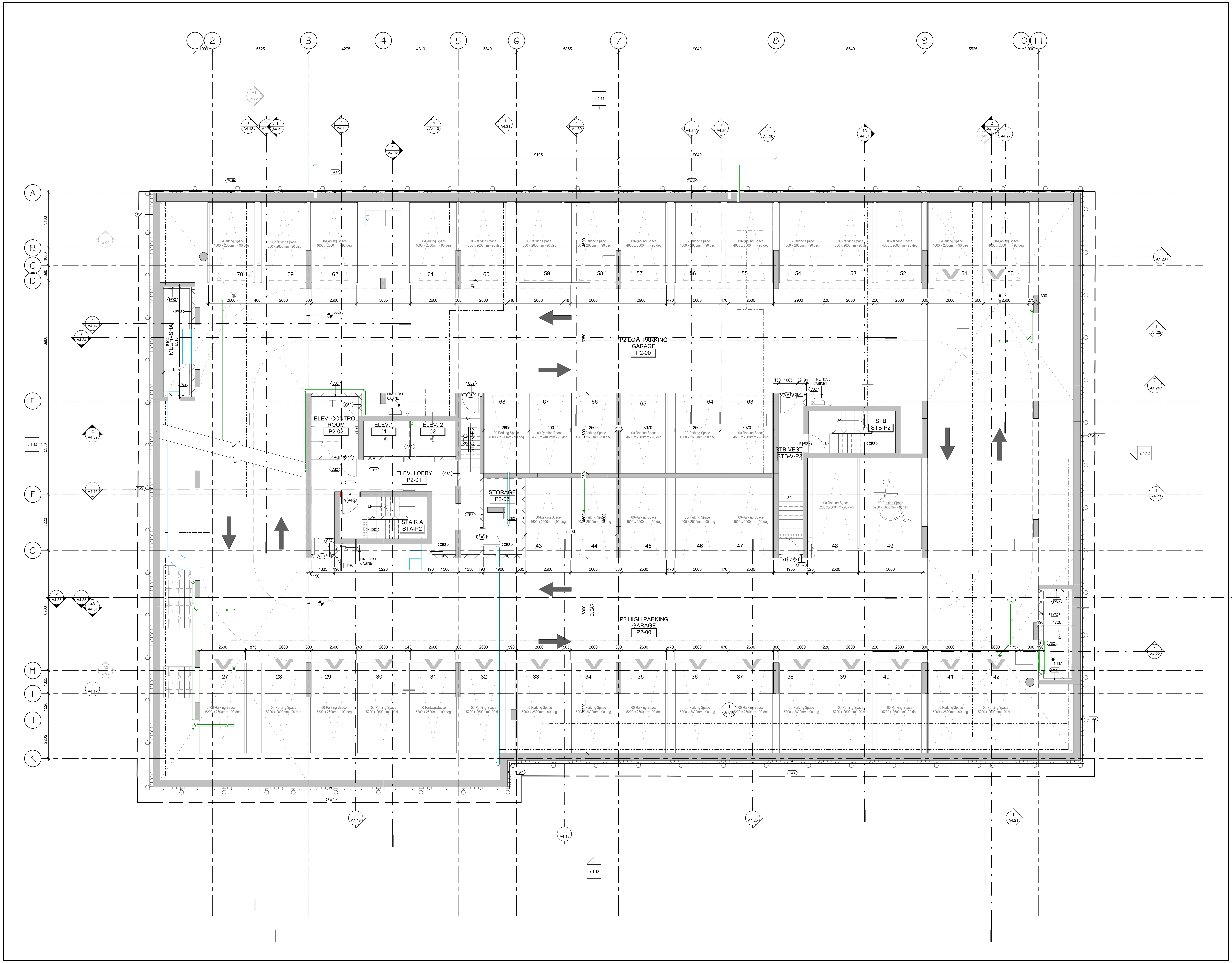
DRAWING TITLE
LEVEL P3 PARKING

DRAWN	DATE	SCALE
Author	11/21/19	1 : 75

PROJECT a4.29B

DRAWING NO.
A2.01

REVISION NO. B



no.	date	revision
C	20.03.12	REVISED FOR ZONING
B	20.01.31	ISSUED FOR EXCAVATION & FOUNDATION PERMIT
A	19.11.22	ISSUED FOR REVIEW

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PROJECT
36 ROBINSON AVENUE

36 ROBINSON AVENUE

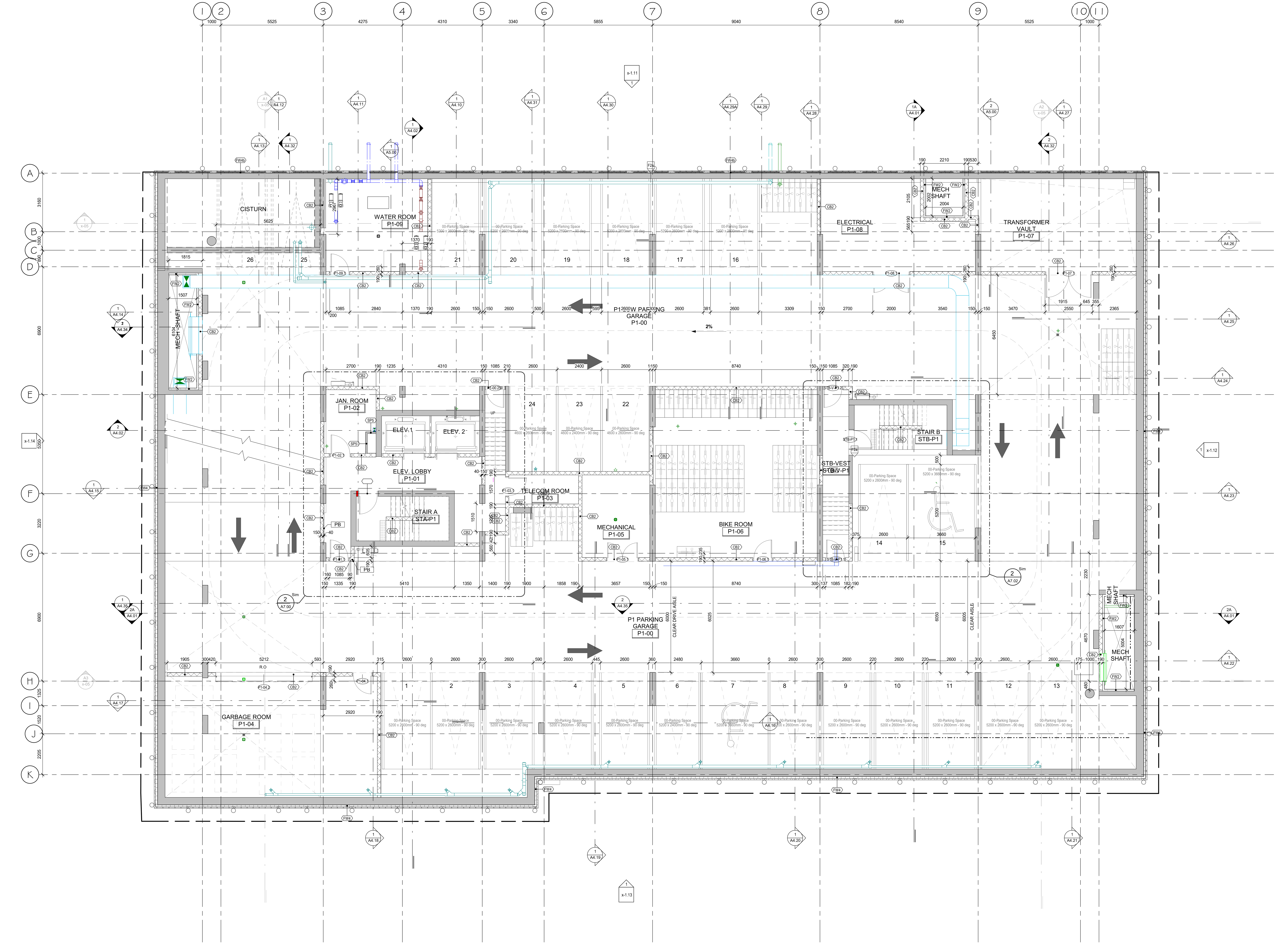
DRAWING TITLE
LEVEL P2 - PARKING

DRAWN	DATE	SCALE
Author	XX/XX/XXXX	1 : 75

PROJECT a4.29B

DRAWING NO. A2.02

REVISION NO. C



1 LEVEL P1 PARKING
A2.03 SCALE: 1 : 75

no.	date	revision
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A	19.11.22	ISSUED FOR REVIEW

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HOBIN ARCHITECTURE

PROJECT
36 ROBINSON AVENUE

36 ROBINSON AVENUE

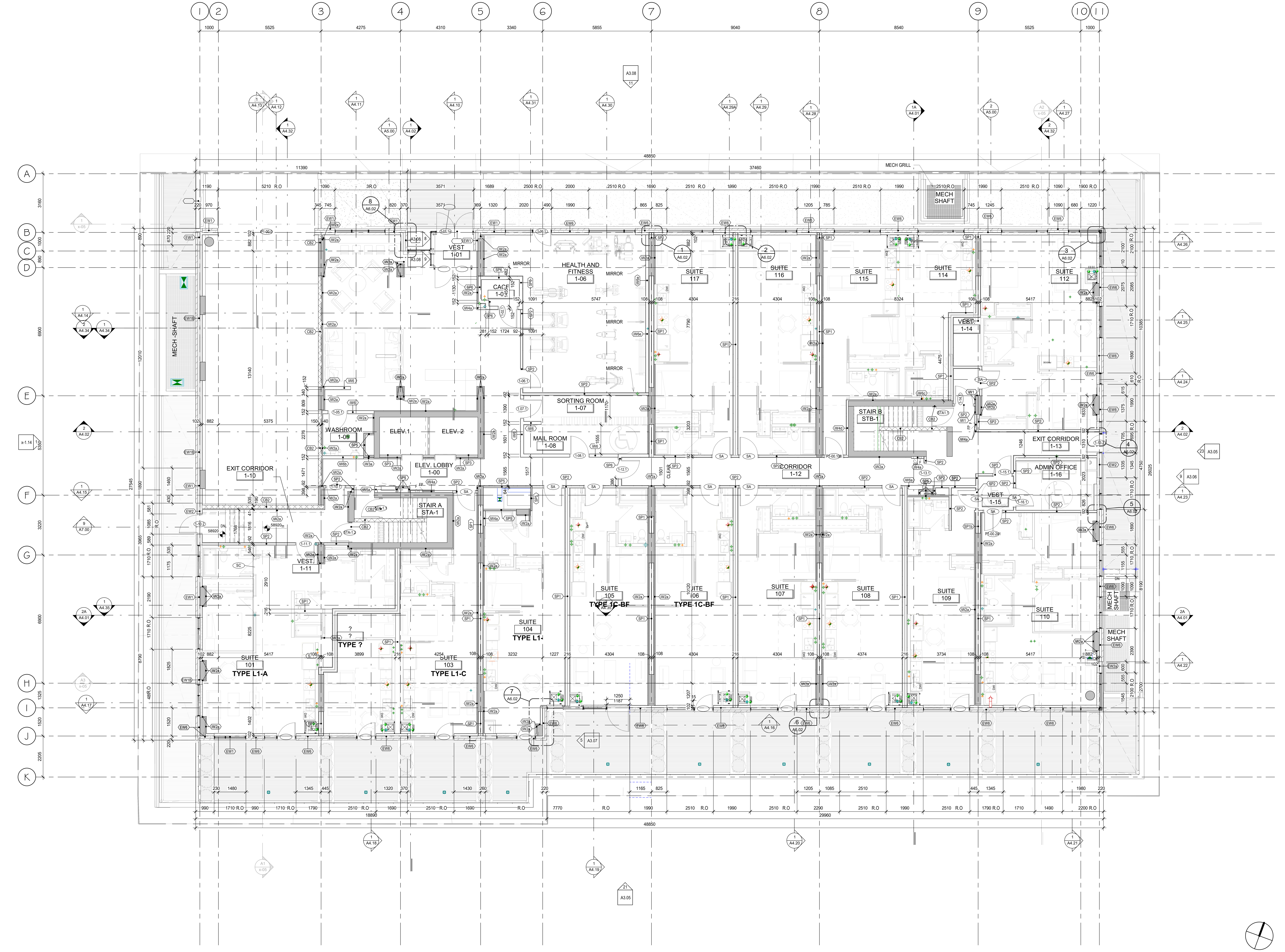
DRAWING TITLE
LEVEL P1 - PARKING

DRAWN	DATE	SCALE
Author	06/13/19	1 : 75

PROJECT
a4.29B

DRAWING NO.
A2.03

REVISION NO. B



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A2.04
LEVEL 1 PLAN
SCALE: 1 : 75

no.	date	revision
B	20.01.31	ISSUED FOR EXCAVATION & FOUNDATION PERMIT
A	19.11.22	ISSUED FOR REVIEW

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HOBIN ARCHITECTURE

PROJECT
36 ROBINSON AVENUE
36 ROBINSON AVENUE

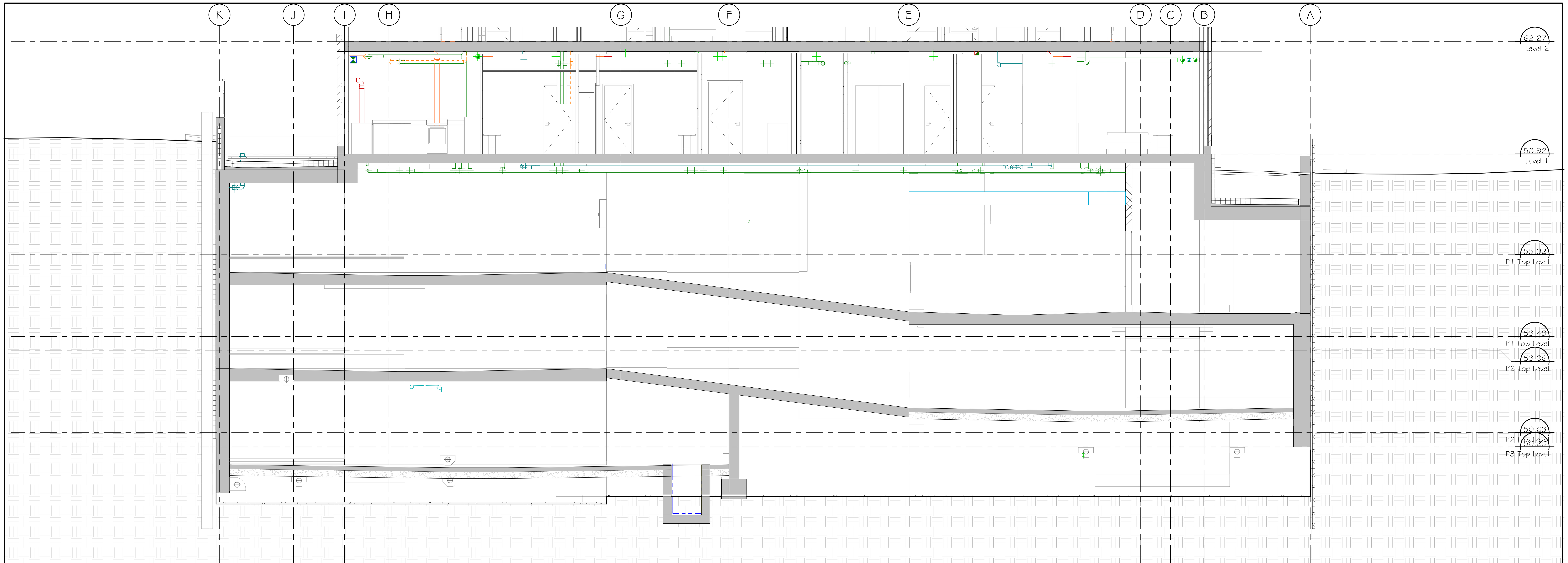
DRAWING TITLE
FLOOR PLAN - LEVEL 1

DRAWN	DATE	SCALE
Author	XX/XX/XXXX	1 : 75

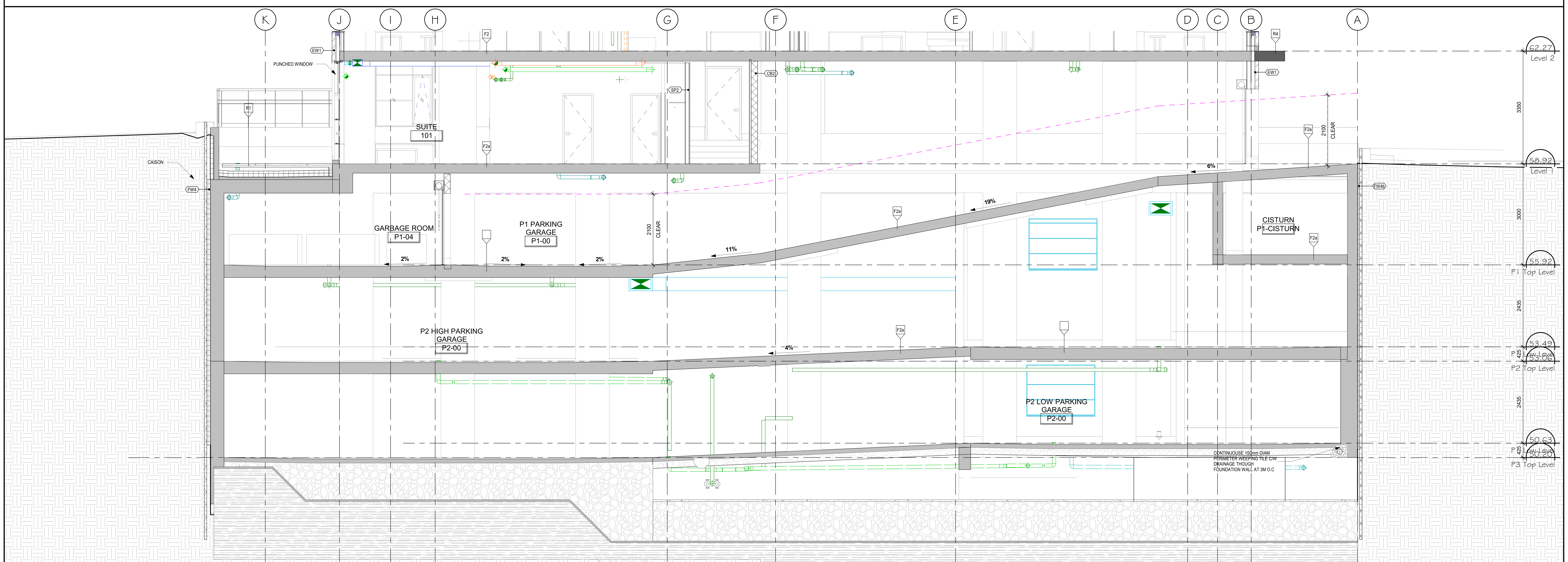
PROJECT
a4.29B

DRAWING NO.
A2.04

REVISION NO. B



2 OVERALL SECTION AT GARAGE ENTRANCE RAMP
A4.32 SCALE: 1 : 50



1 OVERALL SECTION AT GARAGE ENTRANCE RAMP
A4.32 SCALE: 1 : 50

no.	date	revision
A	20.01.31	ISSUED FOR EXCAVATION & FOUNDATION PERMIT

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HOBIN ARCHITECTURE

PROJECT
36 ROBINSON AVENUE
36 ROBINSON AVENUE

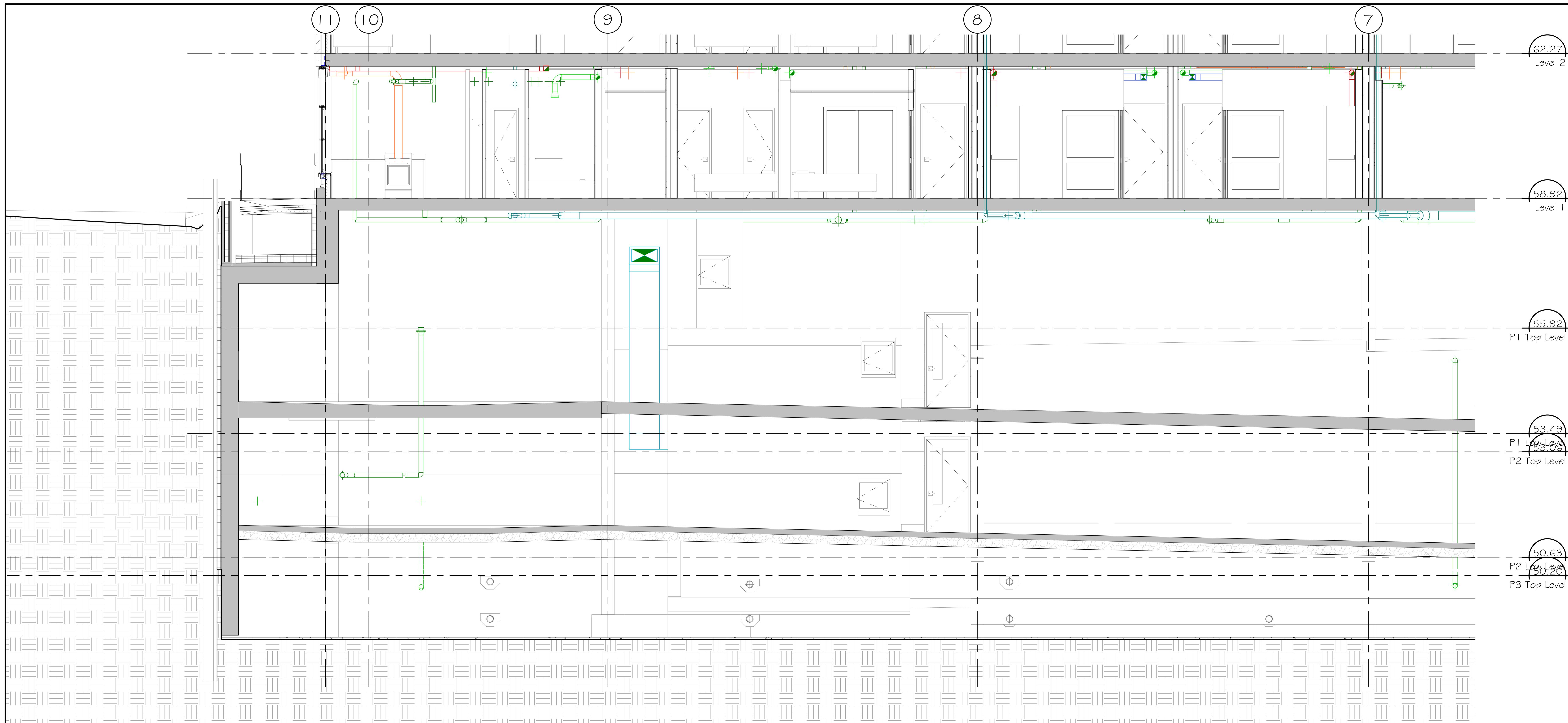
DRAWING TITLE
SECTION THROUGH GARAGE RAMP N-S

DRAWN	DATE	SCALE
Author	12/02/19	1 : 50

PROJECT a4.29B

DRAWING NO. A4.32

REVISION NO. A



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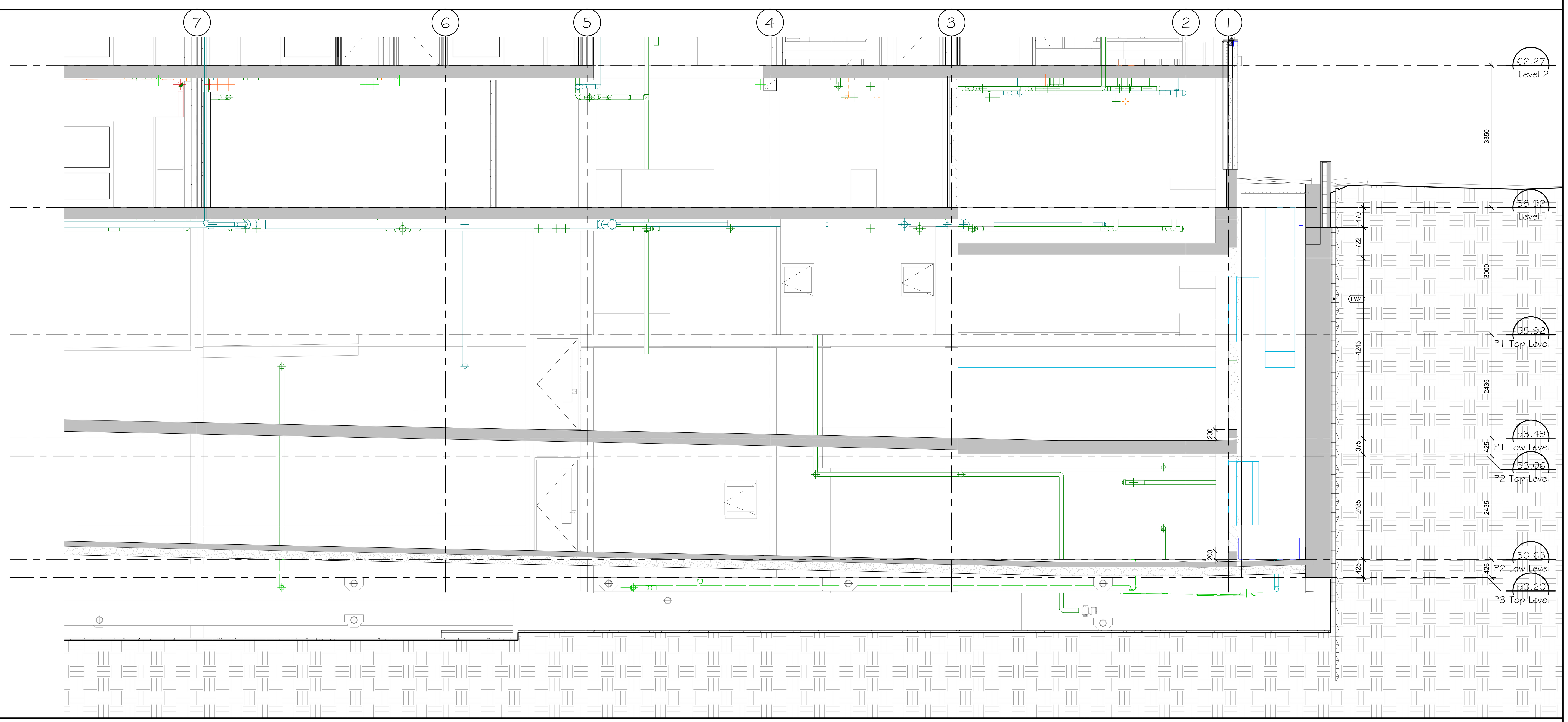
SCALE: 1 : 50



1 A4.34 OVERALL SECTION AT GARAGE ENTRANCE RAMP

SCALE: 1 : 50

no.	date	revision

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All contractors must comply with all

Do not scale drawings.

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PROJECT
36 ROBINSON AVENUE
36 ROBINSON AVENUE

DRAWING TITLE
SECTION THROUGH GARAGE RAMP E-W

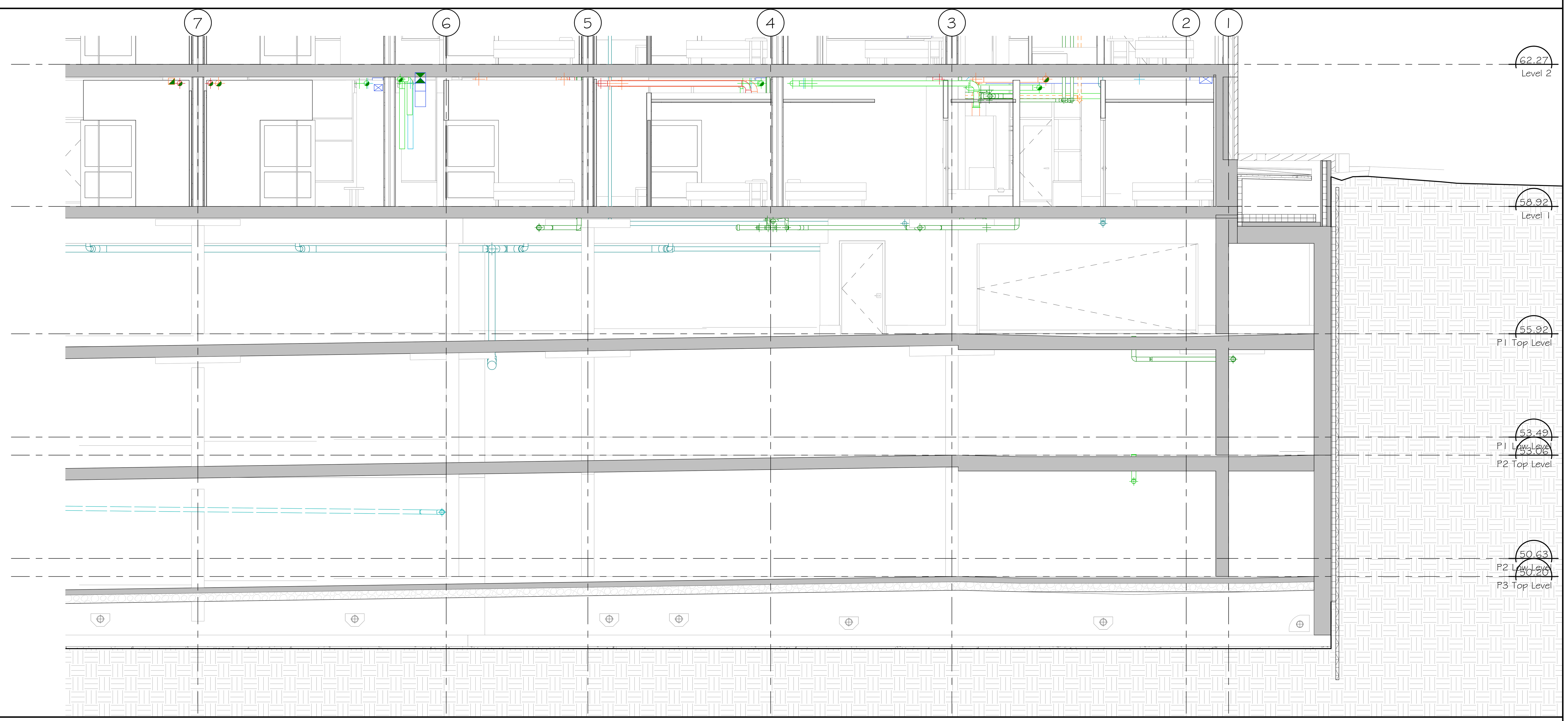
DRAWN	DATE	SCALE
Author	04/15/20	1 : 50

PROJECT a4.29B

DRAWING NO. A4.34

REVISION NO.

2 A4.35 OVERALL SECTION AT GARAGE ENTRANCE RAMP
SCALE: 1 : 50



1 A4.35 OVERALL SECTION AT GARAGE ENTRANCE RAMP
SCALE: 1 : 50

no.	date	revision

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PROJECT
36 ROBINSON AVENUE
36 ROBINSON AVENUE

DRAWING TITLE
SECTION THROUGH GARAGE RAMP E-W

DRAWN	DATE	SCALE
Author	04/15/20	1 : 50

PROJECT a4.29B

DRAWING NO. A4.35

REVISION NO.

APPENDIX 5

City of Ottawa - Sewer Use Program - Best Management Practices

DEWATERING UNCONTAMINATED WATER FROM CONSTRUCTION ACTIVITIES TO THE STORM SEWER

For information and assistant please direct all correspondence to Compliance Officer, Sewer Use Program 800 Green Creek Drive Ottawa ON K1J 1A6; or faxed to 613-745-9197; or scanned and emailed to SUP-PUE@ottawa.ca. Should you have any questions, please call the Sewer Use Program Duty Officer at 613-580-2424 extension 23326.

HOW TO KEEP SEDIMENTS AND POLLUTANTS OUT OF THE STORM DRAINS AND SANITARY SEWERS, AND PROTECT FISH HABITAT

Dewatering activities can occur at construction sites, during in-ground utilities maintenance, and site investigations/ assessments and cleanup. Depending on soil types and site history, stormwater and groundwater pumped from these sites may be contaminated with toxics (such as oil or solvents) and /or laden with sediments.

Discharging any water containing sediments or contaminants into a street, gutter, storm drain, or creek can pollute water, contaminate sediments and harm fish habitat. Some pollutants can also interfere with the operation of the Robert O. Pickard Environmental Centre- the City of Ottawa's wastewater treatment plant.

If sediments or contaminants from your job site enter a catch basin or storm drain system, you have violated the City of Ottawa's Sewer Use By-law (2003-514), as well as provincial and federal regulations. Offenders could be subject to fines and cleanup costs.

However, provided certain conditions are met, sites may dewater certain projects to the storm sewer under certain conditions.

TYPICAL PROJECTS THAT REQUIRE DEWATERING:

- Site Investigation/Assessment
- Construction, both large and small sites
- Foundation work
- Utilities infrastructure installation and repair
  - ✓ Electrical conduits
  - ✓ Vaults
  - ✓ Sewer line and storm drain maintenance
  - ✓ Phone lines and cable TV installation / repair
  - ✓ Tank removal

NOTE: Contaminated or impacted sites that involve Groundwater Remediation are not considered to be "dewatering" projects. The discharge of Remediated Groundwater to the storm sewer system is prohibited by the Sewer Use by-law. For more information on how to discharge remediated groundwater to the City's sewage works, contact the Sewer Use Program Duty Officer.

WHAT TO DO IF GROUNDWATER OR IMPOUNDED STORMWATER HAS SEDIMENTS BUT NO TOXICS ARE PRESENT

Sediments
can clog storm drains, sewer lines, and smother aquatic life

HOW DO YOU DEWATER A SITE WHERE NO CONTAMINATION IS PRESENT IN THE GROUNDWATER OR IMPOUNDED STORMWATER?

ASK YOURSELF THIS QUESTION:

Is the water clear?

YES

If yes, you may be able to pump to the ground, street or storm drain. Check with the Sewer Use Program to see if you will need authorization.

NO

You may be allowed to discharge on the ground, providing no runoff occurs.

NO

For discharge to a storm or sanitary sewer, the solids in the water must be filtered or settled out. Some combination of the options shown on the next two pages may solve the problem.

Depending on the quality of the water after filtering or settling, you may be allowed to pump to the storm or sanitary sewer. The Sewer Use Program will work with you to determine which option is most appropriate.

Solids Disposal

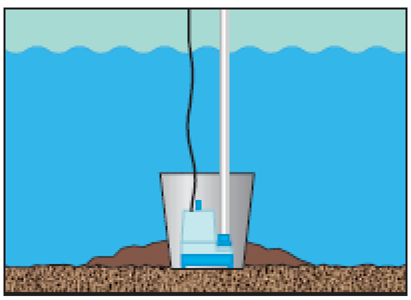
Return settled or filtered solids to the ground, or dry the solids and dispose of them as fill or solid waste.

REMOVING SEDIMENTS FROM GROUNDWATER OR IMPOUNDED STORMWATER

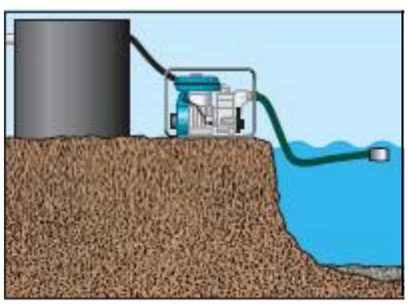
In general, you will need to follow two steps – **1)** source control; **2)** filtration – to remove sediments from groundwater or impounded stormwater before you pump it off your site. Source control measures should be used before filtration. Use a combination of approaches described below for the best results. These are just some of the Best Management Practices available.

Remember to check sediment removal devices frequently to make sure they are unclogged and operating correctly. You may need to make adjustments depending on the amount of sediment in the water you're pumping.

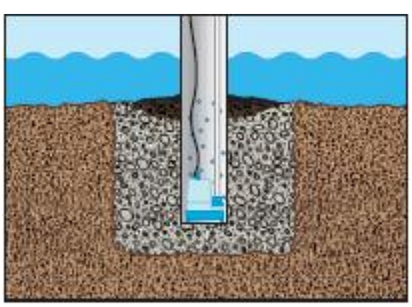
Step 1: Control sediment loading before pumping



Using a submersible pump, pump from a bucket placed below the water level.



Place the end of the suction pipe on a float or similar device to draw off the top. Pump to a tank with sampling port(s).



Dig a small pit and fill with fine gravel. Pump through a perforated pipe sunk partway into the gravel.

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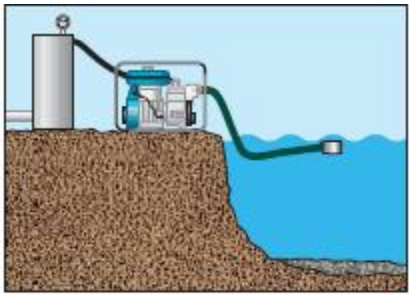
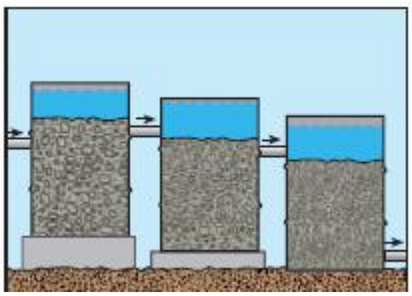
Step 2: (if necessary) Filter before final discharge

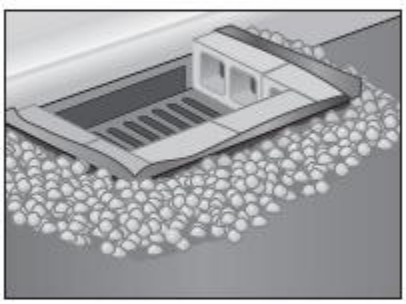
Options:



Pump through a filtering device such as a swimming pool filter with the end of the suction pipe on a float or similar device.

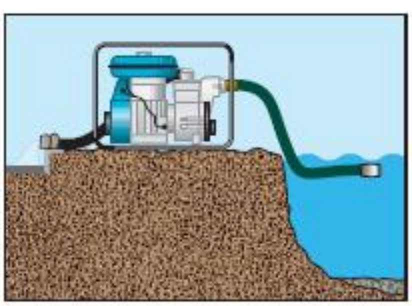


Direct water through a series of drums filled with successively finer gravel and sand.



Although not a preferred option, place filter fabric around the storm drain and anchor in place under the grate.

Surround the storm drain with concrete blocks and wrap the fabric around the outside of the blocks. Hold the fabric in place with crushed rock to complete the filtering dam.
This method is best used in conjunction with other options.



Wrap the end of the suction pipe with filter fabric and use a float or similar device to draw off the surface.

Another way to remove low levels of sediment is to discharge stormwater to a properly designed stormwater treatment facility for the type of discharge. This can include vegetated swales and/or structural devices.