Prepared for:

Arcadis

Block 6 Stormwater Management: SWM Facility Design Memo

Design Brief prepared by:

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1 Introduction

Aquafor Beech was retained by Arcadis on behalf of Rohit Homes to complete the design of subsurface Water Quantity Control Detention Chamber and an Infiltration-based Stormwater Management (SWM) facility in support of the development at Block 6 of the Wateridge Development, located in Ottawa. The facilities are to serve as an integral part of the site's ability to achieve the water balance and quantity control targets in accordance with the City of Ottawa Low Impact Development (LID) Technical Guidance Report (February, 2021) and the Former CFB Rockcliffe Master Servicing Study (MSS) (August 2015).

The site, Block 6, is encompassed by Rue Oshedinaa Street to the East and Rue Kijigong Street to the South, and future development lands to the west. The site is currently vacant and located on the former CFB Rockcliffe air base site. The surrounding roads and underground services for the site have not yet been fully constructed. The proposed site is scheduled for a low-rise mixed use residential development.

The proposed development block consists of two four-storey residential buildings, Building B and Building C, including one level of underground parkade with access from Rue Kijigong Street. The site also features a surface parking lot, servicing both residential buildings, with access from the laneway connected to Rue Oshedinaa Street.

2 Background Information

A review of both existing site conditions and relevant design standards was completed to support the development of the two subsurface SWM facilities. The following subsections outline relevant information from both review exercises.

2.1 Relevant Design Standards

The following design standards were referenced in the design development process for the proposed Infiltration facility:

1. City of Ottawa Sewer Design Guidelines (Second Edition, October 2012)
2. Stormwater Management Planning and Design Manual (Ministry of Environment, Conservation, and Parks, March 2003)
3. City of Ottawa Low Impact Development (LID) Technical Guidance Report: Implementation in Areas with Potential Hydrogeological Constraints (February, 2021)
4. Low Impact Development Stormwater Management Guidance Manual – Draft for Consultation (Ministry of Environment, Conservation, and Parks, January 2022)
5. Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide – Version 1.0 (Toronto Region Conservation Authority, 2016)

2.2 Subsurface Conditions

A geotechnical investigation was completed by Terrapex for Block 6 in January 2024 (updated October 2024) for the Block 6 development area, involving installation of seven (7) boreholes and three (3) subsequent monitoring wells on the Block 6 site. These features were used to classify subsurface soil physical and chemical properties, groundwater depth, and bedrock conditions.

In-situ infiltration testing was also completed by Terrapex at a number of test pits and holes to various depths across the site on November 16th and 20th. Field testing was completed using pre-soaked soil and

a falling head test conducted by adding water into a select soil horizon and monitoring the soil acceptance rate.

The relevant findings from both investigations in regards to design of both the Infiltration chamber and Water Quantity Control detention chamber are outlined below:

1. LID Facility Setbacks
    a. Infiltration and any other LID practices must be located on site such that a minimum horizontal setback of 4.0m is provided between the LID footprint and edge of building foundations per City of Ottawa Low Impact Development (LID) Technical Guidance Report (February, 2021).

2. Bedrock and Groundwater
    a. Infiltration Chamber:
        i. Per Figure 2 – Infiltration Investigation (from Geotechnical Investigation Report by Terrapex included as Appendix A), the proposed Infiltration chamber excavation area lies between bedrock elevations of approximately 84.0 and 84.4 m. The groundwater table was measured at an elevation of 82.20 m (3.67 m below ground) at the closest installed monitoring well MW 6-6 on November 24, 2023. The relevant 1.0 m vertical clearance constraint for the design will be based on bedrock elevations as they are shallower than the observed groundwater elevations.
    b. Water Quantity Control Detention Chamber:
        i. Per Figure 2 – Infiltration Investigation (from Geotechnical Investigation Report by Terrapex included as Appendix A), the proposed Water Quantity Control Detention Chamber excavation area lies between bedrock elevations of approximately 83.3 and 83.9 m. The invert elevation of the Water Quantity Control Detention Chamber shall not be lower than the bedrock elevation for ease of construction considerations.
3. Infiltration Rate
    a. Infiltration Chamber:
        i. In-situ infiltration rates were obtained from test pits or cores dug varying depths below ground surface at INF 6-1 through INF 6-3 per the map provided in Appendix A of this memo. Infiltration rates across INF 6-1 through INF 6-3 averaged to 54 mm/hr. The design infiltration rate adopts a safety factor in accordance with the LID Stormwater Management Guidance Manual, producing an average design infiltration rate of 15.42 mm/hr.
    b. Water Quantity Control Detention Chamber:
        i. In-situ infiltration rates are not relevant to the design of the Water Quantity Control Detention Chamber due to the closed-bottom system.

3 Subsurface SWM Facility Sizing

The following subsections outline the design development process used in sizing the Subsurface SWM facilities.

3.1 SWM Design Targets

To aid in the development of the facilities, several design targets were identified from the various guidance documents outlined in Section 2.2 above. Table 1 below summarizes the design targets applied and source of information.

Table 1: Various Design Targets Applicable to the Subsurface SWM Facilities.

Design Target Category	Target Value or Range	Source
Clearance to bedrock or groundwater (Infiltration Chamber)	Minimum 1.0m	City of Ottawa LID Technical Guidance Report: Implementation in Areas with Potential Hydrogeological Constraints
Erosion Control Storage	4mm rainfall depth across entire site area	Wateridge Phase 2B LID Developer's Checklist
Water Balance Storage	4mm rainfall depth across entire site area	Wateridge Phase 2B LID Developer's Checklist
Water Quantity Control	Volume calculated via Modified Rational Method to control 100-year storm	City of Ottawa Design Standards
Release rate (Water Quantity Control Detention Chamber)	Maximum Allowable release rate of 79 L/s	Wateridge Phase 4 Design Brief (March, 2023)
Water Quality Storage	N/A	N/A
Drawdown Time (Infiltration Chamber)	48-92 hours	City of Ottawa LID Technical Guidance Report: Implementation in Areas with Potential Hydrogeological Constraints

It is noted that the Water Quality Control target constraint does not apply to Block 6 as discharge from this Block is conveyed to the existing SWM facility servicing the Wateridge development lands, which has been designed to provide quality control for its contributing drainage area through a permanent pool and extended detention storage component.

Two Stormwater Management Facilities are proposed: One Water Quantity Control Detention Chamber below the at-grade parking lot to the west of building B, and one Infiltration chamber below the available green space to the southwest of building B.

While the Infiltration chamber must hold and infiltrate the equivalent volume of 4mm of rainfall depth across the entire site area, the design will be prepared such that only runoff generated from the rooftop of building B contributes to the facility to eliminate the need to pre-treatment that is otherwise required. Additional flow exceeding the designed volume of the Infiltration chamber will overflow via an outlet catchbasin featuring a riser outlet pipe connecting to the Quantity Control detention chamber and surcharge through the outlet catchbasin grate in major storm events to drain over the surface down-grade towards the Quantity Control detention chamber.

The Water Quantity Control detention chamber must be able to store an appropriate volume of water to meet the City of Ottawa Design standards. The chamber will be fitted with an outlet catch-basin flow

control orifice to ensure a maximum release rate in accordance with the Wateridge Village Phase 4 Design Brief (2023).

3.2 Proposed Hydrologic Conditions

Intensity-duration-frequency (IDF) data was referenced from the City of Ottawa Sewer Design Guidelines, adopting rainfall intensities for the 2-year to 100-year design storm event under a 10-minute time of concentration. Given that the Infiltration chamber has been designed to only accept inflows from building B rooftop areas, the applicable catchment area was delineated based upon total rooftop area from the proposed four-storey building, with a standard impervious surface runoff coefficient of 0.9 adopted for the hydrological analysis. The Water Quantity Control Detention Chamber receives inflows from general site runoff exclusive of rooftop flows (rooftop runoff from building B and C are handled by other systems). Table 2 through Table 3 below summarize the peak design storm flows and required runoff storage volumes relevant to the design.

Table 2: Design Storm Peak Flows for the Subsurface SWM Facilities.

Return Period	Rainfall Intensity (mm/hr)	Infiltration Chamber Inflow (m^3/s)	Quantity Control Detention Chamber Inflow (m^3/s)
2-year	77.1	0.040	0.060
5-year	104.4	0.057	0.078
10-year	122.5	0.076	0.092
25-year	145.3	0.09	0.12
50-year	162.2	0.11	0.15
100-year	179	0.12	0.17

All inlet pipes to both facilities shall convey up to the 5-year design storm flows under free-flowing conditions in order to meet the minor system standard per the City of Ottawa Sewer Design Guidelines (Second Edition, October 2012). Table 3 below summarizes the specific, quantitative stormwater management targets relevant to the Block 6 site.

Table 3: Total Runoff Volume Storage Requirements for the Infiltration and Quantity Control Facilities.

SWM Category	Target Value	Required Volume (m^3)	Applicable To
Water Balance Storage	4mm rainfall depth across entire site area	46.7m^3	Infiltration facility
Erosion Control Storage	4mm rainfall depth across entire site area	46.7m^3	Infiltration facility
Water Quantity Control Storage	Volume calculated via Modified Rational Method to control 100-year storm	124 m^3	Quantity Control facility
Maximum Release Rate	Maximum Allowable release rate	79 L/s	Quantity Control facility
Drawdown Time	Maximum allowable time for facility to completely drain	48-92 hours	Infiltration facility

To achieve the Water Quantity Control and Maximum Release Rate storage and flow rate targets, the Water Quantity Control Detention Chamber was designed such that a maximum of 124 m^3 of volume is to be stored in the facility at a maximum allowable release rate of 79 L/s via a flow control orifice outlet.

Additionally, to collect the equivalent volume produced from a 4mm rainfall event across the site of 46.7m^3, the rooftop area of building B must capture and direct the runoff generated from a 24mm rainfall event. This rainfall depth is consistent with the 90th percentile rainfall event for the City of Ottawa, or a 27mm depth per the Draft Low Impact Development Stormwater Management Guidance Manual (MECP, 2022).

3.3 Stormwater Management Facilities Summary

With design targets and site constraints established, designs for the SWM facilities were developed. Both facilities consist of a plastic chamber system complete with inlet debris settling rows, inspection ports and inlet and outlet connections. The Infiltration chamber includes an open bottom stone base for infiltration of stored water below the outlet invert, whereas the Water Quantity Control Detention Chamber has a closed bottom consisting of a geotextile impermeable liner with flows being discharged exclusively through the outlet flow control device and the overflow catch basin. A summary of key design information for both facilities is provided in Table 4 below.

Table 4: Key Design Parameters of Proposed SWM Facilities.

Design Parameter	Quantity Control Facility Value	Infiltration Facility Value
Maximum Storage Volume (m^3)	137.5 m^3	52 m^3
Maximum Infiltration Volume (m^3)	N/A	52 m^3
Excavation Footprint Area (m^2)	157 m^2	102 m^2
Total Facility Depth (m)	1.51 m (Aquabox HP)	1.10 m (Aquabox Cube)
Minimum Cover (m)	0.60m	0.60m
Minimum Clearance to Bedrock from invert of Aquabox system (m)	0.15 m	1.00 m
Drawdown Time (hrs)	3.4 hrs	81 hrs
Maximum Release Rate	79.0 L/s	N/A
Orifice Diameter	100 mm	N/A
Inlet Pipe Diameter(s) (mm)	200 mm	200 mm
Outlet Pipe Diameter (mm)	250 mm	N/A
Structural Loading Capacity	HS-25 Rated	HS-25 Rated

In addition to the design information in the above table, various other design aspects were incorporated to enhance the function of the system and allow for greater ease of operation and maintenance. These additional design aspects are outlined and described below:

1. Overflow bypass system
    i. Infiltration chamber: One standard OPSD 705.010 catchbasin is proposed to be installed in the northwest corner of Infiltration chamber, adjacent to the proposed walking path, and features an internal riser outlet pipe which connects to the quantity control detention

chamber before releasing discharge offsite. The invert of the riser shall be set to the top of the infiltration chamber to ensure the target infiltration volume within the facility is achieved before overflow flows into the riser structure. In major storm events when the facility is full and the riser outlet cannot convey sufficient flows, overflow can exit the system via surcharging through the catchbasin grate and drain westward towards the West property line swale and drain back into the quantity control detention chamber via the inlet 2 catchbasin. Finally, a flap valve shall be installed on the downstream end of the outlet pipe connecting the infiltration chamber to the Quantity Control detention chamber. The flap gate shall be installed at the catchbasin (Inlet CB 2 per the design drawings) side wall to ensure ease of access for future maintenance.

   ii. Quantity Control Detention Chamber: One outlet catchbasin is proposed to be installed in the north-east corner of the Quantity Control facility with a connection to a proposed 250mm STM pipe outlet. This outlet catchbasin will receive a small portion of runoff from the aboveground parking lot as well as outflows from the quantity control chamber via a 250mm diameter opening on the catchbasin flush with the chamber sidewall.

2. Outlet Control Device
   i. Quantity Control Detention Chamber: In order to control outflows at or under the maximum allowable release rate, a 100 mm diameter orifice plate will be installed on the outlet pipe at the outlet catchbasin.
3. Subdrain Pipe
   i. Quantity Control Facility: A subgrade pipe is included below the Aquabox system in the base stone levelling course layer to provide an additional 100 mm of depth to the active storage by allowing water to drain from the system at elevations below the main outlet invert. The subdrain pipe will also direct flows into the outlet catchbasin.
4. Inlet Debris Row (Both facilities)
   i. An inlet debris row is included at the inlet location as part of the Aquabox chamber design such that sediment and other debris has the opportunity to settle in a small forebay area before runoff spills over the internal weir wall and into the main chamber area. The debris row concentrates sediment deposition in the system to a small area for ease of maintenance.
5. Inspection Ports (Both facilities)
   i. A combined total of seven inspection ports are proposed for the SWM facilities; five supporting the Quantity Control detention chamber and two supporting the Infiltration chamber. The inspection ports include 375 mm diameter piper risers. These ports can be used for visual inspection inside the chamber or cleanout of sediments via vac truck. One port is provided at each inlet debris row for each facility, with the remainder spread across the main storage chamber area to maximize maintenance and cleanout accessibility.

4 Operation and Maintenance Considerations

A number of operation and maintenance (O&M) practices should be considered by the site owner to ensure the infiltration chamber can maintain its as-designed function in future years. The considerations outlined in Table 5 are summarized from previous industry experience of Aquafor Beech and the TRCAs' Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide.

Table 5: Operation and Maintenance Considerations for Subsurface SWM Facilities.

Design Component	O & M Description	Frequency
Contributing Catchment	Inspect Contributing rooftop area for inlet to Infiltration chamber to ensure no significant leaf litter, sediment, leaking contaminated substances, or other garbage debris are present that may enter the system and cause partial or full blockage of the inlet.	Biannual visual inspections.
Inlet Conveyance System	Inlet should remain unobstructed to ensure runoff enters Infiltration chamber unimpeded. Visual inspection of inlet catch basins should be completed. CCTV and flushing of pipe segments should occur when pipe segments are or suspected to be clogged. Standing water within the catch basins or frequent surcharging are indicative of clogging or capacity issues within the infiltration chamber and outlet system, respectively.	Visual Inspection – biannual Flushing & CCTV – when clogging/damage suspected.
Debris Row/ Pretreatment	For effective debris row function, area should be inspected visually via the inspection port for sediment or other debris accumulation limiting storage capacity or conveyance of inlet flows into the main chamber area. Inlet flushing and vac truck cleanout of the debris row shall be adopted to remove debris and sediment when required.	Biannual visual inspections. Flushing & Vac Truck – when sediment accumulation reaches half the height of the debris row geotextile wall.
Sediment Accumulation	Applicable to Quantity Control facility: Visual inspection in dry weather to quantify sediment accumulation. Where sediment accumulation is surpassing the Aquabox base plate, CCTV, flushing and vac truck cleanout shall be adopted to remove sediment when required.	Biannual visual inspections.
Main Filter Bed Area	Applicable to Infiltration chamber: Visual inspection in dry weather to quantify sediment accumulation and inspections following storm events to monitor draw down time. Should facility draw down exceed 92 hours or sediment accumulation limit inlet/outlet function of facility, flushing and vac truck sediment removal shall be adopted.	Annual visual inspections. Flushing & Vac Truck – when drawdown exceeds 92hrs **OR** sediment accumulation impeding inlet/outlet function.
Outlet Conveyance System	Outlet should remain unobstructed to ensure discharged water leaves the site unimpeded. Visual inspection of outlet catchbasins for standing water can help identify any conveyance problems in the outlet system. Where clogging is suspected, CCTV and flushing of pipe sediments should occur.	Visual Inspection – biannual Flushing & CCTV – when clogging/damage suspected.
Emergency Overflow Outlets	Grate opening of catchbasins along inlet pipe should remain unobstructed and free of debris such that surcharge of excess runoff to the surface in major storm events can occur.	Biannual visual inspections.
Inspection Ports	As a vital component to maintenance access, inspection of the inspection ports to ensure proper function and access is maintained via the surface grates.	Biannual access function inspections.

5 Storm Sewer Outlet Bioswale Restoration

The site's storm sewer outlet connects to an existing trunk sewer on Oshedinaa Street, however must cross the boulevard bioswale along this street in order to achieve connection. The bioswale must be restored to the approved design drawing conditions of the bioswale or better. Design drawings for the appropriate Wateridge development phase can be obtained from Canada Lands Corporation (CLC), or the City of Ottawa.

The following recommendations shall be adopted by the Contractor involved in constructing the Block 6 storm sewer outlet for when crossing the bioswale:

1. Plant material shall be removed and temporarily stored on site in a planter box large enough to ensure plant placement does not exceed the density of the plantings observed within the bioswale prior to removal.
2. Biomedia material must be stored on site separately from all other excavated material to minimize risk of contamination. Use of ESC measures such as sediment logs or sediment fencing shall also be adopted should any risk of surface runoff contamination be present at the storage location.
3. The Contractor shall install a trench box immediately following removal of plant material and excavation of biomedia to ensure excavation walls remain supported and stabilized.
4. To avoid any damaging of the underdrain within the bioswale, the Contractor must provide support for the underdrain during installation of the Block 6 outlet storm sewer.

Figure 1 below shows a typical cross section of the bioswale along Oshedinaa Street.

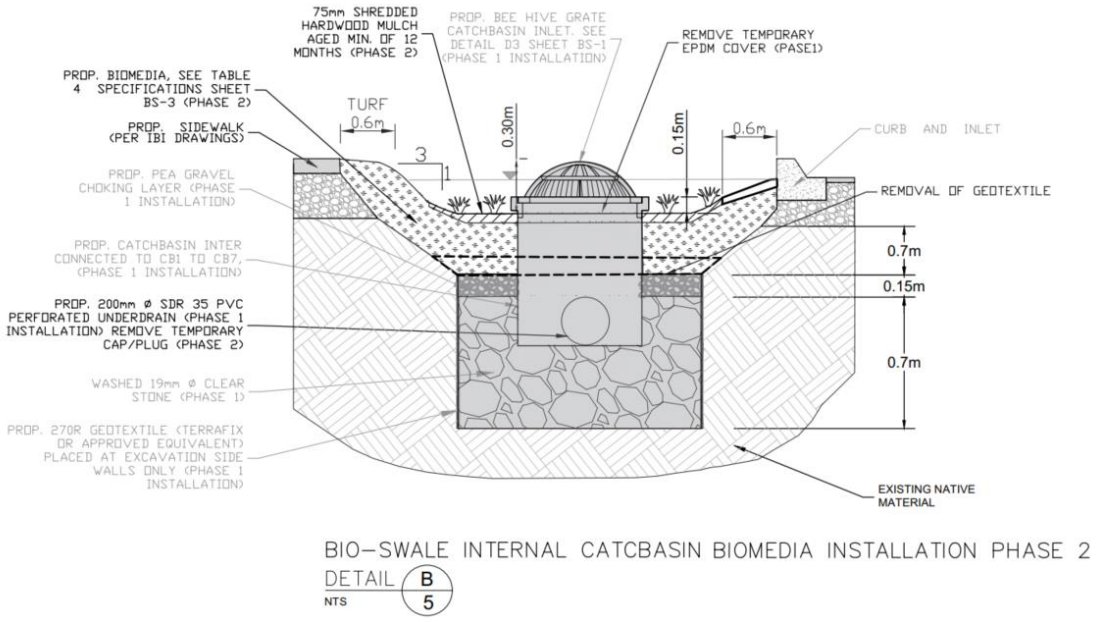

Figure 1: Phase 4 Typical Cross Section Detail for Right of Way Boulevard Bioswale.

Relevant construction tender specifications for the bioswale components are provided under Appendix B as reference for bioswale restoration following storm sewer site outlet installation.

Appendix A: Terrapex Geotechnical Investigation

ADDITIONAL GEOTECHNICAL INVESTIGATION

Wateridge Village - Phase 4, Block 6
Ottawa, Ontario

REPORT

Revision 1

October 1, 2024

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1. INTRODUCTION

Terrapex Environmental Ltd. (Terrapex) has been retained by Rohit Communities to carry out an additional geotechnical investigation for the proposed development located at 1076 Hemlock Private, Wateridge Community Phase 4 (the Site), in the City of Ottawa, Ontario. Authorization to proceed with this study was given by Mr. John Hebert of Rohit Communities.

We understand that Rohit Communities is seeking approval to develop the land at Wateridge Village referred to as Phase 4 including Block 4 with mid-rise residential apartment dwelling and, Block 5 and Block 6 with low-rise residential apartment dwelling. According to the Site Plan provided to Terrapex by Client on January 19, 2024, the Site is scheduled for a mixed-use residential development which would include the following:

- Block 4 will contain mid-rise residential apartment dwelling (Building D, six storeys with one level of underground parking garage).
- Block 5 will contain low-rise residential apartment dwelling (Building A, four storeys with one level of underground parking garage).
- Block 6 will contain two low-rise residential apartment dwellings (Building B and Building C, four storeys with one level of underground parking garage).

Geotechnical investigations have been conducted at the Site previously and the most recent geotechnical investigation report prepared by Terrapex dated February 5, 2019, with a Title of ***Geotechnical Investigation Report, Proposed Mixed-Use Development, Phase 2A & 2B, Wateridge Village, Ottawa, Ontario*** was reviewed. The relevant soil and groundwater information from this previous investigation are presented in this report.

The purpose of this investigation was to characterize the underlying soil and groundwater conditions and to provide recommendations for the detailed design of the proposed development. This report will provide findings from the geotechnical investigation and engineering recommendations for the design and construction of the proposed development at Block 6. The work carried out for Block 4 and Block 5 are reported under separate covers.

This report presents the results of the investigation performed in accordance with the general terms of reference outlined above and is intended for the guidance of the owner and the design architects or engineers only. It is assumed that the design will be in accordance with the applicable building codes and standards.

2. FIELD WORK AND LABORATORY WORK

2.1 FIELD WORK

The fieldwork for this study was carried out on November 8 to 11 and November 19, 2023. It consisted of seven (7) boreholes advanced by a drilling contractor commissioned by Terrapex

utilizing track-mounted drilling equipment. The boreholes are designated as BH/MW6-1, BH6-2, BH/MW6-3, BH6-4 to BH6-5, BH/MW6-6 and BH6-7, advanced to depths ranging from 1.1 to 4.7 m below ground (mbg). Monitoring wells were installed in BH/MW6-1, BH/MW6-3 and BH/MW6-6 for long-term monitoring of the groundwater level. Data loggers were installed in the monitoring wells for real time monitoring of the groundwater level. The location of the boreholes and monitoring wells, together with the boreholes drilled in previous investigation (BH110 and TP205) are presented in Figure 1 of Appendix A.

Standard penetration tests were carried out in the course of advancing the boreholes through the overburden soils to take representative soil samples and to measure penetration index values (N-values) to characterize the condition of the various soil materials. The number of blows of the striking hammer required to drive the split spoon sampler through 300 mm depth increments was recorded and these are presented on the logs in Appendix B as penetration index values.

Bedrock was encountered at depths of 0.7 mbg to 3.0 mbg at all borehole and monitoring well locations, except for BH110. Bedrock was cored from 2.2 mbg to 4.6 mbg in BH/MW6-1, from 1.3 mbg to 4.6 mbg in BH/MW6-3, and from 2.3 mbg to 4.6 mbg in BH/MW6-1 for monitoring well installation.

One Test Pit (TP205) was excavated during the investigation carried out in 2018 to a depth of 1.6 mbg in Block 6. One (1) borehole (BH110) was drilled within Block 6 during the investigation carried out in 2018 to a depth of 1.3 mbg.

Groundwater level observations were made during and upon completion of the borehole drilling, where applicable, as well as in the installed monitoring wells.

The location and ground surface elevation at the locations of the boreholes and monitoring wells were established utilizing a TopCon HiPer V GNSS Receiver referenced to UTM Zone 18T (NAD83) and presented in the attached Borehole Location Plan in Appendix A of this report. The information of the drilled boreholes and installed monitoring wells is summarized in Table 1.

Table 1: Summary of Borehole Information

Borehole No.	Northing (m)	Easting (m)	Ground Elevation (m)	Depth of Borehole (m)	Depth of Monitoring Well (m)
BH/MW6-1	5033727.08	450070.46	82.82	4.7	4.7
BH6-2	5033694.44	450105.97	84.19	1.2	N/A
BH/MW6-3	5033677.45	450119.58	85.70	4.6	4.6
BH6-4	5033626.16	450118.00	87.36	3.0	N/A
BH6-5	5033612.15	450146.62	87.34	3.0	N/A
BH/MW6-6	5033580.10	450125.25	85.87	4.6	4.6
BH6-7	5033564.86	450163.18	86.75	1.8	N/A
BH110	5033554	450130	86.37	1.3	N/A
TP205	5033606	450123	85.81	1.6	N/A

The fieldwork for this project was carried out under the supervision of an experienced technician from this office who laid out the positions of the boreholes in the field; arranged locates of buried

services; effected the drilling, sampling and in situ testing; observed groundwater conditions; and prepared field borehole log sheets.

2.2 GEOTECHNICAL LABORATORY TESTS

The soil samples recovered from the split spoon sampler were properly sealed, labelled and brought to Terrapex's Toronto laboratory for detailed examination. Each soil sample was examined in the laboratory for visual and textural characteristics by the Project Engineer. Moisture content determinations were carried out on all recovered soil samples. The results are plotted on the borehole logs attached in Appendix B.

Five (5) grain size analyses and two (2) Atterberg Limits tests were performed on selected soil samples. The geotechnical laboratory results are provided in Appendix C of this report as well as presented on the respective borehole logs provided in Appendix B. One combined subgrade soil sample obtained from the location of Inf 6-1 was subjected to California Bearing Ratio (CBR) test and the results are presented in Appendix F of this Report.

In addition, two (2) soil samples, BH6-5-SS2 and BH/MW6-2-SS3 were submitted to AGAT Laboratories for determination of pH and sulphate content and their potential for sulphate attack on buried concrete. The results of the tests are enclosed in Appendix E and will be discussed in Section 4.2 of this report.

2.3 INFILTRATION TESTING

Soil infiltration rate testing was carried out in unsaturated soils at locations labeled as Inf6-1 through Inf6-4, as shown in Figure 2 of Appendix A. The field tests were carried out on November 16 and November 20 of 2023. Soils were pre-soaked and then a falling head test was conducted by adding a volume of water into a select soil horizon, and monitoring the rate that it was accepted into the soil. Depending upon the target depth, the water was introduced into the select soil horizon via the screened horizon of a drive-point piezometer, or by introducing a volume of water to the soil using a Pask Permeameter instrument. An electronic sounding tape was used to measure the steady-state flow rate of gravimetrically-fed water into the unsaturated soil horizon. The results of the infiltration test are presented in Appendix D of this report and will be discussed in Section 4.1 of this report.

3. SITE AND SUBSURFACE CONDITONS

Full details of the subsurface soil and groundwater conditions at the site are given on the Borehole Log Sheets attached in Appendix B of this report. The following paragraphs present a description of the site and a commentary on the engineering properties of the various soil materials contacted in the boreholes.

It should be noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design, and therefore, should not be construed as exact planes of geological change.

3.1 SITE DESCRIPTION

The subject site is located at the former CFB Rockcliffe property in the City of Ottawa. The former CFB Rockcliffe property is approximately 310 acres; bounded by Aviation Parkway to the west, Sir George Etienne Cartier Parkway to the North, the National Research Council of Canada campus to the east, and existing residential communities and Montfort Hospital to the south. It is bounded by two bedrock escarpments at the south and north boundaries. The Rockcliffe Airport is also located in the vicinity of the site, just north of Sir George Etienne Cartier Parkway.

Our investigation was limited to Phase 4 and the work carried out for Block 6 was bounded by Kijigong Street from the south, future private driveway from the north, future private driveway from the west and future Oshedinaa Street from the east. The ground surface topography of the site is uneven. The ground surface elevations at the locations of the boreholes vary from 82.8 m to 87.3 m.

3.2 SUBSURFACE SOIL CONDITIONS

In general, the subsurface at the site consists of fill material overlying bedrock.

Fill: Fill material consisting of gravelly sand, sandy silt to silty clay was encountered at all borehole locations, extending to depths varying from 0.7 mbg to 3.0 mbg. The fill material is generally presented in a loose to very dense state (soft to hard for silty clay), with the recorded SPT “N” values varying from 2 to over 50 blows per 300 mm penetration. The moisture content of the fill material ranges between 3% and 38%.

Grain size analyses for five (5) selected soil samples and Atterberg Limits test of one (1) soil samples of the fill material was conducted and the results are presented in Appendix C of this report and summarized in Table 2:

Table 2: Grain size Analyses Results (Fill)

Borehole No.	Sample No.	Grain size Analyses Distribution (%)				Atterberg Limits Test (%)		
		Gravel	Sand	Silt	Clay	LL	PL	PI
BH/MW6-1	SS1A	9	21	27	43	N/A		
BH/MW6-1	SS1B	29	38	23	10	N/A		
BH6-4	SS1	6	8	25	61	58	30	28
BH6-5	SS2	7	7	25	61	N/A		
BH6-6	SS3	18	33	36	13	N/A		

3.3 BEDROCK CONDITIONS

Bedrock was encountered at depths of 0.7 mbg to 3.0 mbg at all borehole and monitoring well locations, except for BH110, corresponding to a geodetic elevation of 80.7 m to 85.1 m. At the location of BH/MW6-1, BH/MW6-3 and BH/MW6-6, the bedrock was proven by rock coring to a depth of 4.6 mbg. The bedrock was also proven by excavation/augering at the other borehole/test pit locations. The approximate depth and geodetic elevation of the bedrock surface at each borehole/test pit location is provided in Table 3.

Table 3: Summary of Bedrock Information

Borehole No.	Depth of Bedrock Surface (m)	Elevation of Bedrock Surface (m)	Note
BH/MW6-1	2.1	80.7	Cored
BH6-2	0.7	83.5	Augered
BH/MW6-3	1.3	84.3	Cored
BH6-4	3.0	84.4	Augered
BH6-5	2.8	84.5	Augered
BH/MW6-6	2.3	83.6	Cored
BH6-7	1.7	85.1	Augered
BH110	N/A	N/A	N/A
TP205	1.6	84.2	Excavated

The bedrock surface should not be considered accurate to better than ±0.5 m and some variations in the bedrock surface elevation across the site should be expected.

Review of available geological mapping and previous geotechnical investigations indicates that the bedrock is of the Ottawa Formation, consisting of limestone with some shale bedding and some sandstone in the basal part. In BH/MW6-1, BH/MW6-3 and BH/MW-6-6, the bedrock was cored from 2.1 m to 4.6 m, from 1.3 m to 4.6 m and from 2.3 m to 4.6 m, respectively. Total Core Recovery (TCR) achieved with the HQ double tube size core bit is 100% and the Rock Quality Designation (RQD) varied from 15% to 84%, which indicate very poor to good quality of bedrock. According to the previous investigations at the site, the rock is classified to be strong to very strong.

3.4 GROUNDWATER CONDITIONS

The groundwater table was measured in the installed monitoring wells on November 24, 2023. The groundwater table measured in the monitoring wells were at depths of 3.67 to 4.30 m, corresponding to elevations of 78.5 m to 82.2 m. The measured groundwater levels are provided in Table 4.

Table 4: Groundwater levels observed in Monitoring Wells

Borehole No.	Ground Elevation (m)	Depth of Well (m)	Date of Reading	Depth of Groundwater (mbg)	Groundwater Elevation (m)
BH/MW6-1	82.82	4.6	11/24/2023	4.3	78.52
BH/MW6-3	85.70	4.6	11/24/2023	--	--
BH/MW6-6	85.87	4.6	11/24/2023	3.67	82.2

More information of the groundwater will be provided after downloading the data from the data loggers.

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

4. SOIL INFILTRATION, CORROSIVITY AND CBR TEST RESULTS

4.1 SOIL INFILTRATION TEST RESULTS

Field-saturated hydraulic conductivity, (Kfs) was calculated from the measurements using following equation (Elrick et. al., 1989):

$$K_{fs} = \frac{C_1 Q_1}{2\pi(H_1)^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha *}\right)}$$

Where:

Kfs =Field saturated hydraulic conductivity (entrapped air present) (cm/sec)

C_1 = Shape factor

Q_1 = flow rate (cm^3/s)

H_1 = Well height (cm)

a = Well radius (cm)

α* = alpha factor (0.15 cm^{-1})

The field measurement data and analysis of the infiltration rate testing are provided in Appendix D. Based on the resulting Kfs (cm/s), the corresponding infiltration rates (mm/hr) were estimated using the covariable relationship presented in the Low Impact Development Stormwater Management Planning and Design Guide (TRCA and CVCA, 2010). A summary of the infiltration rate testing results is presented below in Table 5.

Table 5: Summary of Infiltration Tests

Location Tested	Measured Kfs (cm/s)	Measured Infiltration Rate (mm/hr)	factor of safety	Design Infiltration Rate(mm/hr)
INF6-1	8.00E-05	3.00E-04	62	2.5
INF6-2	2.00E-04	2.00E-05	36	2.5
INF-6-3	1.00E-05	4.00E-04	65	2.5

4.2 TEST RESULTS OF SOIL CORROSION POTENTIAL

Two (2) bulk soil samples collected during the investigation were submitted for corrosion potential tests. The test results are listed in Table 6 and a detail report is presented in in Appendix E of this report.

Table 6: Summary of Soil Corrosivity Tests

SAMPLE ID	PH	SULPHATE (µg/g)
BH6-5 SS2	7.88	38
BH/MW6-6 SS3	8.09	37

The pH of the tested sample indicates a moderate alkalinity. The concentration of water-soluble sulphate content of the tested samples is below the CSA Standard of 0.1% water- soluble sulphate (Table 3 of CSA A23.1/CSA A23.2, Additional Requirement for Concrete Subjected to Sulphate Attack). Special concrete mixes against sulphate attack are therefore not required for the sub-surface concrete. Kg/m^3

4.3 CALIFORNIA BEARING RATIO TEST

One (1) composite sample from the top 1.5 m of the borehole (Inf6-1) was collected at the time of Infiltration test for CBR testing. Proctor test was also performed on the same sample. The results of the test are presented in Appendix C of this report. A summary of the test results is provided in Table 7.

Table 7: Summary of CBR Test

SAMPLE ID	PENETRATION (mm)	CORRECTED STRESS (MPa, after soaking)	BEARING RATIO (%)	MOISTURE AT PENETRATION POINT (%)	MAXIMUM DRY DENSITY (Kg/m3)
INF6-1	2.5	1.10	15.94	10.03	2091
	5.0	2.45	23.79		

5. DISCUSSION AND RECOMMENDATIONS

In this section, the subsurface conditions are interpreted as relevant to the design of the proposed two four-storey building with one level of underground parking garage.

The construction methods described in this report must not be considered as being specifications or recommendations to the prospective contractors, or as being the only suitable methods. Prospective contractors should evaluate all of the factual information, obtain additional subsurface information as they might deem necessary and should select their construction methods, sequencing and equipment based on their own experience in similar ground conditions. The readers of this report are also reminded that the conditions are known only at the borehole locations and in view of the generally wide spacing of the boreholes, conditions may vary significantly between boreholes.

5.1 SITE GRADING

Based on the proposed *"Grading Plan", Sheet Number C-200, prepared by Arcadis, dated September 25, 2024, and the architectural drawings prepared by NORR Architects & Engineers*

Limited, dated September 25, 2024, provided to Terrapex by the Client, it is understood that the underground parking will cover the majority of the site, except for the south of Building C, and southwest corner of Building B. The finished grade in areas which are outside the footprint of the underground parking varies from 85.1 masl to 88.15 masl. According to the elevations surveyed at the borehole locations, the existing topographic elevation within the above area varies from 85.9 masl to 87.4 masl. As such, the proposed grade change is -0.8 m (cut) to 0.7 m (fill).

Prior to carrying out any area grading of the site, the existing fill material should be removed from both cut and fill areas. The exposed subgrade should be inspected by a qualified geotechnical engineer prior to any fill material placement. Fill material should be placed in maximum 300 mm thick lifts and compact to minimum 98% of the SPMDD of the material. If the fill material is used as an engineered fill then must be compacted to 100% of the SPMDD.

5.2 FOUNDATION DESIGN

According to the Site plan provided to Terrapex by Client (Preliminary Site Plan prepared by NORR/Rohit dated May 26, 2023), the proposed buildings on Block 6 will be developed into two low-rise residential apartment dwellings (Building B and Building C, four storeys with one level of underground parking garage). The finished floor elevation at the P1 parking for apartment building was not known to Terrapex at the time of preparing this report but can be assumed at ± 3 m below existing ground for apartment building. The foundation will be about 0.5 to 1.0 m below the finished floor.

The proposed four-storeys building with one level underground parking can be supported by spread and strip footings founded on bedrock minimum 1.0 m below the bedrock surface for a factored bearing resistance at Ultimate Limit States of 1 MPa (ULS).

Foundations designed to the specified bearing capacity stated above are expected to settle less than 25 mm total and 19 mm differential.

Where it is necessary to place footings on bedrock at different levels, the upper footing must be founded below an imaginary 1 horizontal to 1 vertical line (1H:1V in bedrock) drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

The bedrock may weather rapidly between wetting and drying cycles. In view of this, it is suggested that a lean concrete mat slab be placed immediately after the excavation is complete to keep the bedrock intact, unless the footings are cast immediately after excavating.

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

All footings exposed to seasonal freezing conditions should be provided with at least 1.8 m of earth cover or equivalent thermal insulation against frost.

5.3 CONCRETE SLAB-ON-GRADE

Based on the borehole information, the basement floor slab for apartment building is expected to be in the bedrock. The floor slab can be cast as slab-on-grade provided a 200 mm layer of clear crushed stone (19 mm maximum size) is placed between the underside of the floor slab and the exposed bedrock surface. A perimeter and underfloor drainage system will be required around the exterior basement walls.

5.4 EXCAVATION, BACKFILL AND GROUNDWATER CONTROL

Based on the borehole findings, excavation for foundations, basements, sewer trenches and utilities will be carried out through fill material consisting of sandy silt to clayey silt and bedrock. No significant groundwater issue is anticipated for the excavation and installation of the foundations. It is expected that any seepage, which occurs during wet periods, can be removed by strategically placed sump pumps.

Excavation of the soil strata is not expected to pose any difficulty and can be carried out with heavy hydraulic excavators. Bedrock excavation is anticipated across the site. According to the rock core data from the previous investigations, the bedrock generally consists of strong to very strong limestone with interbedded shale of variable bed thicknesses and depth across the site.

Bedrock excavation is expected to be carried out using line drilling and blasting, hoe ramming or both. Provision should be made in the excavation contract to include the use of these techniques for excavation in bedrock. Any blasting should be carried out in accordance with City of Ottawa Special Provision S.P. No: F-1201 and under the supervision of a blasting specialist engineer. Vibration monitoring of the blasting operation should be carried out to ensure that the blasting meets the limiting vibration criteria at all times.

The contractor should submit a complete and detailed blasting design and monitoring proposal prepared by a blasting/vibrations specialist prior to commencing blasting. This would have to be reviewed and accepted in relation to the requirements of the blasting specifications. Vibration monitoring of the blasting should be carried out to ensure that the blasting meets the limiting vibration criteria at all times. A pre-blast condition survey should be carried out of surrounding structures and utilities located within 100 m of the excavation site. The condition survey should also include the National Research Council's Montreal Road Campus located east of the subject site.

All excavations must be carried out in accordance with Occupational Health and Safety Act (OHSA). With respect to OHSA, the near surface fill material is expected to conform to Type 3 soils. The bedrock is classified as Type 1 soil.

Temporary excavations for slopes in Type 3 soil should not exceed 1.0 horizontal to 1.0 vertical. Excavations in the bedrock may be cut with vertical side-walls. In the event very loose and/or soft soils are encountered at shallow depths or within zones of persistent seepage, it will be necessary to flatten the side slopes as necessary to achieve stable conditions.

For excavations through multiple soil types, the side slope geometry is governed by the soil with the highest number designation. Excavation side-slopes should not be unduly left exposed to inclement weather. Excavation slopes consisting of sandy soils will be prone to gullying in periods of wet weather, unless the slopes are properly sheeted with tarpaulins.

Where workers must enter excavations extending deeper than 1.2 m below grade, the excavation side-walls must be suitably sloped and/or braced in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.
It should be noted that the on-site fill material may contain boulders, cobbles and remnants of former buildings in the form of buried concrete. Provisions must be made in the excavation and foundation installation contracts for the removal of possible boulders and concrete.

Based on the borehole information, the existing fill is considered unsuitable for re-use as backfill material as it contains organics and other debris. Excavated native soils free from organics can be used as general construction backfill, provided their moisture content is within 2 percent of their optimum moisture contents which will require significant aeration.

Imported granular fill, which can be compacted with hand-held equipment, should be used in confined areas.

Based on observations made during drilling of the boreholes and excavation of the test pits, close examination of the soil samples extracted from the boreholes, and groundwater measurements made in the monitoring wells, significant groundwater problems are not anticipated within the presumed excavation depths throughout the site. It is expected that any seepage from wet sand seams and perched water, which occurs during wet periods, can be removed by pumping from sumps.

5.5 LATERAL EARTH PRESSURE

The lateral earth pressures acting on basement walls may be calculated from the following expression.

$$\mathbf{P = K (\gamma h + q)}$$

Where **P** = lateral pressure in kPa acting at a depth h (m) below ground surface

K = lateral earth pressure coefficient, K = 0.40 for vertical walls in overburden and horizontal backfill; K= 0.25 for vertical walls in bedrock.

γ = unit weight of backfill (kN/m^3), a value of 19.5 kN/m^3 may be used for fill and 26.0 kN/m^3 for bedrock

q = the complete surcharge loading (kPa)

This equation assumes that free-draining backfill and positive drainage is provided to ensure that there is no hydrostatic pressure acting in conjunction with the earth pressure.

5.6 EARTHQUAKE DESIGN PARAMETERS

The 2012 Ontario Building Code (OBC) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of the Site Classification for Seismic Site Response are set out in Table 4.1.8.4.A of the 2012 OBC. The classification is based on the determination of the average shear wave velocity in the top 30 metres of the site stratigraphy, where shear wave velocity (vs) measurements have been taken. In the absence of such measurements, the classification is estimated on the basis of empirical analysis of undrained shear strength or penetration resistance. The applicable penetration resistance is that which has been corrected to a rod energy efficiency of 60% of the theoretical maximum or the (N_{60}) value.

Based on the current and previous borehole and test pit information, the subsurface stratigraphy generally comprises surficial topsoil and asphaltic concrete pavement, underlain by fill material, followed by various native soils consisting of silty sand to sand, sandy silt to silt, and clay and silt soils, underlain by limestone bedrock at shallow depths. Based on the above, the site designation for seismic analysis is estimated to be Class B according to Table 4.1.8.4.A from the quoted code.

The site specific 5% damped spectral acceleration coefficients, and the peak ground acceleration factors are provided in the 2012 Ontario Building.

5.7 PAVEMENT DESIGN

5.7.1 On-Grade Construction

Based on the existing topography of the site and the proposed grades, re-grading of the subgrade will be required. It is anticipated that the sub-grade material for the pavement will generally comprise of engineered fill.

The subgrade should be thoroughly proof-rolled and re-compacted to ensure uniformity in subgrade strength and support. Lift thicknesses should not exceed 200 mm in a loose state and the excavated site material should be compacted using heavy vibratory rollers.

The recommended pavement structures provided in Table 6 are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples. The values may need to be adjusted based on the city of Ottawa Engineering Standard. Consequently, the recommended pavement structures should be considered for preliminary design purposes only. A functional design life of eight to ten years has been used to establish the pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific traffic data and design life requirements and will

involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific data input from the client.

Table 8: Recommended Asphaltic Concrete Pavement Structure Design

Pavement Layer	Compaction Requirements	Light Duty Pavement	Heavy Duty Pavement
Surface Course	as per OPSS 310	40 mm Superpave 12.5 Level B Asphalt (PG58-34)	40 mm Superpave 12.5 Level D Asphalt (PG64-34)
Binder Course	as per OPSS 310	50 mm Superpave 19 mm Level B Asphalt (PG58-34)	100 mm Superpave 19 mm Level D Asphalt (PG64-34)
Granular Base	100% SPMDD	150 mm Granular 'A' (OPSS 1010) Pit Run or 19 mm Crusher Run Limestone	150 mm Granular 'A' (OPSS 1010) Pit Run or 19 mm Crusher Run Limestone
Granular Sub-Base	100% SPMDD	450 mm Granular 'B' Type II (OPSS 1010)	600 mm Granular 'B' Type II (OPSS 1010)

The subgrade must be compacted to at least 98% of SPMDD for at least the upper 600 mm and 95% below this level. The granular base and sub-base materials should be compacted to a minimum of 100% SPMDD.

The long-term performance of the proposed pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as practically possible when fill is placed and that the subgrade is not disturbed and weakened after it is exposed.

Control of surface water is a significant factor in achieving good pavement life. Grading adjacent to the pavement areas must be designed so that water is not allowed to pond adjacent to the outside edges of the pavement or curb. In addition, the need for adequate drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (preferably at a minimum gradient of three percent) to provide effective drainage toward subgrade drains. Continuous sub-drains are recommended to intercept excess subsurface moisture at the curb lines and catch basins. The invert of sub-drains should be maintained at least 0.3 m below subgrade level.

Additional comments on the construction of pavement areas are as follows:

- As part of the subgrade preparation, the proposed pavement areas should be stripped of vegetation, topsoil, unsuitable earth fill and other obvious objectionable material. The subgrade should be properly shaped and sloped as required, and then proof-rolled. Loose/soft or spongy subgrade areas should be sub-excavated and replaced with suitable approved material compacted to at least 98% of SPMDD.
- Where new fill is needed to increase the grade or replace disturbed portions of the subgrade, excavated inorganic soils or similar clean imported fill materials may be used, provided their moisture content is maintained within 2 % of the soil's optimum moisture content. All fill must be placed and compacted to not less than 98% of SPMDD.
- For fine-grained soils, as encountered at the site, the degree of compaction specification

alone cannot ensure distress free subgrade. Proof-rolling must be carried out and witnessed by Terrapex personnel for final recommendations of sub-base thicknesses.

- In the event that pavement construction takes place in the spring thaw, the late fall, or following periods of significant rainfall, it should be anticipated that an increase in thickness of the granular sub-base layer will be required to compensate for reduced subgrade strength.

5.7.2 Above Parking Garage Roof

The pavement above the parking garage roof slab may be comprised of a minimum of 75 mm thick layer of granular 'A' topped with asphaltic concrete having a minimum thickness of 80 mm (40 mm HL8 and 40 mm HL3). The asphaltic concrete materials should be rolled and compacted in accordance with OPSS 310 requirements.

The gradation and physical properties of HL-3 and HL-8 asphaltic concrete, and Granular 'A' shall conform to the OPSS standards.

The critical section of pavement will be at the transition between the pavement on grade and the pavement above the garage roof slab. In order to alleviate the detrimental effects of dynamic loading / settlement / pavement depression in the backfill to the rigid garage roof structure, it is recommended that an approach type slab be constructed at the entrance/exit points, by extending the granular sub-base to greater depths along the exterior garage wall.

The granular courses of the pavement should be placed in lifts not exceeding 150 mm thick and be compacted to a minimum of 100% SPMDD.

6. LIMITATIONS OF REPORT

The conclusion and recommendations in this report are based on information determined at the inspection locations. Soil and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the soil investigation. The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known to us, in our analysis certain assumptions had to be made as set out in this report. The actual conditions may, however, vary from those assumed, in which case changes and modifications may be required to our recommendations.

This report was prepared for Rohit Communities by Terrapex Environmental Ltd. The material in it reflects Terrapex Environmental Ltd. judgement in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions which the Third Party may make based on it, are the sole responsibility of such Third Parties.

We recommend, therefore, that Terrapex be retained during the final design stage to review the design drawings and to verify that they are consistent with Terrapex's recommendations, or the assumptions made in our analysis. We recommend also that Terrapex be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the test holes. In cases when these recommendations are not followed, the company's responsibility is limited to accurately interpreting the conditions encountered at the test holes, only.

The comments given in this report on potential construction problems and possible methods are intended for the guidance of the design engineer, only. The number of inspection locations may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

Respectfully submitted,

TERRAPEX ENVIRONMENTAL LTD.

Thomas Yan., P.Eng.
Senior Geotechnical Engineer

Meysam Najari, PhD
Vice President, Geotechnical Services

APPENDIX A

Borehole Location Plan

LEGEND

- PROPOSED PLAN OF SUBDIVISION
- BOREHOLE (TERRAPEX, 2023)
- MONITORING WELL (TERRAPEX, 2023)
- BOREHOLE (TERRAPEX, 2018)
- TEST PIT (TERRAPEX, 2018)

0 25 50 75
Metres

DATA SOURCE: CITY OF OTTAWA
MAP PROJECTION: NAD 1983 UTM ZONE 18N

CLIENT: CLC

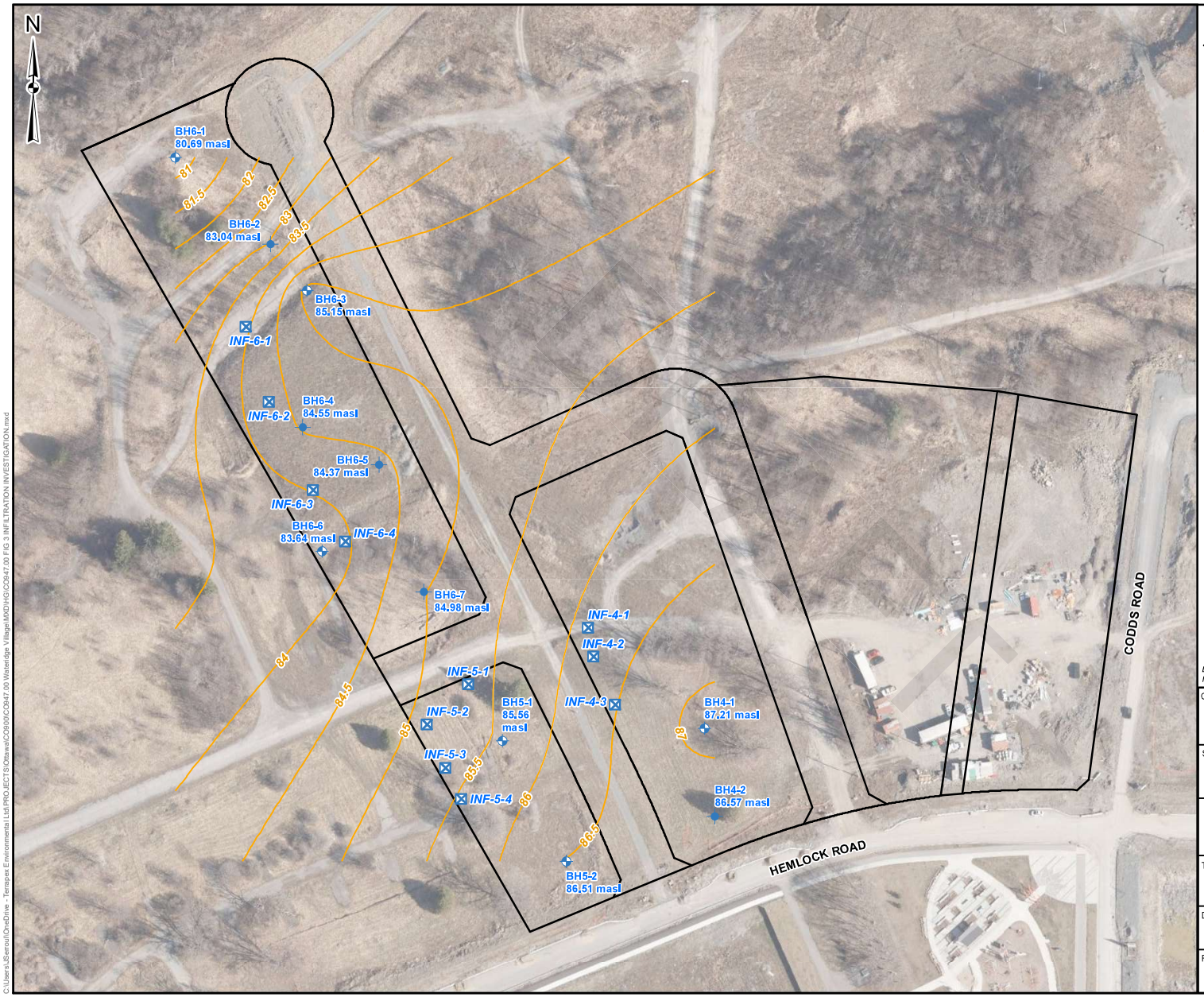
SITE LOCATION: WATERIDGE VILLAGE, OTTAWA, ONTARIO

TERRAPEX

TITLE: **GENERAL SITE LAYOUT**

DRAWN BY:	PROJECT NO.:	CHECKED BY:
JS	CO947.00	TY
REVISION:	DATE:	FIGURE:
00	DECEMBER 2023	1

C:\Users\JSeroul\OneDrive - Terrapex Environmental Ltd\PROJECTS\Ottawa\CO900\CO947.00 Waterdge Village\MXD\GEOTECHNICAL\CO947.00 FIG 2 GENERAL SITE LAYOUT.mxd



LEGEND

- PROPOSED PLAN OF SUBDIVISION
- INFILTRATION TESTING LOCATION
- BOREHOLE (TERRAPEX, 2023)
- MONITORING WELL (TERRAPEX, 2023)
- BEDROCK SURFACE CONTOURS

0 25 50 75
Metres

DATA SOURCE: CITY OF OTTAWA
MAP PROJECTION: NAD 1983 UTM ZONE 18N

CLIENT:
CLC

SITE LOCATION:
WATERIDGE VILLAGE
OTTAWA, ONTARIO

TERRAPEX

TITLE:
INFILTRATION INVESTIGATION

DRAWN BY:	PROJECT NO.:	CHECKED BY:
JS	CO947.00	CB
REVISION:	DATE:	FIGURE:
00	NOVEMBER 2023	**2**

C:\Users\JSerroul\OneDrive - Terrapex Environmental Ltd\PROJECTS\Ottawa\CO900\CO947.00 Waterdge Village\MXD\HG\CO947.00 FIG 3 INFILTRATION INVESTIGATION.mxd

APPENDIX B

Borehole Log Sheets

CLIENT: Rohit Communities	PROJECT NO.: CO947.00	**RECORD OF: BH/MW6-1**
ADDRESS: Wateridge Village / Hemlock Road Area		
CITY/PROVINCE: Ottawa, ON	NORTHING (m): 5033727.08	EASTING (m): 450070.46 ELEV. (m) 82.82
CONTRACTOR: George Downing Estate Drilling Ltd	METHOD:	
BOREHOLE DIAMETER (cm): 20	WELL DIAMETER (cm): 5	SCREEN SLOT #: 10 SAND TYPE: 2 SEALANT TYPE: Bentonite

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) / N-VALUE (Blows/300mm)	WATER CONTENT (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL) (new title)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
FILL stiff, grey, moist sandy silty clay, trace gravel & organics ---- Gr=8.7%,Sa=21.5%,Si=26.6%,Cl=43.2%.	0 0.5	82.5	12	20.7 16.8	1A 1B		50			Bentonite	50 mm monitoring well was installed and the water level measured on November 24, 2023: 4.30 mbgs
very dense, light brown, moist SILTY GRAVELLY SAND trace to some clay, rock pieces ---- Gr=29.2%, Sa=37.5%, Si=23.5%, Cl=9.8%.	1 1.5	82 81.5	53	10.7	2		40				
	2	81	50/125	11.5	3		100				
Bedrock Cored to depth of 4.67 m. TCR(1) = 100% RQD(1) = 15%	2.5 3	80.5 80			R1					Sand Screen + Sand	
TCR(2) = 100% RQD(2) = 45%	3.5 4	79.5 79			R2						
END OF BOREHOLE	4.5	78.5									END OF BOREHOLE: 4.67 mbgs ELEV.(m) = 78.1

TERRAPEX

LOGGED BY: UB	DRILLING DATE: 10-11-2023
INPUT BY: RR	MONITORING DATE:
REVIEWED BY: TY	PAGE 1 OF 1

CLIENT: Rohit Communities	PROJECT NO.: CO947.00	**RECORD OF: BH6-2**
ADDRESS: Wateridge Village / Hemlock Road Area		
CITY/PROVINCE: Ottawa, ON	NORTHING (m): 5033694.44	EASTING (m): 450105.97 ELEV. (m) 84.19
CONTRACTOR: George Downing Estate Drilling Ltd	METHOD:	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm):	SCREEN SLOT #: SAND TYPE: SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) ● 40 80 120 160 / N-VALUE (Blows/300mm) ▲ 20 40 60 80	WATER CONTENT (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL) (new title)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL compact to dense, grey, moist sandy silty clay trace gravel, trace oxidation	0	84	▲ 30	■ 8.0 2.7	1A		50				
		Bedrock Cored to depth of 1.15 m.	0.5	83.5			1B 2						
			1										
		END OF BOREHOLE											END OF BOREHOLE: 1.15 mbgs ELEV.(m) = 83.0

TERRAPEX

LOGGED BY: UB	DRILLING DATE: 10-11-2023
INPUT BY: RR	MONITORING DATE:
REVIEWED BY: TY	PAGE 1 OF 1

CLIENT: Rohit Communities	PROJECT NO.: CO947.00	**RECORD OF: BH6-3**
ADDRESS: Wateridge Village / Hemlock Road Area		
CITY/PROVINCE: Ottawa, ON	NORTHING (m): 5033677.45	EASTING (m): 450119.58 ELEV. (m) 85.70
CONTRACTOR: George Downing Estate Drilling Ltd	METHOD:	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm):	SCREEN SLOT #: SAND TYPE: SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) ● / N-VALUE (Blows/300mm) ▲ 40 80 120 160 / 20 40 60 80	WATER CONTENT (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL) (new title)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL very stiff, brown, moist silty clay some gravel, some sand	0 0.5 1	85.5 85	22 ▲	24.8 ■	1		50				
		Bedrock Cored to depth of 3.50 m. TCR(1) = 100% RQD(1) = 16% TCR(2) = 100% RQD(2) = 30%	1.5 2 2.5 3 3.5 4	84.5 84 83.5 83 82.5 82 81.5			R1 R2						
		END OF BOREHOLE	4.5										END OF BOREHOLE: 4.64 mbgs ELEV.(m) = 81.0

TERRAPEX

LOGGED BY: UB	DRILLING DATE: 09-11-2023
INPUT BY: RR	MONITORING DATE:
REVIEWED BY: TY	PAGE 1 OF 1

CLIENT: Rohit Communities	PROJECT NO.: CO947.00	**RECORD OF: BH6-4**
ADDRESS: Wateridge Village / Hemlock Road Area		
CITY/PROVINCE: Ottawa, ON	NORTHING (m): 5033626.16	EASTING (m): 450118.00 ELEV. (m) 87.36
CONTRACTOR: George Downing Estate Drilling Ltd	METHOD:	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm):	SCREEN SLOT #: SAND TYPE: SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) ● 40 80 120 160 / N-VALUE (Blows/300mm) ▲ 20 40 60 80	WATER CONTENT (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL) (new title)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL soft to firm, grey, moist silty clay trace gravel, trace sand, trace organics ---- Gr=6.0%, Sa=7.8%, Si=25.4%, Cl=60.8%. LL=58.3%, PI=28. ---- stiff	0 0.5 1 1.5 2 2.5	87 86.5 86 85.5 85	7 6 4 11	29.4 32.1 34.9 38.1	1 2 3 4		42 33 50 50				
		END OF BOREHOLE											END OF BOREHOLE: 2.77 mbgs ELEV.(m) = 84.6

TERRAPEX

LOGGED BY: UB	DRILLING DATE: 10-11-2023
INPUT BY: RR	MONITORING DATE:
REVIEWED BY: TY	PAGE 1 OF 1

CLIENT: Rohit Communities	PROJECT NO.: CO947.00	**RECORD OF: BH6-5**
ADDRESS: Wateridge Village / Hemlock Road Area		
CITY/PROVINCE: Ottawa, ON	NORTHING (m): 5033612.15	EASTING (m): 450146.62 ELEV. (m) 87.34
CONTRACTOR: George Downing Estate Drilling Ltd	METHOD:	
BOREHOLE DIAMETER (cm):	WELL DIAMETER (cm):	SCREEN SLOT #: SAND TYPE: SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) ● 40 80 120 160 / N-VALUE (Blows/300mm) ▲ 20 40 60 80	WATER CONTENT (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL) (new title)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL soft, grey, moist silty clay trace gravel, trace sand, trace organics ---- Gr=7.3%, Sa=7.5%, Si=24.6%, Cl=60.6%. ---- stiff	0 0.5 1 1.5 2 2.5	87 86.5 86 85.5 85 84.5	3 2 2 13	32.8 34.6 32.9 30.5	1 2 3 4		58 42 50 100				
		Bedrock Core to depth of 2.97 m. END OF BOREHOLE											END OF BOREHOLE: 2.97 mbgs ELEV.(m) = 84.5

TERRAPEX

LOGGED BY: UB	DRILLING DATE: 10-11-2023
INPUT BY: RR	MONITORING DATE:
REVIEWED BY: TY	PAGE 1 OF 1

CLIENT: Rohit Communities	PROJECT NO.: CO947.00	**RECORD OF: BH/MW6-6**
ADDRESS: Wateridge Village / Hemlock Road Area		
CITY/PROVINCE: Ottawa, ON	NORTHING (m): 5033580.10	EASTING (m): 450125.25 ELEV. (m) 85.87
CONTRACTOR: George Downing Estate Drilling Ltd	METHOD:	
BOREHOLE DIAMETER (cm): 20	WELL DIAMETER (cm): 5	SCREEN SLOT #: 10 SAND TYPE: 2 SEALANT TYPE: Bentonite

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) ● / N-VALUE (Blows/300mm) ▲	WATER CONTENT (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL) (new title)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL loose, grey, moist sandy silt some gravel, some clay, trace organics	0	85.5	8	20.4	1		58			Bentonite	Bentonite 50 mm monitoring well was installed and the water level measured on November 24, 2023: 3.67 mbgs
		---- Gr=17.8%, Sa=33.2%, Si=36.3%, Cl=12.7%.	0.5	85	5	18.1	2		42				
		---- rock pieces	1.5	84.5									
		Bedrock Cored to depth of 4.64 m.	2	84	8	12.8	3		50				
		TCR(1) = 100% RQD(1) = 84%	2.5	83.5								Sand	Sand Screen + Sand
			3	83			R1						
		TCR(2) = 100% RQD(2) = 74%	3.5	82.5									
			4	82			R2						
		END OF BOREHOLE	4.5	81.5									END OF BOREHOLE: 4.64 mbgs ELEV.(m) = 81.2

TERRAPEX

LOGGED BY: UB	DRILLING DATE: 10-11-2023
INPUT BY: RR	MONITORING DATE: 24-11-2023
REVIEWED BY: TY	PAGE 1 OF 1

CLIENT: Rohit Communities | PROJECT NO.: CO947.00 | **RECORD OF: BH6-7**

ADDRESS: Wateridge Village / Hemlock Road Area

CITY/PROVINCE: Ottawa, ON | NORTHING (m): 5033564.86 | EASTING (m): 450163.18 | ELEV. (m) 86.75

CONTRACTOR: George Downing Estate Drilling Ltd | METHOD:

BOREHOLE DIAMETER (cm): | WELL DIAMETER (cm): | SCREEN SLOT #: | SAND TYPE: | SEALANT TYPE:

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	SHEAR STRENGTH (kPa) ● / N-VALUE (Blows/300mm) ▲ 20 40 60 80	WATER CONTENT (%) PL W.C. LL 20 40 60 80	SAMPLE NO.	SAMPLE TYPE	RECOVERY (%)	SV/TOV (ppm or %LEL) (new title)	LABORATORY TESTING	WELL INSTALLATION	REMARKS
		FILL very dense, brown, moist sand and gravel some silt, trace clay	0 0.5 1 1.5	86.5 86 85.5 85	▲ 50 50/125 ▲	■ 19.4 ■ 8.9	1 2		100 42				
		Bedrock Cored to depth of 1.80 m. END OF BOREHOLE											END OF BOREHOLE: 1.80 mbgs ELEV.(m) = 84.9

TERRAPEX

LOGGED BY: UB | DRILLING DATE: 08-11-2023

INPUT BY: RR | MONITORING DATE:

REVIEWED BY: TY | PAGE 1 OF 1

CLIENT: Canada Lands Company CLC Limited	METHOD: Hollow Stem Auger & Split Spoon		**BH No.: 110**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 86.374	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033554	EASTING: 450130	PROJECT NO.: CO682.00

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

GWL (m)	SOIL SYMBOL	SOIL DESCRIPTION	DEPTH (m)	ELEVATION (m)	Shear Strength (kPa) / N-Value (Blows/300mm)	Water Content (%) PL W.C. LL	SAMPLE NO.	SAMPLE TYPE	SPT(N)	Well Construction	REMARKS
		FROZEN GROUND	0	86.25							Borehole caved-in at 0.91 m bgs and dry on completion.
		very dense, damp, grey gravel, some sand (FILL)	0.25	86	80		1A		80		
			0.5	85.75			1B				
		compact, damp to wet, brown sandy silt, some gravel, trace organics trace oxidization (FILL)	0.75	85.5			2A				
			1	85.25	31				31		Auger refusal at 1.40 m bgs.
		compact to very dense, moist to wet, dark brown, silty gravel, trace sand, trace organics and rock fragments (FILL)	1.25				2B				
		END OF BOREHOLE									

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LOGGED BY: RH | DRILLING DATE: November 19, 2018

REVIEWED BY: VN |

CLIENT: Canada Lands Company CLC Limited	METHOD: Excavator		**TP No.: 205**
PROJECT: Wateridge Village	PROJECT ENGINEER: VN	ELEV. (m) 85.810	
LOCATION: Rockcliffe, Ottawa	NORTHING: 5033606	EASTING: 450123	PROJECT NO.: CO682.00

SAMPLE TYPE: AUGER | DRIVEN | CORING | DYNAMIC CONE | SHELBY | SPLIT SPOON

DEPTH (m)	INSTRUMENTATION DATA	REMARKS	Shear Strength (kPa) ● 40 80 120 160 / Static Cone Tip Resistance (kg/cm 2) ▲ 50 100 150 200	PL W.C. LL 20 40 60 80	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO.	SPT(N)	ELEVATION (m)
0		On completion the test pit was dry and open.				moist, grey gravel some to trace sand (FILL)				85.75
0.25										85.5
0.5						damp, dark brown topsoil, trace rootlets (FILL)				85.25
0.75										85
1										84.75
1.25						damp, brown SANDY SILT trace clay, trace gravel				84.5
1.5		Refusal @ 1.64 m bgs on Limestone Bedrock								84.25
						END OF TEST PIT				

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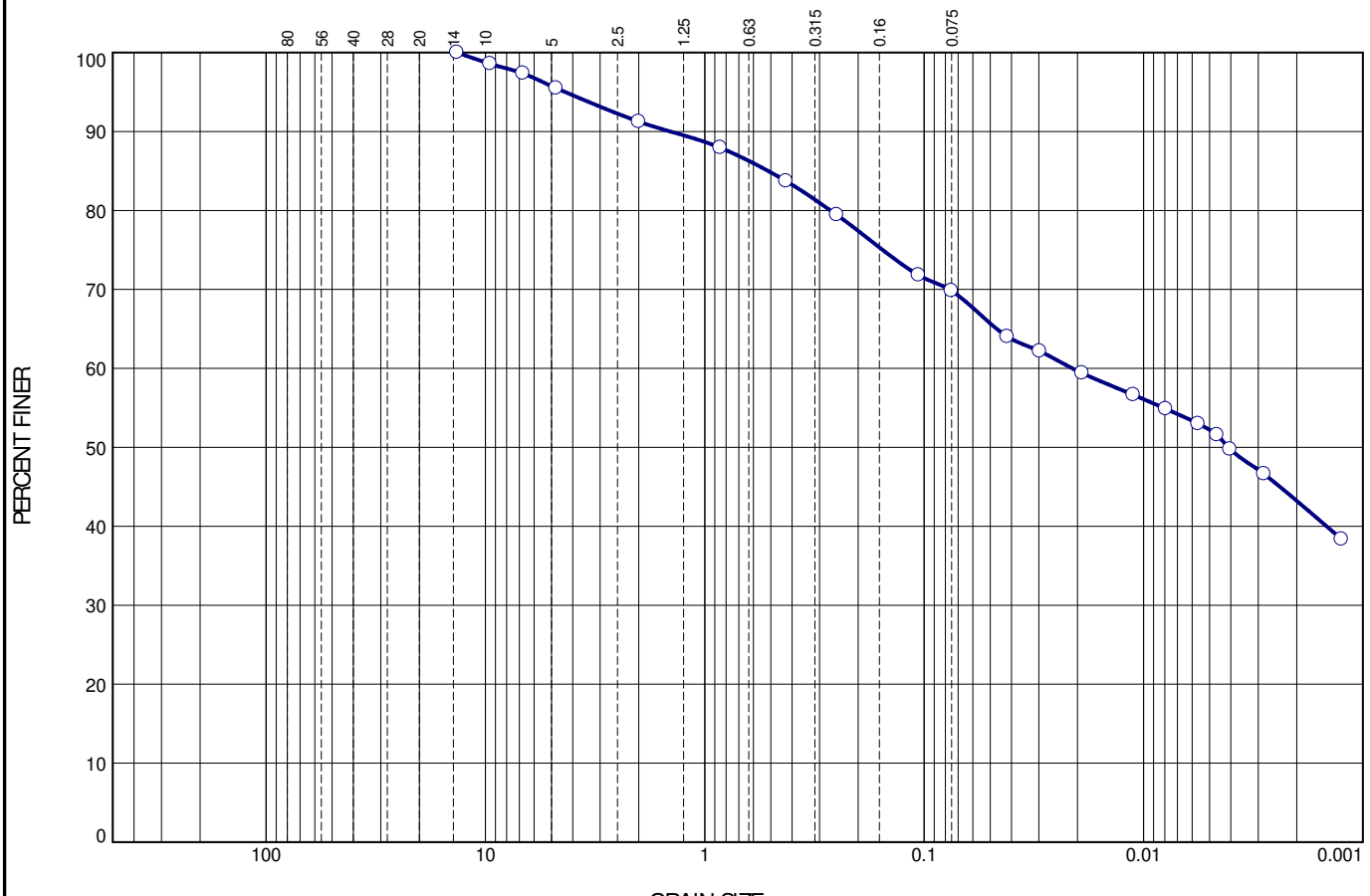
LOGGED BY: RH | DRILLING DATE: December 14,
REVIEWED BY: VN | Page 1 of 1

APPENDIX C

Geotechnical Laboratory Test Results

Particle Size Distribution Report

ASTM D422



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	8.7	7.6	13.9	26.6	43.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.5138	0.0211	0.0041					

Material Description	Test Date	USCS	NM
○ SANDY SILTY CLAY trace gravel	Dec 6/23		

Project No. CO947.00 Client: Rohit Communities

Project: Wateridge Village

○Sample Number: BH6-1 SS1A

Terrapex

Toronto, Ontario

Remarks:

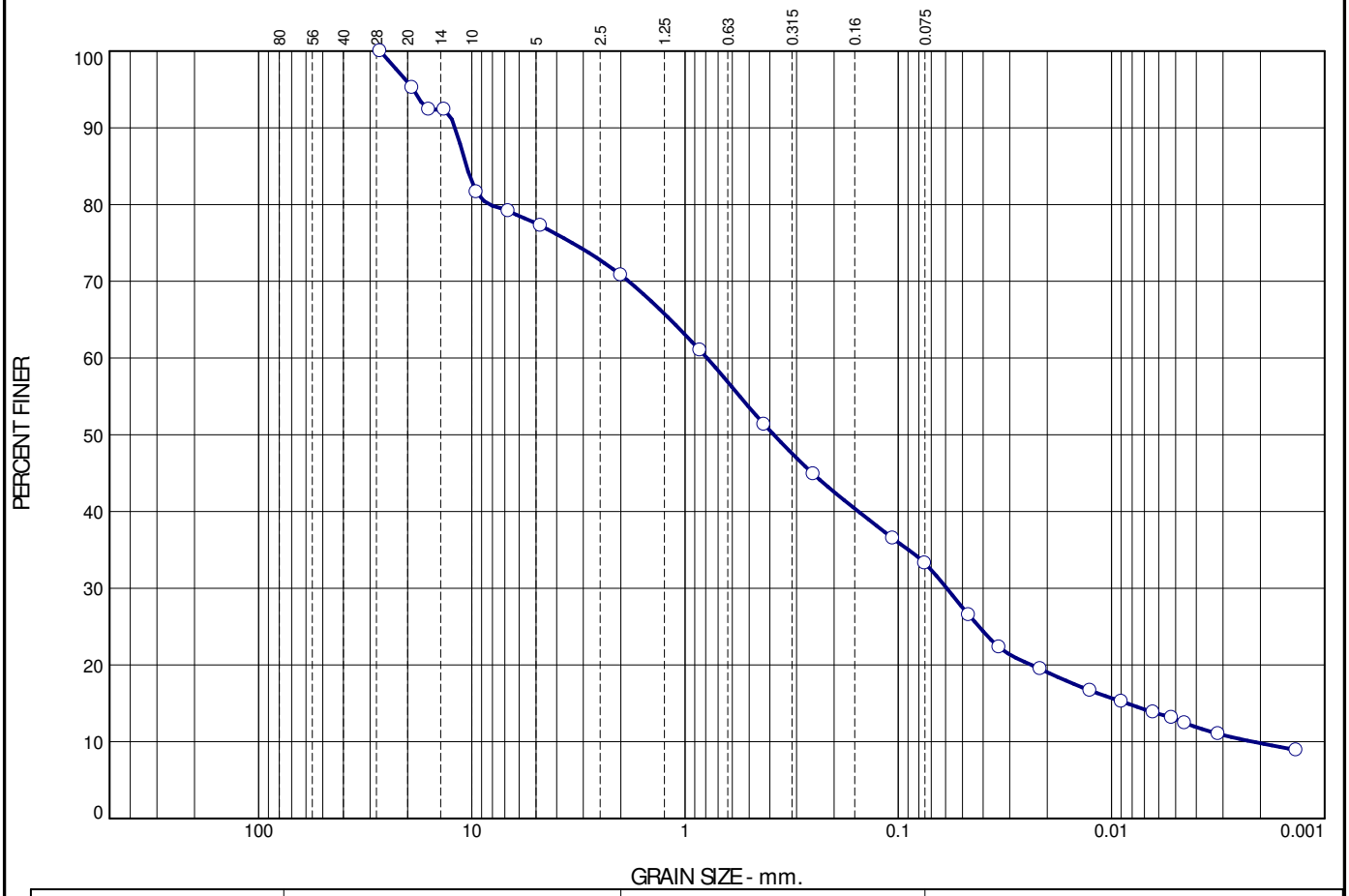
○Hydrometer Details: Spc. Grav. = 2.75(assumed); Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/l

Figure 3

Tested By: SC

Particle Size Distribution Report

ASTM D422



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	29.2	19.5	18.0	23.5	9.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			10.5867	0.7875	0.3832	0.0592	0.0085	0.0022	2.05	362.42

Material Description	Test Date	USCS	NM
○ SILTY GRAVELLY SAND trace to some clay	Dec 6/23		

Project No. CO947.00 Client: Rohit Communities

Project: Wateridge Village

○Sample Number: BH6-1 SS1B

Terrapex

Toronto, Ontario

Remarks:

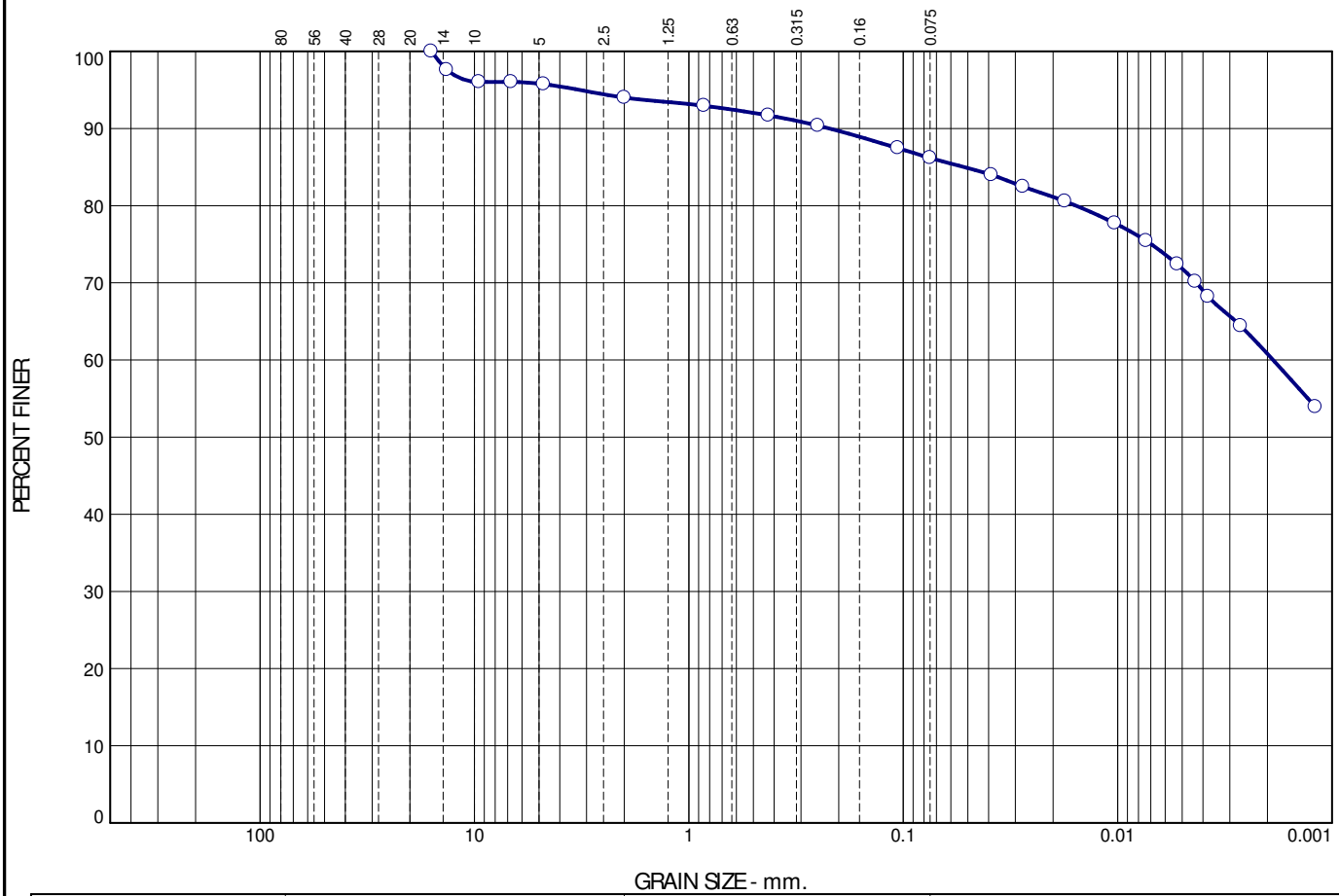
○Hydrometer Details: Spc. Grav. = 2.75(assumed); Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/l

Figure 4

Tested By: SC

Particle Size Distribution Report

ASTM D422



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	6.0	2.3	5.5	25.4	60.8

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	58.3	30.2	0.0519	0.0019						

Material Description	Test Date	USCS	NM
○ SILTY CLAY trace sand trace gravel	Dec 6/23	CH	

Project No. CO947.00 Client: Rohit Communities

Project: Wateridge Village

○Sample Number: BH6-4 SS1

Terrapex

Toronto, Ontario

Remarks:

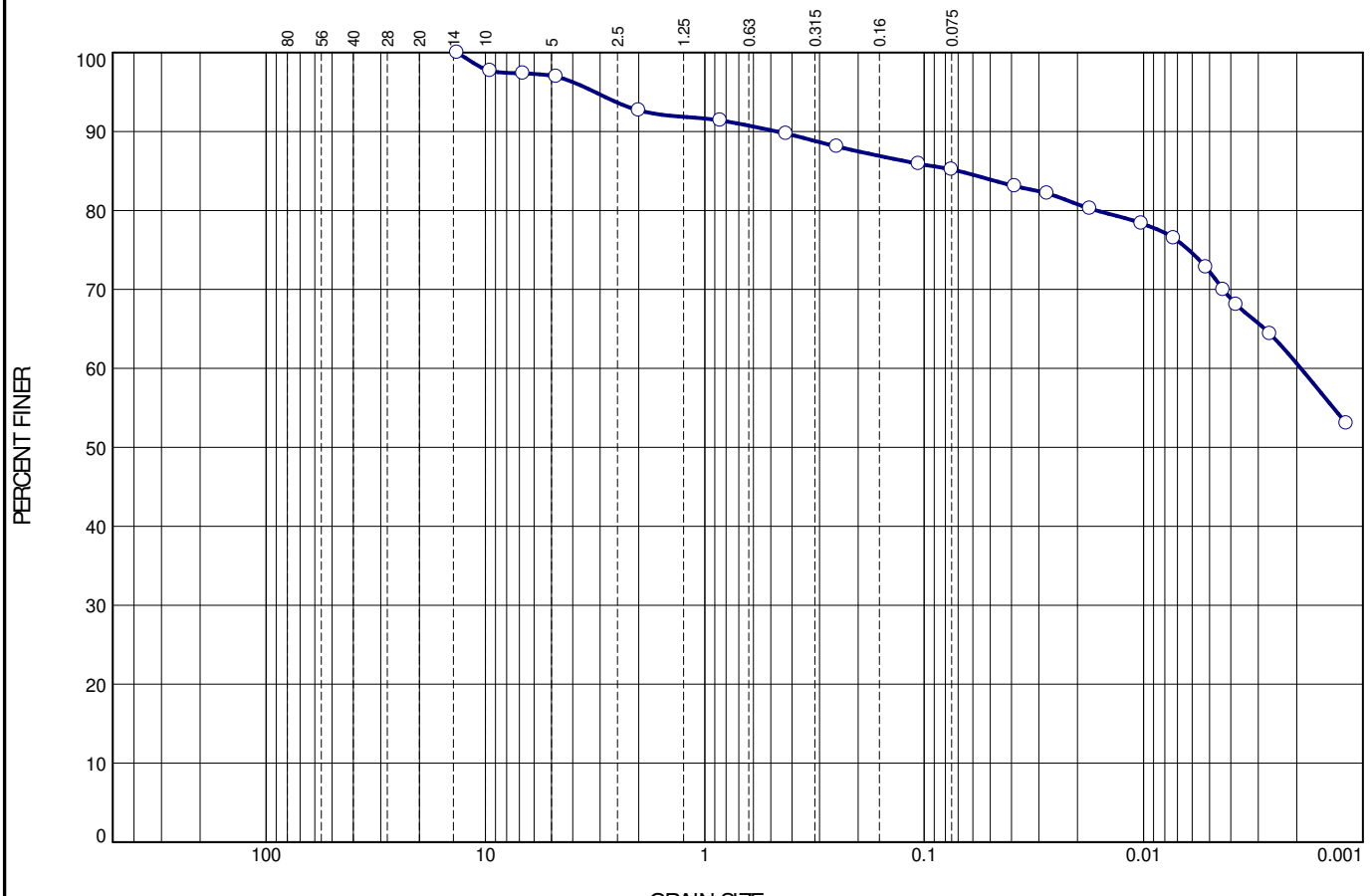
○Hydrometer Details: Spc. Grav. = 2.75(assumed); Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/l

Figure 5

Tested By: SC

Particle Size Distribution Report

ASTM D422



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	7.3	3.0	4.5	24.6	60.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.0700	0.0019						

Material Description	Test Date	USCS	NM
○ SILTY CLAY trace sand trace gravel	Dec 6/23		

Project No. CO947.00 Client: Rohit Communities

Project: Wateridge Village

○Sample Number: BH6-5 SS2

Terrapex

Toronto, Ontario

Remarks:

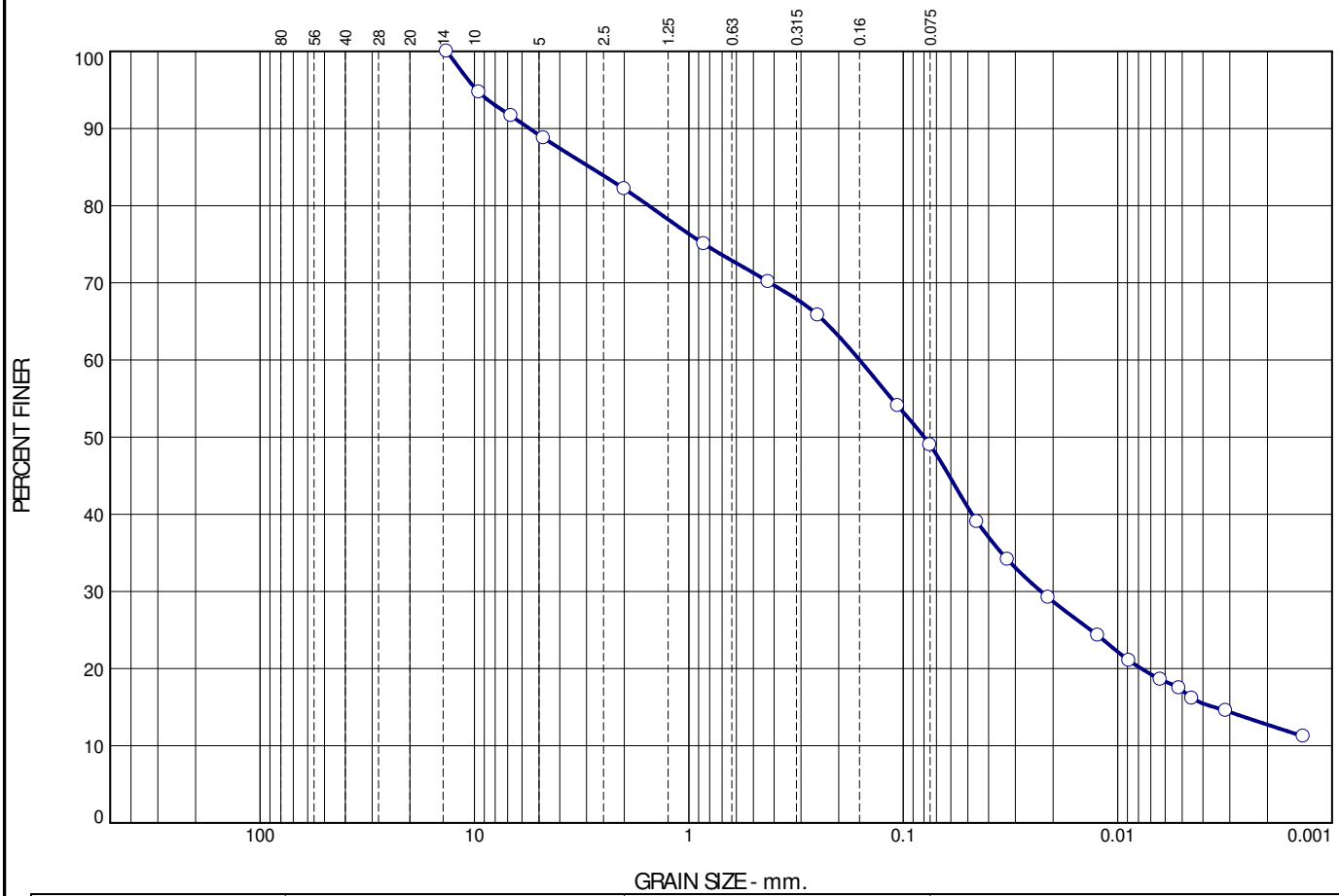
○Hydrometer Details: Spc. Grav. = 2.75(assumed); Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/l

Figure 6

Tested By: SC

Particle Size Distribution Report

ASTM D422



	% +3"	% Gravel	% Sand		% Fines	
			Coarse	Fine	Silt	Clay
○	0.0	17.8	12.1	21.1	36.3	12.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			2.8934	0.1598	0.0798	0.0228	0.0035			

Material Description	Test Date	USCS	NM
○ SANDY SILT some gravel some clay	Dec 6/23		

Project No. CO947.00 Client: Rohit Communities

Project: Wateridge Village

○Sample Number: BH6-6 SS3

Terrapex

Toronto, Ontario

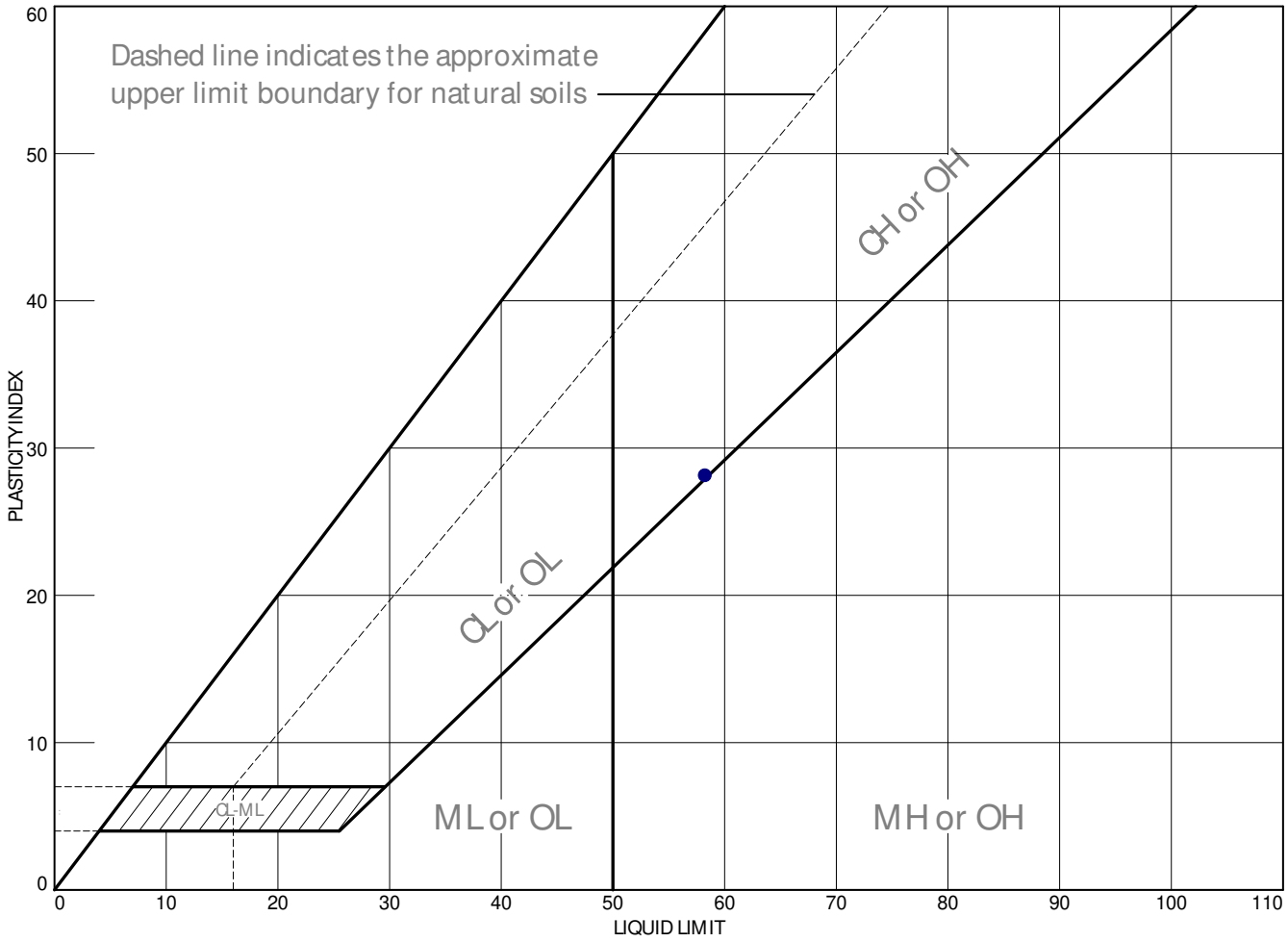
Remarks:

○Hydrometer Details: Spc. Grav. = 2.75(assumed); Vb=53cm^3; L2=13.8cm; L1=10.7cm; hs= 0.16cm/Div; A=30.2cm^2; Mass of Disp. Agent=40g/l

Figure 7

Tested By: SC

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SILTY CLAY trace sand trace gravel	58.3	30.2	28.1	91.7	86.2	CH

Project No. CO947.00 Client: Rohit Communities

Project: Wateridge Village

●Sample Number: BH6-4 SS1

Remarks:

●Test Date: December 11, 2023

Terrapex

Toronto, Ontario

Figure 9

Tested By: AM

APPENDIX D

Certificate of Chemical Analysis

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED
90 SCARSDALE RD
TORONTO, ON M3B2R7
(905) 474-5265
ATTENTION TO: Reza Rafiee
PROJECT: CO947.00
AGAT WORK ORDER: 23T101726
SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganic Team Lead
DATE REPORTED: Dec 12, 2023
PAGES (INCLUDING COVER): 6
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 23T101726

PROJECT: CO947.00

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED

ATTENTION TO: Reza Rafiee

SAMPLING SITE:WATERIDGE VILLAGE

SAMPLED BY:UB/JM

(Soil) pH and Sulphate in Soil

DATE RECEIVED: 2023-12-07

DATE REPORTED: 2023-12-12

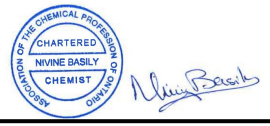
SAMPLE DESCRIPTION:				BH4-2-SS1&2	BH5-1-SS2&3	BH6-5-SS2	BH6-6-SS3
SAMPLE TYPE:				Soil	Soil	Soil	Soil
DATE SAMPLED:				2023-11-08 08:50	2023-11-08 12:50	2023-11-10 09:40	2023-11-10 10:25
Parameter	Unit	G / S	RDL	5525935	5525936	5525937	5525938
Sulphate (2:1)	µg/g		2	31	36	38	37
pH (2:1)	pH Units		NA	7.97	8.64	7.88	8.09

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

5525935-5525938 pH and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



AGAT Laboratories

5835 COOPERS AVENUE
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED

AGAT WORK ORDER: 23T101726

PROJECT: CO947.00

ATTENTION TO: Reza Rafiee

SAMPLING SITE:WATERIDGE VILLAGE

SAMPLED BY:UB/JM

Soil Analysis

RPT Date: Dec 12, 2023			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(Soil) pH and Sulphate in Soil															
Sulphate (2:1)	5517672		1100	1110	0.9%	< 2	94%	70%	130%	95%	80%	120%	NA	70%	130%
pH (2:1)	5525010		7.68	7.61	0.9%	NA	96%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:

AGAT Laboratories

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CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Time Markers

AGAT WORK ORDER: 23T101726
PROJECT: CO947.00

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED

ATTENTION TO: Reza Rafiee

Sample ID	Sample Description	Sample Type	Date Sampled	Date Received
5525935	BH4-2-SS1&2	Soil	08-NOV-2023	07-DEC-2023

(Soil) pH and Sulphate in Soil

Parameter	Date Prepared	Date Analyzed	Initials
Sulphate (2:1)	08-DEC-2023	08-DEC-2023	LC
pH (2:1)	08-DEC-2023	08-DEC-2023	XL

Sample ID	Sample Description	Sample Type	Date Sampled	Date Received
5525936	BH5-1-SS2&3	Soil	08-NOV-2023	07-DEC-2023

(Soil) pH and Sulphate in Soil

Parameter	Date Prepared	Date Analyzed	Initials
Sulphate (2:1)	08-DEC-2023	08-DEC-2023	LC
pH (2:1)	08-DEC-2023	08-DEC-2023	XL

Sample ID	Sample Description	Sample Type	Date Sampled	Date Received
5525937	BH6-5-SS2	Soil	10-NOV-2023	07-DEC-2023

(Soil) pH and Sulphate in Soil

Parameter	Date Prepared	Date Analyzed	Initials
Sulphate (2:1)	08-DEC-2023	08-DEC-2023	LC
pH (2:1)	08-DEC-2023	08-DEC-2023	XL

Sample ID	Sample Description	Sample Type	Date Sampled	Date Received
5525938	BH6-6-SS3	Soil	10-NOV-2023	07-DEC-2023

(Soil) pH and Sulphate in Soil

Parameter	Date Prepared	Date Analyzed	Initials
Sulphate (2:1)	08-DEC-2023	08-DEC-2023	LC
pH (2:1)	08-DEC-2023	08-DEC-2023	XL

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: TERRAPEX ENVIRONMENTAL LIMITED

AGAT WORK ORDER: 23T101726

PROJECT: CO947.00

ATTENTION TO: Reza Rafiee

SAMPLING SITE:WATERIDGE VILLAGE

SAMPLED BY:UB/JM

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only
Work Order #: 23T101726
Cooler Quantity: 1 large
Arrival Temperatures: 1.8 | 2.0 | 2.2
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes: Loose ice

Report Information:
Company: TERRAPEX
Contact: REZA RAFIEE
Address: 90 Scarsdale Road., Toronto, ON.
Phone: 416-991-6242 Fax:
Reports to be sent to:
1. Email: r.rafiee@terrapex.com
2. Email:

Regulatory Requirements: NA
(Please check all applicable boxes)
☐ Regulation 153/04 — Table (Indicate One) ☐Ind/Com ☐Res/Park ☐Agriculture; Soil Texture (Check One) ☐Coarse ☐Fine
☐ Excess Soils R406 — Table (Indicate One)
☐ Regulation 558
☐ CCME
☐ Sewer Use ☐Sanitary ☐Storm — Region
☐ Prov. Water Quality Objectives (PWQO)
☐ Other — Indicate One

Turnaround Time (TAT) Required:
Regular TAT ☑ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays
For 'Same Day' analysis, please contact your AGAT CPM

Project Information:
Project: CO947.00
Site Location: Waterridge Village
Sampled By: UB/JM
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☑ No
Report Guideline on *Certificate of Analysis* ☐ Yes ☑ No

Invoice Information: Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email: accountspayable@terrapex.com

Sample Matrix Legend
B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC Y/N	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	PAHs	PCBs	VOC	Aroclors	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach ☐ Metals ☐ VOCs ☐ SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Corrosivity: Include Moisture ☐ Sulphide ☐	pH	Water Soluble Sulphate				Potentially Hazardous or High Concentration (Y/N)
BH4-2-SS1 & 2	8/11/23	8:50 AM PM	1	S																			NA
~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~																			~~[illegible]~~
BH5-1-SS2 & 3	8/11/23	12:50 AM PM	1	S																			NA
~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~																			~~[illegible]~~
BH6-5-SS2	10/11/23	9:40 AM PM	1	S																			NA
BH6-6-SS3	10/11/23	10:25 AM PM	1	S																			NA
		AM PM																					
		AM PM																					
		AM PM																					
		AM PM																					
		AM PM																					

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
John L	5/12/23	6:00 pm	Aniqa Tahir	07/12/23	1:20 pm
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 1 of 1
N°: T-137621

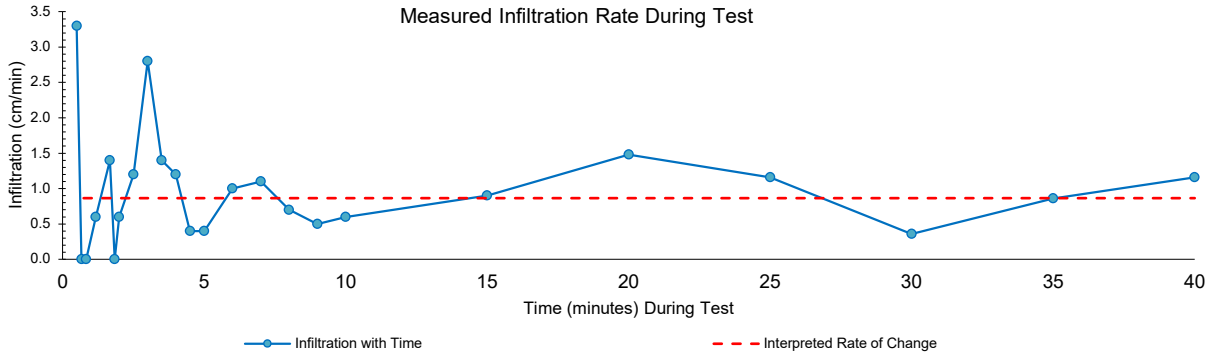
APPENDIX E

Field Infiltration Test Results

Constant Head Well Permeameter Test Report

TERRAPEX

Project:	Rohit Wateridge Village	
Project Number:	CO947	
Location Name	Inf 6-1	
Approximate Location:	450090.093	easting (metres)
	5033652.523	northing (metres)
Approximate Depth Tested:	0.4	mbg
	85.0	masl



Field Measurements:

Elapsed Time	Water Level	Water Level Change	Infiltration
(min)	(cm)	(cm)	(cm/min)
0.17	39.6	-	-
0.50	38.5	1.10	3.30
0.67	38.5	0.00	0.00
0.83	38.5	0.00	0.00
1.17	38.3	0.20	0.60
1.67	37.6	0.70	1.40
1.83	37.6	0.00	0.00
2.00	37.5	0.10	0.60
2.50	36.9	0.60	1.20
3.00	35.5	1.40	2.80
3.50	36.2	0.70	1.40
4.00	35.6	0.60	1.20
4.50	35.4	0.20	0.40
5.00	35.2	0.20	0.40
6.00	34.2	1.00	1.00
7.00	33.1	1.10	1.10
8.00	32.4	0.70	0.70
9.00	31.9	0.50	0.50
10.00	31.3	0.60	0.60
15	26.8	4.50	0.90
20	19.4	7.40	1.48
25.00	13.6	5.80	1.16
30.00	11.8	1.80	0.36
35.00	7.5	4.30	0.86
40.00	1.7	5.80	1.16

Date of Field Measurements: 20-Nov-23
Field Representative: EB
Reviewed: ZK
Reviewed: ZK

Soil Description

moist sandy silty clay

Test Conditions:

Instrument: 1" stainless steel Solinst Drivepoint Instrument

hole radius (a) =	6	cm
Water column height in hole (H_1) =	5	cm
Ambient Air Temperature at Testing =	4	^{o}C

Interpretations:

Soil Capillary Type =	Strong	
Soil Type Coefficient (α*) =	0.04	cm^{-1}
Average Water Level Change (R_1) =	0.01	cm/s
Steady Intake Water Rate (Q_1) =	0.50	cm^3/s
Shape factor for H_1/a = (C_1) =	0.54	-

Field Saturated Hydraulic Conductivity (K_{fs}):

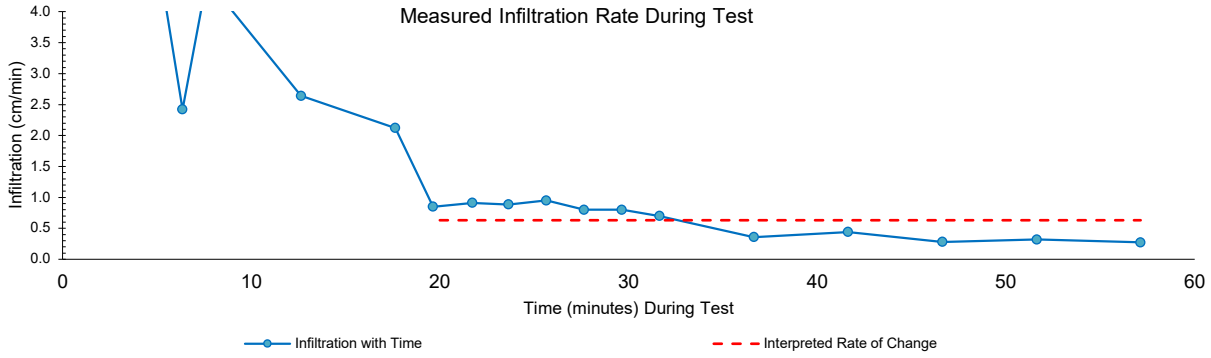
K_{fs} =	3E-04	cm/s
K_{fs} corrected to 4°C ('freshet') [1] =	3E-04	cm/s
K_{fs} corrected to 24°C ('summer') [1] =	5E-04	cm/s

[1] (Streeter and Wylie, 1975)
[1] (Reynolds, 2008 and 2015)

Constant Head Well Permeameter Test Report

TERRAPEX

Project:	Rohit Wateridge Village	
Project Number:	CO947	
Location Name	Inf 6-2	
Approximate Location:	450101.874	easting (metres)
	5033632.943	northing (metres)
Approximate Depth Tested:	2.2	mbg
	85.2	masl



Field Measurements:

Elapsed Time	Water Level	Water Level Change	Infiltration
(min)	(cm)	(cm)	(cm/min)
0.20	100	-	-
0.55	160	60.00	171.43
1.20	195	35.00	53.85
1.95	200	5.00	6.67
2.70	210	10.00	13.33
4.28	220	10.00	6.32
6.35	225	5.00	2.42
7.63	230.8	5.80	4.52
12.63	244	13.20	2.64
17.63	254.6	10.60	2.12
19.63	256.3	1.70	0.85
21.72	258.2	1.90	0.91
23.63	259.9	1.70	0.89
25.63	261.8	1.90	0.95
27.63	263.4	1.60	0.80
29.63	265	1.60	0.80
31.63	266.4	1.40	0.70
36.63	268.2	1.80	0.36
41.63	270.4	2.20	0.44
46.633333	271.8	1.40	0.28
51.633333	273.4	1.60	0.32
57.13	274.9	1.50	0.27

Date of Field Measurements: 16-Nov-23
Field Representative: EB
Reviewed: ZK
Reviewed: ZK

Soil Description

moist sandy silty clay

Test Conditions:

Instrument: 1" stainless steel Solinst Drivepoint Instrument

hole radius (a) =	2.54	cm
Water column height in hole (H_1) =	15.24	cm
Ambient Air Temperature at Testing =	4	^{o}C

Interpretations:

Soil Capillary Type =	Strong	
Soil Type Coefficient (α^*) =	0.04	cm^{-1}
Average Water Level Change (R_1) =	0.01	cm/s
Steady Intake Water Rate (Q_1) =	0.05	cm^3/s
Shape factor for H_1/a = (C_1) =	1.80	-

Field Saturated Hydraulic Conductivity (K_{fs}):

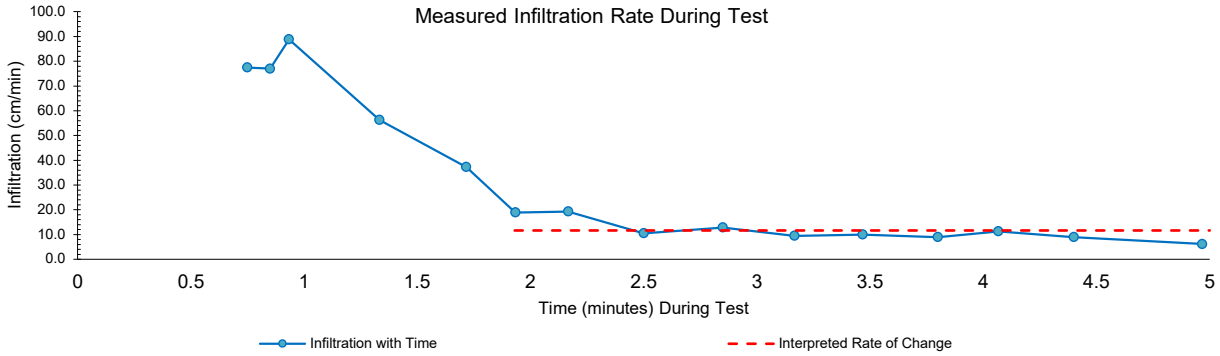
K_{fs} =	2E-05	cm/s
K_{fs} corrected to 4^{o}C ('freshet') [1] =	2E-05	cm/s
K_{fs} corrected to 24^{o}C ('summer') [1] =	4E-05	cm/s

[1] (Streeter and Wylie, 1975)
[1] (Reynolds, 2008 and 2015)

Constant Head Well Permeameter Test Report

TERRAPEX

Project:	Rohit Wateridge Village	
Project Number:	CO947	
Location Name	Inf 6-3	
Approximate Location:	450119.334	easting (metres)
	5033599.579	northing (metres)
Approximate Depth Tested:	1.5	mbg
	85.3	masl



Field Measurements:

Elapsed Time	Water Level	Water Level Change	Infiltration
(min)	(cm)	(cm)	(cm/min)
0.58	85.1	-	-
0.75	98	12.90	77.40
0.85	105.7	7.70	77.00
0.93	113.1	7.40	88.80
1.33	135.6	22.50	56.25
1.72	149.9	14.30	37.30
1.93	154	4.10	18.92
2.17	158.5	4.50	19.29
2.50	162	3.50	10.50
2.85	166.5	4.50	12.86
3.17	169.5	3.00	9.47
3.47	172.5	3.00	10.00
3.80	175.5	3.00	9.00
4.07	178.5	3.00	11.25
4.40	181.5	3.00	9.00
4.97	185	3.50	6.18

Date of Field Measurements: 16-Nov-23
Field Representative: EB
Reviewed: ZK
Reviewed: ZK

Soil Description

moist sandy silty clay

Test Conditions:

Instrument: 1" stainless steel Solinst Drivepoint Instrument

hole radius (a) =	2.54	cm
Water column height in hole (H_1) =	15.24	cm
Ambient Air Temperature at Testing =	4	^{o}C

Interpretations:

Soil Capillary Type =	Strong	
Soil Type Coefficient (α*) =	0.04	cm^{-1}
Average Water Level Change (R_1) =	0.19	cm/s
Steady Intake Water Rate (Q_1) =	0.97	cm^3/s
Shape factor for H_1/a = (C_1) =	1.80	-

Field Saturated Hydraulic Conductivity (K_{fs}):

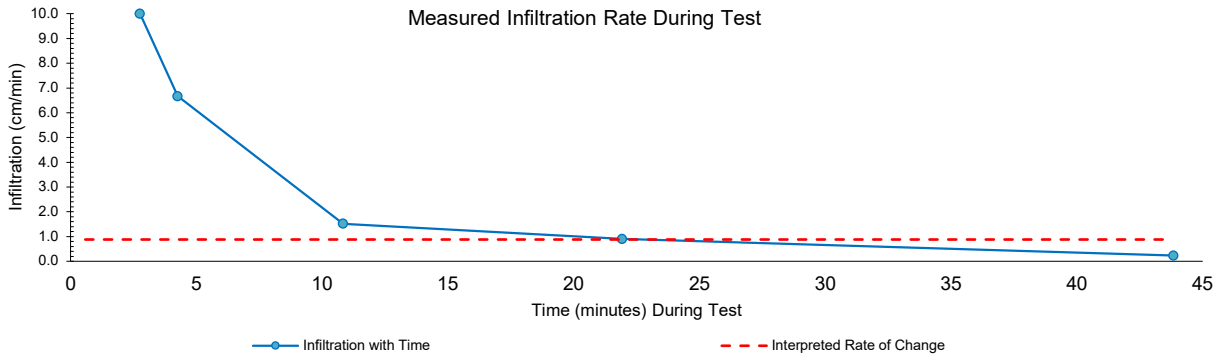
K_{fs} =	4E-04	cm/s
K_{fs} corrected to 4°C ('freshet') [1] =	4E-04	cm/s
K_{fs} corrected to 24°C ('summer') [1] =	8E-04	cm/s

[1] (Streeter and Wylie, 1975)
[1] (Reynolds, 2008 and 2015)

Constant Head Well Permeameter Test Report

TERRAPEX

Project:	Rohit Wateridge Village	
Project Number:	CO947	
Location Name	Inf 6-4	
Approximate Location:	450132.294	easting (metres)
	5033578.57	northing (metres)
Approximate Depth Tested:	1.0	mbg
	84.5	masl



Field Measurements:

Elapsed Time	Water Level	Water Level Change	Infiltration
(min)	(cm)	(cm)	(cm/min)
0.00	33	-	-
0.17	43	10.00	60.00
0.33	63	20.00	120.00
0.42	83	20.00	240.00
0.58	93	10.00	60.00
0.75	103	10.00	60.00
0.83	113	10.00	120.00
1.00	123	10.00	60.00
1.25	133	10.00	40.00
1.75	143	10.00	20.00
2.75	153	10.00	10.00
4.25	163	10.00	6.67
10.83	173	10.00	1.52
21.92	183	10.00	0.90
43.83	188	5.00	0.23

Soil Description

moist sandy silty clay

Test Conditions:

Instrument: 1" stainless steel Solinst Drivepoint Instrument

hole radius (a) =	2.54	cm
Water column height in hole (H_1) =	15.24	cm
Ambient Air Temperature at Testing =	10	^{o}C

Interpretations:

Soil Capillary Type =	Strong	
Soil Type Coefficient (α*) =	0.04	cm^{-1}
Average Water Level Change (R_1) =	0.01	cm/s
Steady Intake Water Rate (Q_1) =	0.07	cm^3/s
Shape factor for H_1/a = (C_1) =	1.80	-

Field Saturated Hydraulic Conductivity (K_{fs}):

K_{fs} =	3E-05	cm/s
K_{fs} corrected to 4°C ('freshet') [1] =	3E-05	cm/s
K_{fs} corrected to 24°C ('summer') [1] =	5E-05	cm/s

Date of Field Measurements:	16-Nov-23
Field Representative:	EB
Reviewed:	ZK
Reviewed:	ZK

[1] (Streeter and Wylie, 1975)

[1] (Reynolds, 2008 and 2015)

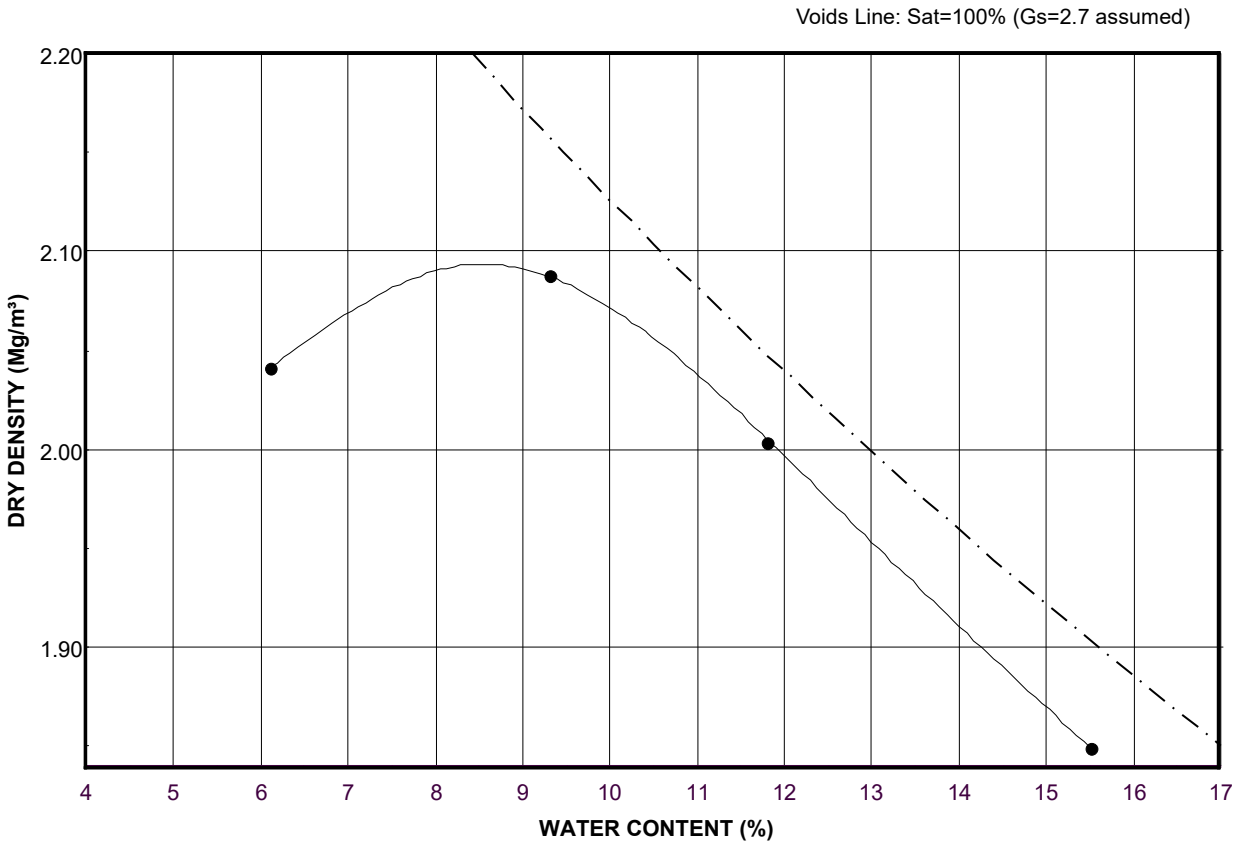
APPENDIX F

California Bearing Ratio Test Results

LABORATORY COMPACTION TEST

ASTM D698 Method C

FIGURE



Standard
Proctor Test Results

Sample:
INF 6-1

Max Dry Density:
2.091 Mg/m³

Optimum Water
Content: 8.5%

Natural Water
Content: N/A

Project Number: CA0011941.3280 (3000)
Checked By: AH

WSP Canada Inc.

LABID: 23-998
Date: 19-Dec-23

CALIFORNIA BEARING RATIO TEST (CBR) ASTM D1883

PROJECT NUMBER	CA0011941.3280(3000)	SAMPLE NUMBER	INF6-1
PROJECT NAME	Terrapex/Lab Testing/Miss.	SAMPLE DEPTH (m)	-
BOREHOLE NUMBER	-	DATE	12/15/2023

TEST INFORMATION

STRAIN RATE, mm/min	1.27	PARTICLE SIZE, mm	<19
RAM AREA, cm^2	19.44	COMPACTION	ASTM D698 Method C
LOAD CELL NUMBER	234341	NUMBER OF LAYERS	3
SURCHARGE, kg	4.54	BLOWS PER LAYER	56
SOAKING TIME, hr	92.2	RELATIVE COMPACTION, %	99

SAMPLE INFORMATION

	UNSOAKED	*SOAKED*		*UNSOAKED*	*SOAKED*
SAMPLE HEIGHT, cm	11.63	11.88	DRY WEIGHT, g	4413.21	4413.21
SAMPLE DIAMETER, cm	15.22	15.22	WATER CONTENT, %	8.59	9.71
SAMPLE AREA, cm^2	181.94	181.94	UNIT WEIGHT, kN/m^3	22.20	21.96
SAMPLE VOLUME, cc	2115.92	2161.59	DRY UNIT WT., kN/m^3	20.45	20.01
WET WEIGHT, g	4792.30	4841.60			

PENETRATION

UNSOAKED			SOAKED		
Penetration (mm)	Load (kgf)	Bearing Stress (MPa)	Penetration (mm)	Load (kgf)	Bearing Stress (MPa)
0.0	-	0.00	0.0	0.00	0.00
0.5	-	0.00	0.5	7.81	0.04
1.0	-	0.00	1.0	30.78	0.16
1.5	-	0.00	1.5	73.51	0.37
2.0	-	0.00	2.0	110.73	0.56
2.5	-	0.00	**2.5**	**151.63**	0.76
3.0	-	0.00	3.0	193.90	0.98
3.5	-	0.00	3.5	240.76	1.21
4.0	-	0.00	4.0	287.63	1.45
4.5	-	0.00	4.5	348.28	1.76
5.0	-	0.00	**5.0**	**398.37**	2.01
5.5	-	0.00	5.5	449.37	2.27
6.0	-	0.00	6.0	501.29	2.53
6.5	-	0.00	6.5	551.83	2.78
7.0	-	0.00	7.0	600.99	3.03
7.5	-	0.00	7.5	653.38	3.30
8.0	-	0.00	8.0	704.84	3.56
8.5	-	0.00	8.5	754.00	3.80
9.0	-	0.00	9.0	809.14	4.08
9.5	-	0.00	9.5	871.63	4.40
10.0	-	0.00	10.0	918.95	4.64
10.5	-	0.00	10.5	965.82	4.87
11.0	-	0.00	11.0	1015.90	5.13
11.5	-	0.00	11.5	1058.63	5.34
12.0	-	0.00	12.0	1107.80	5.59
12.5	-	0.00	12.5	1138.12	5.74
13.0	-	0.00	13.0	1180.40	5.95

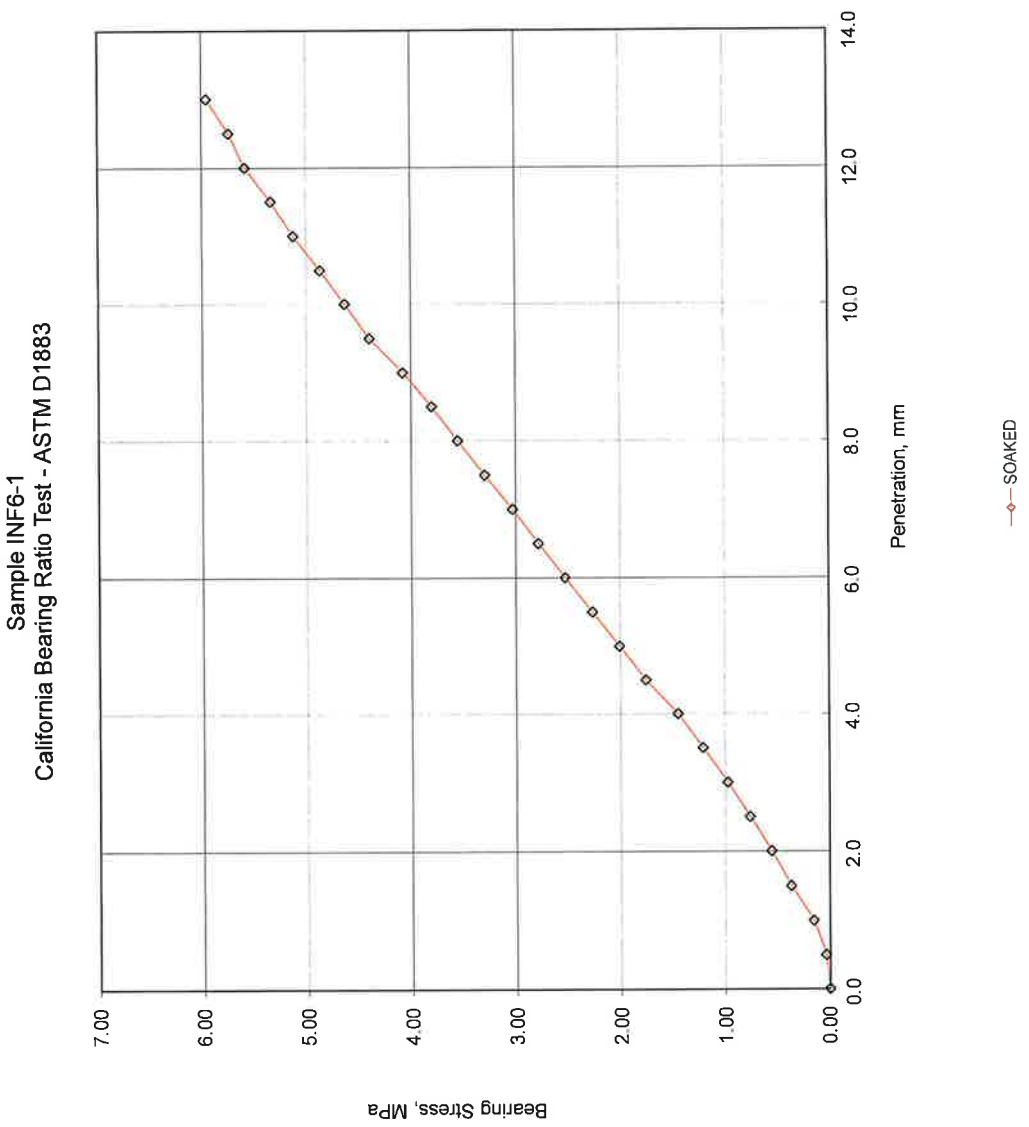
TEST RESULTS

	SOAKED
WATER CONTENT AT PENETRATION POINT, %	10.03
SWELL, %	2.16
CORRECTED STRESS VALUE (at 2.5 mm), MPa	1.10
CORRECTED STRESS VALUE (at 5.0 mm), MPa	2.45
BEARING RATIO (at 2.5 mm), %	***15.94***
BEARING RATIO (at 5.0 mm), %	***23.79***

Checked By: AH

WSP CANADA INC

CALIFORNIA BEARING RATIO TEST (CBR)



Project No.CA-0011941.3280(3000) **WSP Canada Inc.** Checked By: AH

Appendix B: Bioswale Construction Specifications

Supply and Install 600mm x 600mm Catchbasin (OPSD 705.010) Including Frame and Beehive Grate

The requirements of **OPSS 407** shall apply to these items, except as otherwise specified herein.

Work under this item shall include all materials, equipment, and labour necessary to supply and install/place the catchbasins as detailed on the contract drawings. This works shall include catchbasins with a 600mm sump and catchbasins without sumps as detailed on the contract drawings. Each catchbasin installation shall include a beehive grate (Product JW-105B) or approved equivalent per contract drawings.

- ***Measurement and Basis for Payment***

Measurement for this item shall be each unit. Payments made to the Contractor under this item shall include all labour, materials, and equipment for the installation of each catchbasin unit regardless of depth, at the applicable unit prices tendered.

Payment at the Contract unit prices shall be full compensation for supplying all materials, for all excavation and for the disposal as directed by the Agency of surplus excavated materials, for the placing and compacting of granular bedding and backfill, for the construction or installation of the precast unit, for catchbasin adjustments required, for the supply and installation of the frame and grate, for benching, and for all other items of Work necessary to complete the structures in accordance with the Contract requirements.

Catchbasin Waterproof Membrane

Work under this item shall include all materials, equipment, and labour necessary to seal inside and outside of joints with mortar and a 600mm wide strip of waterproof membrane.

The waterproof membrane shall be placed to form a continuous barrier centered around the exterior of all buried and exposed joints. The waterproof membrane shall be free of folds, tears, and wrinkles. The waterproof membrane shall be joined so that the material laps a minimum of 500mm and shall be pinned together. The Contractor shall ensure that the catch basin is sealed at all joints. The waterproof membrane shall be “MEL-ROL” by W.R. MEADOWS of MILTON ONTARIO or approved equivalent.

- ***Measurement and Basis for Payment***

Measurement for this item shall be each unit. All materials, labour and equipment required to complete the works shall be included under SP-17 Supply and Install 600mm x 600mm Catchbasin (**OPSD 705.010**) Including Frame and Beehive Grate.

Supply and Install Sewer Connections Including Excavation, Bedding and Cover and Backfill

The requirements of **OPSS 490** and manufactures standards for construction of pipe sewers shall apply, except as modified herein.

- ***PVC SDR35 Pipe***

As a minimum, all pipes shall be marked to designate the pipe manufacturer, pipe class, and Manufacturer's Quality Assurance Stamp. Each fitting or special shall be marked to indicate its position in the pipeline.

- ***HDPE Pipe***

As a minimum, all pipes shall be marked to designate the pipe manufacturer, pipe class, and Manufacturer's Quality Assurance Stamp. Each fitting or special shall be marked to indicate its position in the pipeline.

- ***Bedding and Cover Materials***

Class 'B' bedding and cover material, specifically 20mm Crusher-Run Limestone, shall be used for entire sections of the solid sewer sections and shall conform to the requirements of **OPSS 1010**. The cost of this shall be included in the unit price provided for this item. Bedding and cover heights shall be installed per **OPSD 802.030** and **802.032**.

All subgrade conditions must be inspected and approved by a geotechnical Engineer/ Contract Administrator retained by the Contractor prior to placement of bedding and cover material with reports and records provided to the Contract Administrator and Owner for their review and records.

- ***Joints***

All pipe joints shall be leak proofed or wrapped with a waterproof membrane as specified by the product manufacturer.

- ***Backfill Material***

Backfill shall be according to **OPSS 902**.

On-site inorganic soils may be suitable for trench backfill for areas not within the road right-of-way or below surface structures. All specific requirements for native backfill installation shall be provided by the Contractor at no additional cost should native backfill material be approved for use.

Native backfill with a moisture content of 3% or more shall not be installed until properly dried such that adequate compaction can be achieved. Native backfill shall be installed in 200mm lifts and compacted to

98% SPMDD at a water content close to optimum (within 3% of optimum).

Native backfill must not include particles greater than 100mm dimensions, greater than 15% of the material larger than 4.8mm, and greater than 5% organic content by weight, as well as visible roots or topsoil.

Native/excavated fill material used as backfill must be approved for use by a Geotechnical Engineer/ Contract Administrator retained by the Contractor prior to backfilling with reports and records provided to the Contract Administrator and Owner for their review and records. The Contractor shall also provide compaction reports.

Unshrinkable backfill shall be required to backfill pipe section situated within the road right-or- way, the use of such unshrinkable backfill shall be considered included in the tendered item price.

The height of backfilling under roadway and curb sections or under surface structures is to be at the level where the existing or proposed granular road/surface feature subgrade begins, as per **OPSD 802.030** and **802.032.** The height of backfill in all other areas shall be a maximum of 300mm below finish grade.

Where badly weathered or loose soils are encounter, they should be sub-excavated and replaced with bedding material compacted to 95% SPD. Payment for additional excavation and bedding material shall be made based on a time and material basis. Quantities for any soft spotrestoration shall be verified through on-site measurements as agreed upon between the Contract Administrator and Contractor. Approval of all soft spot restoration shall be made by the geotechnical Engineer/ Contract Administrator retained by the Contactor with reports and records provided to the Contract Administrator and Owner for their review and records.

- ***Pipe Support at Catchbasin***

Concrete pipe support at catchbasins and maintenance holes shall be required as shown on standard **OPSD 708.02**.

- ***Removal of Abandoned Utilities***

The Contractor shall include in their unit price bid for this item, the removal of abandoned utilities in order to complete their work.

- ***Curb and Gutter Removal and Restoration***

The unit price bid for this item shall include the sawcutting, removal and disposal of curb and gutter and reinstallation of curb and gutter sections where required for the installation of the storm sewer sections per **OPSS 510** and City of Ottawa Sidewalks, curbs and pathways standard detail drawings.

- ***Sidewalk Removal and Restoration***

The unit price bid for this item shall include the sawcutting, removal and disposal of sidewalk and

reinstallation of sidewalk sections where required for the installation of the storm sewer sections per **OPSS 510** and City of Ottawa Sidewalks, curbs and pathways standard detail drawings.

- ***Road Asphalt and Base Removal and Restoration***

The unit price bid for this item shall include the sawcutting, removal and disposal of asphalt and road base materials and reinstallation of base materials and asphalt sections where required for the installation of the storm sewer sections per **OPSS 510** and IBI standards and detail drawings.

- ***Measurement and Basis for Payment***

Payment shall be made at the price bid per linear metre for supplying all materials, carrying out all excavation, dewatering, sheathing, shoring and disposal of excess material, supplying and installing sewer pipe, supplying placing and compacting bedding, cover and backfill material, supplying and placing concrete bedding, pavement restoration, sidewalk, curb and gutter, and boulevard removal and restoration (as required), and all other work to complete the storm sewer system as specified on the Contract Drawings, and herein.

Supply and Install 200mm PVC SDR35 Perforated & Solid Underdrains

The requirements of **OPSS 401** and **OPSS 410** shall apply and govern except as amended or extended herein.

Works under this item comprise the supply of all equipment, labour, and materials required for the installation of 200mm diameter sections of PVC SDR35 pipe (smooth interior, perforated & solid) required for the bioswales including all connections with structures and manufacturer approved fittings as shown in the Contract Drawings and/or directed by the Engineer/ Contract Administrator. It should be noted that bedding and backfill for the pipe shall consist of the 20mm clear stone aggregate per SP-21. Solid piping shall be used within 1.0m of connections with catch basins/maintenance holes and sidewalls of permeable pavement and bioswale excavations.

The Contractor is to supply and install the PVC pipes as indicated on the drawings. The underdrain material is specified as Heavy walled PVC (polyvinyl chloride) SDR35 pipe. The underdrain shall meet the requirements of **OPSS 1840** and **OPSD 1801,** and **CSA B182.8** for open profile sewer and drainage pipe. All piping shall use manufacturer approved couplings and fittings.

All perforated pipe section must arrive on-site with manufactured perforations. The installation of manual perforations onsite is not acceptable unless approved by the Engineer/ Contract Administrator.

The Contractor shall note that the unit price per linear meter for piping shall include the cost of the following items associated with the piping work:

- Any shoring, if required.
- De-watering of the excavation.
- Excavation and off-site disposal of underdrains requiring trenching.
- Supply, place and connection of underdrain works.

- Manufacturer approvedcouplings and fittings.
- Connections with proposed and existing maintenance hole and catchbasins.
- All underdrains using plastic pipe shall require deflection testing as per **OPSS 410.07.15.05 prior** to placing of surface works.

- ***Measurement and Basis of Payment***

Measurement for this item shall be linear meters. Payments made to the Contractor under this item shall include all labour, materials, and equipment for the installation of these items at the applicable unit prices tendered.

Supply and Install Aggregates (20mm Washed Clear Stone, HPB, & 3- 10mm Washed Pea Gravel)

Work under this item shall include all materials, equipment, and labour necessary to supply and install/place, and grade aggregate material for the bioswales.

For the bioswales stone reservoir layers, material shall consist of a clear, crushed, angular, washed 20mm diameter stone confirming to **ASTM No. 57** and installed as per the thickness and details as shown on Contract Drawings. Choking course layers shall consisted of a 150mm thick layer of 3-10mm washed pea gravel material.

All aggregate material shall be washed and cleaned and shall be free from fines. All aggregates shall have equal to or less than 2% passing the No. 200 (0.075 mm) sieve. Aggregate material shall be supplied, placed and sized as detail on Contract Drawings.

- ***Measurement and Basis of Payment***

Payments made to the Contractor under this item shall include all labour, materials, and equipment for the installation of these items at the applicable unit prices tendered. Measurement for this item shall be tonnes.

Supply and Install Geotextile (Filter Fabric)

Work under this item shall include all materials, equipment, and labour necessary to supply and install/place a needle punched non-woven geotextile between open grade field stone used to line the sidewalls of the permeable pavement and bioswale excavations in addition to lining the bottom and sides of the permeable pavement underdrain trench excavations in order to prevent fine migration from the native soils into the open grade stone and biomedia. This material shall conform to the material specifications in **OPSS 1860** Class II geotextile fabrics (i.e Terrafix 270R or approved equivalent).

Geotextile material shall be placed smooth and free of tension stress, folds, wrinkles and creases. Each successive strip of geotextile shall overlap the previously overlapped by 600 mm. Geotextile used within permeable pavement underdrain trench excavations shall extend 300mm along permeable pavement subgrade on either side of the trench. Geotextile install along sidewalls of the bioswale and permeable pavement excavations shall extend 300mm along bottom of excavation and be pinned down by open

graded, granular backfill.

For the selection of geotextile fabric, the following criteria shall be followed:

- Apparent Opening Size (AOS) OR Percent Open Area (POA):
- For fine grained soils, the AOS ≤ 0.3mm (non-woven fabrics) and POA ≥ 4% (woven fabrics)
- Hydraulic Conductivity (k, in cm/sec)
- k (fabric) > k (soil)
- Permittivity {k (fabric)/ thickness (fabric)}(in sec-1)
- For fine grained soil, the permittivity shall be 0.1 sec-1.

The installed geotextile shall be protected from displacement, damage or deterioration before, during, and after placement of material layers. The Contractor shall replace any damaged or deteriorated geotextile to the approval of the Engineer/ Contract Administrator.

- ***Measurement and Basis of Payment***

Measurement for payment will be in square metres of geotextile placed and will be calculated by multiplying the length by the width of the area where fabric is placed. No allowance will be made for seams and overlaps. Payment at the Contract price shall be full compensation for all labour, equipment and material to do the work. The Contractor must supply receipts which clearly identify the product type prior to issuances of payment.

Supply and Install Clay Seals

Work under this item shall include all equipment, labour, and materials required to install all clay seals including all items as indicated in the contract drawing details. The clay seals shall meet the requirements of **OPSD 802.095**, the associated special provisions and City of Ottawa standards.

- ***Measurement and Basis of Payment***

Measurement of this items shall be per unit installed (i.e. each). Payments made to the Contractor under this item shall be considered as payment in full for these items in the applicable unit prices tendered.

Supply and Install Bioswale Monitoring Wells

Work under this item shall include all materials, equipment, and labour necessary to supply and install monitoring wells as specified on the Contract Drawings. The item shall include the supply of all labour, equipment and materials to install/undertake the following:

Additional excavation and off-site disposal of material required to install well sumps. 150mm

diameter PVC piping and manufacturer fittings required for well assembly.

6 ¼" I.D x 12" height flush mount monitoring well covers (bolt-down) available from Wellmaster Pipe and Supply Inc. (Tel: 1-800-387-9355) or approved equivalent. Models may vary.

20mm diameter, washed clear stone to fill sump. Geotextile to
line sump excavation sidewalls and bottom.

- ***Measurement and Basis of Payment***

Measurement for payment will be per each monitoring well supplied, assembled and installed. Payment at this Contract unit price for this item shall include all labour, materials, and equipment to complete the work.

Catch Basin TemporaryOff-line Measures (EPDM Liner and Plugs)

Work under this item shall include all materials, equipment, and labour necessary to install all EPDM liners in all bioswale internal catchbasins and plug all bioswale underdrain connections upon completion of Phase 1. Works shall also include the removal of all EPDM liners and underdrain plugs upon completion of Phase 2 with approval from the Contract Administrator.

The EPDM liners and underdrain plugs shall be installed per contract drawings.

- ***Measurement and Basis for Payment***

All materials, labour and equipment required to complete the works shall be included in this unit price and measured per each catch basin sealed. Payment at the contract unit price for theabove items shall be compensation in full for supplying all labour, equipment, and materials to complete the work.

Supply and Install Biomedia

Work under this item shall include all materials, equipment, and labour necessary to supply and install Biomedia as per the Contract Drawings including:

- ***Materials***

Biomedia shall be obtained premix from supplier. Contact Greely Sand and Gravel at 613-821- 3003 or 416-791-6700, or approved equivalent. Media shall be comprised of a mix of organic matter and sand in the following proportions:

85-88% sand (grain size 2.0-0.05mm) 8-

12% fines (less than 0.05mm)

3-5% organic matter

Filter media is to remain free from contamination from clay, in-situ soils or other debris throughout the duration of the construction period. For more details on media specification, refer to construction notes on contract drawings. Filter media is to conform to Table 1 Media for bioswale facility as detailed in the contract drawings. On-site mixing of media is not acceptable.

- ***Sampling and Testing***

Contractor to provide testing results prior to installation for the parameters shown on the design drawings or as specified by the Engineer/ Contract Administrator. Deliveredmediashall be tested and approved by the Engineer/ Contract Administrator prior to installation. Media installed without Engineer/ Contract Administrator approval shall be removed at the Contractor's expense if deemed necessary by the Engineer/ Contract Administrator. The Contractor will be solely responsible for all required media testing expenses. Media testing results can be expected approximately 2 - 3 weeks after submission to lab. The Contractor is responsible for any delays suffered as a result of testing. No compensation will be provided for delays due to media analysis. In any areas where the tests do not meet the specifications, rectification and retesting shall be done at the Contractor's expense.

Contractors' equipment and method of materials testing are subject to the approval by the Engineer/ Contract Administrator. The Contractor shall receive and use chain of custodies provided by the Engineer/ Contract Administrator with the approved tests to be performed as part of the media certification. The Agency shall not be responsible for expenses suffered should the Contractor pre-emptively undertaking testing using the incorrect testing parameters.

The Contractor must fulfill the following biomedia testing requirements to ensure that the desired filter media mixes areachieved.

i. The Contractor must provide a hand mixed sample of the proposed filter media to be submitted for analysis. Hand mix samples are intent to roughly gauge the proportions of materials required in order to satisfy the specifications. Depending on the soil manufacturer/Contractor, submission of hand mixed samples may have to be conducted several times to obtain a passing sample. Analytical results must be submitted to and approved by the Engineer/ Contract Administrator prior to beginning mechanical mixing operations.

ii. Media samples from mechanically mixed operations must be submitted for analysis and satisfy the media specifications. To minimize contamination and clean out the mixing system prior to sampling, a minimum of ten (10) cubic meters of filter media must be passed through the system and disposed of. A minimum of three (3) samples shall be collected from the next ten (10) cubic meters of material including one from the bottom of the pile (1-3 m^3 of material), the middle (4-6 m^3 of material), and top (7-10m^3 of material). Approved mechanically mixed samples shall be issued

for installation.

iii. All hand and mechanically mixed samples must be submitted to a certified laboratory. Chain of Custodies which details the required testing to be conducted should be assemble by the Engineer/ Contract Administrator and provided to the Contractor.

iv. Obtaining media samples shall be conducted by the Contractor.

v. The Contractor shall notify the Engineer/ Contract Administrator when the mechanically mixing operations shall be taking place and be provided the opportunity to observe the source material being used for mediadevelopment and mixing operations. The Contractor must ensure that access for sampling is provided to the Engineer/ Contract Administrator if necessary.

vi. Delivered media shall be tested and approved by the Engineer/ Contract Administrator prior to installation and originate from the same location and use the same materials as the approved samples.

vii. Media installed without Engineer/ Contract Administrator clearance shall be removed at the Contractor's expense if deemed necessary by the Engineer/ Contract Administrator.

viii. The Contractor is solely responsible for all required media testing expenses.

ix. The Contractor is responsible for any delays suffered as a result of testing. No compensation will be provided for delays due to media analysis.

- ***Execution***

a) Spread biomedia within excavated limits and fill to required design grades. Placement on biomedia shall be in 150-200mm lift. Each lift shall be properly consolidated by soaking the media with water prior to placing of sequential lifts. Grade as required to achieve proposed ditch profile and cross-section.
b) Soak biomedia with water to achieve natural consolidation and fill areas of settling to required design grades. Ensure positive drainage is provided.
c) Install surface treatments immediately following biomedia placement. Placement of biomedia shall only be permitted if surface treatment placement is to immediately follow.

- ***Other Conditions***

Biomedia shall remain free from contamination from clay, in-situ soils, or other sources of contamination throughout the duration of the construction period. Any potential risk of contamination shall be investigated by the Engineer/ Contract Administrator. The Contractor may not claim for delays suffered as a result of such activities. Shall contamination of the biomedia be confirmed, the Contractor shall be responsible for rectifying the area of contamination, as delineated by the Engineer/ Contract Administrator, through the removal and off-site disposal of contaminated material and replacement thereof usingapproved biomedia, at the Contractor's own expense.

Prior to acceptance, the Contractor shall repair any erosion and areas of settlement which may occur within the bioswale areas.

- ***Measurement and Basis of Payment***

Measurement shall be per tonne of material supplied and installed. Payments made to the Contractor under this item shall be compensation in full for all labour, material, and equipment per the applicable unit prices tendered.

Supply and Install Hardwood Mulch

Work under this item shall include all materials, equipment, and labour necessary to supply and install shredded Natural Hardwood Mulch over all areas specified on the Contract Drawings. Installation shall conform to the requirements of **OPSS 804** and **572**. Obtain the approval of the Contract Administrator of the finished grading surface before proceeding with mulch.

The hardwood mulch shall be aged a minimum 12 month prior to installation. The hardwood mulch shall be laid smooth to a minimum depth of 75mm and reduced to 50 mm around the base of trunks and shrubs as specified in the contract drawings within bioswale areas. The hardwood mulch shall meet the adjoining grass areas and paving and top surface of adjacent hard surfaces unless shown otherwise on the drawings.

It is the Contractor's responsibility to take all necessary precautions as required to protect all newly mulched areas from damage. If broadleaf weeds appear in maintained areas, Contractor shall remove weeds by hand.

- ***Measurement and Basis of Payment***

Measurement for payment shall be made on a per cubic meter basis. Payment at the contract unit price for the above items shall be compensation in full for supplying all labour, equipment, and materials to complete the work.

Supply and Install Aluminum Edging

Work under this item shall include all materials, equipment, and labour necessary to supply and install 3.2mm x 140mm 1.82mm thick Black duraflex aluminum edging at all locations specified on the Contract Drawings. The Contractor shall submit shop drawings or material specifications to the Contract Administrator for approval prior to installation.

- ***Measurement and Basis of Payment***

Measurement for payment shall be made on a per linear meter basis. Payment at the contract unit price for the above items shall be compensation in full for supplying all labour, equipment, and materials to complete the work.

Supply and Install Bioswale Plantings

Work under this item shall include all materials, equipment, and labour necessary to supply and install, of all specified plant material within the bioswale Area 1 as per the drawings and details.

- ***References***

Abbreviations and Acronyms:

- All work shall conform to currentOPSS specifications and OPSD standard details.

- ***Quality Assurance***

Contractor Qualifications: Work specified herein shall be done by experienced, qualified personnel, under the direction or supervision of a foreman with minimum five (5) years of horticultural and planting experience.

- ***Source Quality Control***

- Make arrangements for prior inspection and approval of plant material at source of supply and at a time mutually agreedupon.
- Prior approval will not invalidate rejection of stock at later inspection should it prove defective or damaged.

- ***Submittals***

- Green Material Data Sheet
  - Submit completed GMDS with all supporting documentation for the Engineer/ Contract Administrator's review with shop drawings.
  - If more than one type of material or product is supplied, provide a separate GMDS for each.
- Affidavits
  - Submit affidavits to certify that manufactured or processed materials supplied in bulk meet specified requirements, if requested.

- Maintenance Instructions
    - Submit instructions on maintenance procedures to be followed after end of specified maintenance period.

- ***Delivery, Storage and Handling***

- Label manufactured, processed or otherwise prepared materials that are packaged with full details of contents and source of supply.
- Store and protect products to prevent damage from moisture

Plant Material:

- Transport plants specified "B&B" with solid balls wrapped with 150 gram hessian burlap. Wrap balls under 450mm diameter. with single thickness, between 450mm and 1000mm diameter with double thickness, and 1000mm diameter and over with double thickness and drum laced with 5mm rope at 200mm spacing.
- Transport plants with frozen ball only when they are complete with root systems intact.
- Transport plants with branches tied to prevent damage, and padded to avoid abrasion from equipment.
- Prevent drying out of any part of plants from time of removal at place of origin until they are planted. While temporarily stored at site, protect them with soil, or similar materials, and keep moist.
- Spray plant materials with an anti desiccant immediately before moving them from their original location. Apply a sufficient amount over trunks, branches, and foliage. Plants may be re-sprayed after planting.

Site Conditions

- Environmental Requirements: Install landscaping specified in this Section under weather conditions and in growth season suitable for each specified material, and as approved.

Scheduling Work

- Schedule work to minimize conflict with other trades on work site to minimize repairs of work previously executed.

Warranty

- Plants accepted during the period from January 15 to July 15 shall be warranted until July 15 the following three (3) years.
- Plants accepted during the period from July 15 to December 15 shall be warrantedfor three (3) years from date of acceptance.
- The warranty periods listed above shall apply to all nursery grown plants.
- During the warranty period, replace all plants which are dead, missing, or which are not in healthy, vigorous growing condition immediately upon notification and do all maintenance.
- Notify the Agency and Engineer/ Contract Administrator, in writing, of any corrective or preventive measures necessary to safeguard planting and date measures performed.

- Supply and plant all replacements in strict accordance with Drawings and Specification and warrant replacements as specified.
- During warranty period, remove from site any plant material that has died, or failed to grow satisfactorily as determined by the Engineer/ Contract Administrator.
- Replace plant material immediately upon notification. Extend warranty of replacement plant material for a period equal to the original warranty period.
- Continue such replacement and warranty until plant material is acceptable.

Products

Materials

i. Sustainability Characteristics: It is the responsibility of the Contractor to ensure mandatory credits, measures, targets, etc, are met.

ii. Biomedia: For finished grading biomedia shall be used to finalize surface grading and act as growing media within the proposed Bioswaleareas.

iii. Shredded Hardwood Mulch: Aged (minimum 12 months) shredded hardwood mulch shall be used around trees, perennials and shrubs as required.

iv. Topsoil: Topsoil shall be used to restore areas outside of Bioswale areas as boulevards, excluding areas where biomedia has been installed. Cross-contamination shall not be accepted.

v. Anti-desiccant: Emulsion to form permeable film over plant surfaces, and mixed according to manufacturer's directions.

vi. Accessories:

- Tree Wrapping: Minimum 250 grams/m^2 mass first quality burlap in strips from 150mm to 250mm wide, or heavy waterproof crepe paper 100mm to 150mm wide.

- Stakes: For Cable Anchors: 150mm diameter galvanized steel disc, screw in type.
  For trees: T rail iron stakes primed with 1 brush coat of matte black paint.

- Cable, Wires: Zinc coated steel cable of diameters suitable for anticipated stresses for trees over 150mm caliper; and zinc coated pliable wire of minimum 3mm for trees between 75mm and 150mm caliper and minimum 2.5mm for those under 75 diameter Mm.

- Eye Bolts, Turnbuckles: Zinc coated. Turnbucklesshall have 10mm diameter bolts for trees over 75mm caliper and 5mm diameter bolts under 75mm.

- Hose: 12mm diameter New black rubber, 2 ply reinforced.

vii. Plant Material:

- Quality and Source: Comply with Guide Specification for Nursery Stock 1996 Edition of Canadian Nursery Trades Association referring to size and development of plant material

and root ball. Measure plants when branches are in their natural position. Height and spread dimensions refer to main body of plant and not from branch tip to branch tip. All plants shall be No. 1grade.

- Plant materials obtained from area with milder climatic conditions from those of site are acceptable only when moved to site prior to the breaking of buds in their original location and heeled in in a protected area until conditions are suitable for planting.

- Use trees and shrubs with strong fibrous root system free of disease, insects, defects or injuries and structurally sound. Use trees with straight trunks, well and characteristically branched for species. Plants must have been pruned regularly, but not later than 1 growing season prior to arrival on site.

- Plant material that has come out of dormant stage and is too far advanced will not be accepted unless prior approval is obtained.

- Prepare plants with cleanly cut roots: split roots will not be accepted. Cut roots atedges of ball when combing is not practised. Paint ends of cut roots 25mm diameter and larger with asphalt emulsion.
- Ensure that plants are healthy; in vigorous growth; well branched; densely foliated in leaf; with well developed root systems; and free of disease, damage, insect pests, and eggs orlarvae.

- Ensure that woody stems, branches, and trunks are free of sun scalds, frost cracks, rodent damage, abrasions, and cuts; that old wounds are completely calloused over; that pruning wounds have vigorous bark growth on all edges, and that all parts are moist and show live green cambium tissue when cut.

- Container grown stock is acceptable if containers are large enough for root development. Root system must be able to hold soil when removed from container. Plants that have become root bound are not acceptable. Container stock must have been fertilized with slow releasing fertilizer.

- Balled and Burlapped: All coniferous and broad leafed evergreens must be dug with soil ball. Deciduous trees in excess of 300cm height must have been dug with large firm ball. Root balls must include 75 per cent of fibrous and feeder root system. This excludes use of native trees grown in light sandy or rocky soil. Secure root balls with burlap, heavy twine and rope. For large trees, wrap ball in double layer of burlap and drum lace with minimum 10mm diameter rope. Protect root balls against sudden changes in temperature and exposure to heavy rainfall.

- Substitutions: Substitutions to plant material as indicated on planting plan is not permitted unless written approval has been obtained as to type, variety and size. Plant substitutions must be of similar species and of equal size as those originally specified.

- Plants larger than specified will be accepted without liability to extra charges if they meet all specified requirements fortheir size.

viii. Mulch: Aged Shredded Hardwood (minimum 12 months).

ix. Wound Dressing: Horticulturally acceptable non-toxic, non hardening emulsion.

- ***Execution***

Examination

- Examine site before commencement of installation, and inform Consultant if site conditions will not permit completion of landscaping installed by this Section as specified.
- Ensure that sub grade preparation and drainage is satisfactory for continuing maintenance and growth of specified landscape plant materials.

Preparation

- Stake locations of plant pits for approval before they are excavated.
- Excavate plant pits to a minimum of 600mm and allow at least 150mm of planting soil under rootballs of all shrubs. Ensure that rootballs of trees is firmly supported by undisturbed subgrade.
- Remove rocks, existing and abandoned construction work or similar obstructions to 150mm below bottom of pit. Do not remove any obstruction until approval has been given by Consultant.
- Dispose of surplus excavated material away from site. Surplus material not used for backfilling shall not be spread elsewhere throughout Bioswales such that final grades are altered.
- Test plant pits for water percolation prior to the placement of plant material. Ensure drainage adequate for the plant survival.

Planting Time

- Plant material noted for spring planting only must be planted in dormant period before buds have broken.
- Plant material imported from region with warmer climatic
- Plant evergreens in spring before bud break. Planting of such stock with root balls may start after middle of August. Apply anti desiccant to evergreens before digging.
- Plant only under conditions that are conductive to health and physical conditions of plants.
- Provide planting schedule. Extending planting operations over long period using limited crew will not be acceptable.

Planting Methods

- Partially fill planting pit with biomedia mix
- Set plants plumb and after settlement has taken place, so that they are in the same relation to grade as they originally grew.
- Place bare root plants with roots in their natural position.
- Face shrubs and trees as approved to give best appearance when viewed from prime vantage points.
- Pull away and remove burlap, rope and wire from tops and sides but not bottoms, of root

balls. Ensure that balls rest on a minimum of 150mm of planting soil.
- Do not plant stock with root balls that have been racked or broken during delivery, handling or planting.
- Backfill around roots with planting soil in 150mm layers. Tamp in place to pack firmly and to eliminate all air pockets around roots.
- For each plant, not located in a planting bed, provide an earth saucer at its base of the same diameter as its planting pit in which to retain water.
- Thoroughly water when planting pit is half filled. When water has drained, complete backfilling, and water again.

Trunk Wrapping and Plant Support

- Wrap main tree stems of 50mm caliper, or greater, from grade to just above second branches.
- Before wrapping, spray trunks with a wettable powder of long residual insecticide to provide protection from borers.
- Apply wrapping spirally and snugly with overlap to shed rain, and held in place with cord.
- Brace upright trees and large shrubs with three guys. Install a turnbuckle in each guy to allow for takeup. Use cable or wire and required for anticipated stresses.
- Attach guys to anchors spaced equidistant around plant and 60mm below grade.
- Attach guys to trunks of trees above lower branches and to shrubs where possible, but in all cases so that plant is not subjected to undue strain. Cover guys with rubber hose where they contact plant.

Pruning

- Prune plants a minimum amount after planting, but sufficiently to remove dead or injured members, to compensate for loss of roots when transplanted, and to shape the plant into natural character as intended by landscape design.
- Do not remove leaders.
- Make cuts smooth, clean and flush to branch collar. Leave no stubs beyond branch collar.
- Cut back cambium to living tissue where cuts are made, and at bruises, scars and other injuries. Shape wood to prevent retention of water.
- Paint over pruned cuts of greater than 25mm and other treated areas with tree paint.

Mulch Beds

- Place mulch to an average depth of 75mm distributed uniformly, in planting areas.

Adjustment and Replacement

- At time of final acceptance, at substantial completion, and again at termination of warranty period, landscaping installed by this Section will be inspected by the Engineer/ Contract Administrator. Make required adjustments and replacements of defective landscape installations at no additional cost.
- Commencement of warranty period is predicated on acceptance of landscaping with only minor deficiencies.
- Perform adjustment and replacement of defective landscaping installations with materials of same size, variety and quality of material replaced, as approved by the Engineer/ Contract

Administrator.

- Replace landscaping installations under a warranty of the same length and conditions applicable for original Contract. Date renewed warranty from time of approval of replacement.
- Replace plant stock that is dead, or not in flourishing and satisfactory growing state, or that does not meet specification requirements. Remove dead stock immediately. Replace stock at proper time during planting season. Disapproved but growing stock may be left, its warranty period extended, and inspected again next planting season. At this time request for replacement may be made.
- After settlement has occurred at planting saucers in sodded areas, backfill with biomedia and mulch around base of plant, ensure that grades blend smoothly with adjacent grades.
- Remove tree wrapping, tree stakes and guy wires at end of warranty period.
- Ensure that all paved areas, structures and adjacent landscape elements are clean and all debris is disposed of.

- ***Measurement of Payment***

Measurement for this item shall be for each unit supplied and installed. Payments made to the Contractor under this item shall include all labour, materials, and equipment for the supply, installation, and maintenance of these items at the applicable unit prices tendered. All planting accessories and appurtenances shall be included in the applicable unit prices tendered under this item.