STORMWATER MANAGEMENT REPORT

WHELAN TRUCK REPAIR INC.

158 CARDEVCO ROAD, OTTAWA

PREPARED FOR

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REVISIONS & SUBMISSIONS

Revision #	Comments	Date
00	60% Design Issued for Review and Comment	December 2, 2022
01	Revised per City Comments (January 27, 2023)	August 17, 2023
02	Revised per City Comments (September 29, 2023)	November 30, 2023
03	Revisions to accommodate easement adjustments	November 25, 2024
04	Revised per City Comments (January 8, 2025)	January 27, 2025
05	Same as Rev 04, but with updated "Issued for Construction" plans. No changes to body of report.	April 1, 2025
06	Revised per City and MVCA Comments	September 25, 2025

EXECUTIVE SUMMARY

Shade Group Inc. was retained by Whelan Truck Repair Inc. to provide civil engineering design services pertaining to the proposed development at 158 Cardevco Road, Ottawa. The development is understood to include construction of an addition to the existing structure which is to consist of a new 50' by 100' pre-engineered building that is to be connected to the existing 50' by 100' structure by way of a new 14' x 100' breezeway.

The subject property is located at 158 Cardevco Road; approximately 400m north of Richardson Side Road and approximately 300m west of Carp Road. The site is located within a development adopted by way of Plan of Subdivision known as the Cardevco Industrial Park. Cardevco Industrial Park was adopted by Plan of Subdivision 4M-356.

The primary objective of this report is to provide stormwater management details in accordance with the recommendations and guidelines provided by the Ministry of the Environment, Conservation and Parks (MECP), the City of Ottawa and the Mississippi Valley Conservation Authority (MVCA). As this property is encompassed within a formerly adopted Plan of Subdivision, this report has also been prepared in reference to the specifications as outlined in the Subdivision Agreement for 4M-356, as applicable.

The site is rural in nature and serviced by private well and septic. For further information pertaining site servicing, refer to the Site Servicing Report prepared by Paterson Group.

The site has been designed to restrict post-development peak flow rates up to the 100-year storm event to no more than the 2-year pre-development peak flow rate, per City of Ottawa specifications.

The proposed stormwater management system is to be comprised of a clearstone filled perimeter drain, lined with an impermeable membrane, along much of the perimeter of the site; and two concrete storage tanks for additional temporary stormwater storage. The perimeter drain is intended to intercept overland sheet flow, offer particle filtration through the clearstone, and offer temporary retention storage for runoff, without impeding traffic flow on the site. The trench bottom will be sloped at 0.5% and will convey runoff towards an outlet control structure that is to be comprised of an 83mm orifice within a manhole structure housing an oil-grit separator intended to provide enhanced quality control treatment of runoff prior to release. Runoff out of the treatment unit will be directed to the City's roadside ditch, with all infrastructure located on private property so as not to impede future City maintenance works. The proposed system is intended to meet the City's specifications for both quality and quantity treatment for the site.

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1.0 INTRODUCTION

Shade Group Inc. was retained by Whelan Truck Repair Inc. to provide civil engineering design services pertaining to the proposed development at 158 Cardevco Road, Ottawa. The development is understood to include construction of an addition to the existing structure which is to consist of a new 50’ by 100’ pre-engineered building that is to be connected to the existing 50’ by 100’ structure by way of a new 14’ x 100’ breezeway. We understand that the proposed development is subject to Site Plan Control under the *Planning Act*.

2.0 OBJECTIVE

Shade Group was retained to prepare the civil engineering design works associated with the subject property. Our scope of work included preparation of the following:

- Grading and Drainage Plan (**Appendix J**);
- Stormwater Management Report.

The primary objective of this report is to provide stormwater management details in accordance with the recommendations and guidelines provided by the Ministry of the Environment, Conservation and Parks (MECP), the City of Ottawa and the Mississippi Valley Conservation Authority (MVCA). As this property is encompassed within a formerly adopted Plan of Subdivision, this report has also been prepared in reference to the specifications as outlined in the Subdivision Agreement for 4M-356 (as applicable).

3.0 BACKGROUND INFORMATION

The following guides, standards and supporting reports were referenced in the preparation of this report:

3.1 GUIDELINES & STANDARDS & WATERSHED STUDIES

- **City of Ottawa Sewer Design Guidelines**, Second Edition, City of Ottawa, October 2012;
- **Technical Bulletin ISDTB-2014-01**, City of Ottawa, February 5, 2014;
- **Technical Bulletin PIDTB-2016-01**, City of Ottawa, September 6, 2016;
- **Stormwater Management Planning and Design Manual**, Ministry of the Environment, March 2003;
- **Interpretation Bulletin: Ontario Ministry of Environment and Climate Change Expectations Re: Stormwater Management**, Ministry of the Environment and Climate Change (Now Ministry of the Environment, Conservation and Parks), February 2015;
- **Carp River Watershed/Subwatershed Study**, Robinson Consultants Inc., December 2004;
- **Huntley Creek 2017 Catchment Report**, Mississippi Valley Conservation Authority, 2017.

3.2 SUPPORTING STUDIES

- **Geotechnical Investigation (Rev 04)** Proposed Building Addition 158 Cardevco Road, Paterson Group, November 22, 2024.
- **Site Servicing Report (Rev 04)** Site Plan Application 158 Cardevco Road, Paterson Group, January 27, 2025.
- **Groundwater Monitoring Program** Proposed Industrial Addition 158 Cardevco Road, Paterson Group, November 22, 2024.

3.3 OTHER

- **Pre-application Consultation Meeting Notes**, City File No PC2022-0012, February 11, 2022;
- **Preliminary Structural Engineering Drawing Package**, S0-S8, Daido Group Inc, November 14, 2021;
- **Site Plan + Architectural Drawing Package**, A0-A6, Chris A. Leggett Architect Inc, November 12, 2021;
- Former **Site Plan**, Pri-Tec Construction Ltd., January 1991;
- **Subdivision Agreement**, November 15, 1982;
- **Site Grading Plan Cardevco Industrial Park**, R. W. Connelly Associates Ltd, March 1990 (Drawing No. 88-1370-SGP);
- **Phase II Environmental Site Investigation**, Paterson Group, November 21, 2024;
- **City of Ottawa Comments**, January 27, 2023;
- **City of Ottawa Comments**, September 27, 2023;
- **City of Ottawa Comments,** January 8, 2025;
- **City of Ottawa Comments,** August 21, 2025;
- **Input from Pri-Tec Staff and the Developer (Whelan Truck Repair)**.

4.0 PROJECT DESCRIPTION

The subject property is located at 158 Cardevco Road; approximately 400m north of Richardson Side Road and approximately 300m west of Carp Road. The site is located within a development adopted by Plan of Subdivision and is known as the Cardevco Industrial Park. Cardevco Industrial Park was adopted by Plan of Subdivision 4M-356.

The legal description of the subject property is Part of Block 11, Registered Plan 4M-356. The PIN for the subject property is 04536-0142.

The property is a corner lot and is bounded by Cardevco Road to the north and west; a (currently) vacant gravel storage yard to the south (154 Cardevco Road); and R&R Auto Repairs to the east (164 Cardevco Road). The subdivision is comprised of rural industrial lots; including R&R Auto Repairs, Akman Construction, Harris Rebar, Virtucom Metals, Carp and Cardevco West End Self Storage; just to name a few.

The subdivision is rural in nature, with roadside ditches used for stormwater conveyance, and each lot is serviced by private well and septic. There are no public services (sewer or water).

An aerial photograph of the subject property has been provided in Figure 1, while a Location Plan is available in **Appendix A**.

Figure 1: Map of subject property location. Source: GeoOttawa (accessed 2022-10-25)

4.1 SITE TOPOGRAPHY

A topographic survey was completed by Annis, O'Sullivan, Vollebekk Ltd. (AOV) dated July 12, 2022 and supplied to Shade Group by Pri-Tec for preparation of the civil engineering design. Supplemental information was provided by AOV Summer 2024 to confirm the contributing drainage area associated with the side yard swale located between 158 and 154 Cardevco Road.

The subject property ranges in elevation from approximately 117.00m to 117.20m at the property line adjacent Cardevco Road, to approximately 118.00m at the highest point of the property adjacent the existing structure. The existing structure is located at the highpoint of the property, with runoff directed away in either a southwesterly or northeasterly manner towards the surrounding ditches. These drainage patterns are consistent with the Site Grading Plan for the Cardevco Industrial Park (R.W. Connelly Associates Ltd, March 1990).

4.2 RECEIVING WATERSHED

The entirety of the property drains either indirectly (by way of a side yard swale located along the northeast property boundary) or directly (via overland sheet flow) to the Cardevco Road roadside ditch. The Cardevco Road roadside ditch flows in a north and easterly manner from the subject property – outletting to the roadside ditch at Carp Road.

The subject property is located within the subwatershed of Huntley Creek, which is a tributary to the Carp River.

4.3 SOURCE PROTECTION

The subject property is located within an Intake Protection Zone 3 within a Groundwater Recharge Area. The property is also identified as located within a Highly Vulnerable Aquifer. (Source Protection Information Atlas, Ministry of the Environment, Conservation and Parks).

4.4 SUBSURFACE CONDITIONS

A geotechnical investigation was performed by Paterson Group. As part of their works, three test pits were advanced on the site.

The Geotechnical Investigation Report describes the subsurface conditions as *"2 to 2.2m thick fill layer underlain by a native silty sand deposit. The fill material was generally observed to consist of compact to very dense brown silty sand with gravel, crushed stone, brick fragments, asphalt and concrete….A compact, brown native silty sand with gravel and traces of cobbles was encountered underlying the fill."*

Practical refusal is noted as being approximately 2.1-3.1m below grade on inferred bedrock surface. (Geotechnical Investigation, Section 4.2, Paterson Group, November 22, 2024)

Groundwater infiltration was noted at depths of approximately 1.6 to 1.8m. (Geotechnical Investigation, Section 4.3, Paterson Group, November 22, 2024).

A subsequent Phase II – Environmental Site Investigation (Patterson, November 21, 2024) also included subsurface investigations, which were conducted on March 24, 2023. Groundwater was encountered during their investigations at elevations ranging from 1.09-1.80m below grade.

4.5 INFILTRATION TESTING

Infiltration testing was conducted by McIntosh Perry Consulting Engineers Ltd. (MPCE) on June 29, 2023. Shade Group personnel were on-site to observe the works completed. Infiltration testing was completed by MPCE staff using a Guelph Permeameter. A total of 5 test pits were excavated using a backhoe, to varying depths; in locations specified by Shade Group as to the anticipated approximate location for the infiltration galleries. The design of the infiltration galleries has been discussed in Section 8.6, with calculations enclosed in **Appendix D**. A design rate of 5.0mm/hr was used for the site.

A summary of the test holes, depth of testing, and results, has been included in Table 1 below; while the results received from MPCE have been enclosed in **Appendix E**.

Table 1: Infiltration testing results

Test Pit Location	Hole ID	Depth (m)	Test Results (mm/hr)	Design Rate (3.5 safety factor) (mm/hr)
Southwest	1A	1	22.15	6.33
	1B	2	17.49	5.00
	1C	0.6	17.77	5.08
Northeast	2A	2	17.38	4.97
	2B	1	34.07	9.74

5.0 SITE SERVICING

The site is serviced by private well and septic. For more details pertaining to site servicing, refer to the Site Servicing Report prepared by Paterson Group.

6.0 UTILITIES

The site is understood to be serviced by overhead utilities as well as natural gas. No changes to utilities or services are proposed as part of the proposed addition. Any servicing extensions would be handled internally as part of the build; with design to be provided by the electrical or mechanical designer (i.e. by others), as applicable.

7.0 GRADING AND DRAINAGE

A Grading and Drainage Plan has been prepared as part of the scope of work undertaken by Shade Group. The Grading and Drainage Plan includes such details as existing and proposed spot elevations; overland flow routes; location of existing well and septic; location of proposed stormwater measures, etc. A copy of the plan has been provided in **Appendix J**.

8.0 STORMWATER MANAGEMENT DESIGN

8.1 METHODOLOGY

The stormwater peak flow calculations were completed using the Rational Method.

$$Q = 2.78CIA$$

Where

Q	=	Flow Rate (L/s)
C	=	Runoff coefficient
I	=	Rainfall intensity (mm/hr)
A	=	Drainage area (ha)

The use of the Rational Method is permitted per the City of Ottawa Sewer Design Guidelines – as the subject development is less than 40 hectares (City Guidelines - Section 3.5.1.1).

8.2 DESIGN CRITERIA AND CONSTRAINTS

Stormwater design criteria have been established in reference to current design practices as outlined in the City of Ottawa Sewer Design Guidelines, through consultation with City of Ottawa Staff (pre-application consultation, February 2022), through input from the Mississippi Valley Conservation Authority (pre-consultation completed by others), and through specifications provided by the client's representative (Pri-Tec).

8.2.1 QUANTITY CONTROL

- Post-development peak flow conditions for the 2 through 100-year storm events have been controlled to not exceed the 2-year pre-development peak flow rate;
- Pre-development conditions have been determined using the smaller of a runoff coefficient of 0.5 or the actual site runoff coefficient (City of Ottawa – Section 8.3.7.3);
- Infiltration of the site to be no less than 104mm/yr.

8.2.2 QUALITY CONTROL

- The site has been designed to ensure a minimum 80% Total Suspended Solids (TSS) removal rate (pre-application consultation, February 2022).

8.2.3 RUNOFF COEFFICIENTS

The following coefficients were used to develop a weighted runoff coefficient for each area in post-development conditions:

Paved and Roof Areas	0.90
Grass	0.20
Off-Site Areas	0.50
Gravel Surfaces	0.60

The runoff coefficients have been increased by 25% for the 100-year storm (up to a maximum value of C=1.0), as per City of Ottawa Sewer Design Guidelines, Section 5.4.5.2.1.

8.2.4 TIME OF CONCENTRATION

The time of concentration used to calculate peak flow rates was 10 minutes as per City of Ottawa Sewer Design Guidelines, Section 5.4.5.2 ("*an inlet time of 10 minutes is to be used for all land uses and lot grading configurations*").

8.2.5 RAINFALL INTENSITY

Rainfall intensities were derived from City of Ottawa Sewer Design Guidelines (City Guidelines - Section 5.4.2), where

$$\text{2-Year Intensity} = 732.951 / (\text{Time in min} + 6.199)^{0.810}$$
$$\text{5-Year Intensity} = 998.071 / (\text{Time in min} + 6.053)^{0.814}$$
$$\text{10-Year Intensity} = 1174.184 / (\text{Time in min} + 6.014)^{0.816}$$
$$\text{100-Year intensity} = 1735.688 / (\text{Time in min} + 6.014)^{0.820}$$

8.3 PRE-DEVELOPMENT DRAINAGE PATTERNS

Under pre-development conditions the site has been assessed as a single drainage area measuring approximately 0.56 hectares. The majority of the site consists of impervious or relatively impervious (gravel) surfaces. A small grass area on-site is located at the northwest corner, encompassing the existing septic system. The property houses an approximately 466m^2 building that includes truck and auto repair shop bays and a small office.

The existing building is located at the highest point of the property at an elevation of approximately 118.00. Runoff is conveyed by overland sheet flow in a north, west or easterly direction, towards the Cardevco Road roadside ditch.

Under pre-development conditions, the site has a calculated runoff coefficient of 0.58; however as per the City Design Standards (Section 8.3.7.3), a runoff coefficient of 0.50 was used to calculate the pre-development allowable release rates.

Under pre-development conditions, the property is estimated to have peak flow rates of 60 L/s for the 2-year storm event. This calculated flow rate has been used as the control rate for the design of the restricted outlet during post-development conditions.

A Pre-Development Drainage Area Plan and associated calculations have been enclosed in **Appendix B**.

8.4 POST-DEVELOPMENT DRAINAGE PATTERNS

Under post-development conditions, the site has been split into three sub-drainage areas: B1, B2 and B3.

Post-development drainage area B1 encompasses the southern half of the property and part of the new proposed addition. Runoff from B1 is to be conveyed by overland sheet flow towards a proposed stormwater perimeter drain along the perimeter of the site. B1 encompasses an area of approximately 0.32 hectares and has a weighted runoff coefficient of approximately 0.59 (2-10-year) and 0.73 (100-year). The peak flow rate under uncontrolled post-development conditions is estimated to be 41 L/s, 55 L/s, 64 L/s and 116 L/s for the 2-, 5-, 10- and 100-year storm events respectively.

Post-development drainage area B2 encompasses a northern portion of the property as well as a portion of land along the east property line. The area encompasses part of the existing structure, the grassed swale on the east property line, and a small area of gravel parking. Runoff from B2 will remain uncontrolled and will flow via overland sheet flow or shallow concentrated flow (grassed swale), consistent with conditions prior to the addition. B2 encompasses an area of approximately 0.18 hectares and has a weighted runoff coefficient of approximately 0.44 (2-10 year) and 0.52 (100-year). The peak flow rate under uncontrolled post-development conditions is estimated to be 17 L/s, 22 L/s, 26 L/s and 46 L/s for the 2-, 5-, 10- and 100-year storm events respectively.

Post-development drainage area B3 encompasses half the roof from the existing building, the entirety of the roof from the new proposed breezeway, and half the roof of the new addition. Runoff from these rooftops will be controlled by way of roof scuppers connected to downspouts, outletting to infiltration galleries to be located beneath the existing gravel parking/driving area. The area measures approximately 0.06 hectares and has a weighted runoff coefficient of 0.90 (2-10-year) and 1.0 (100-year). The peak flow rate from the rooftop is estimated to be 12 L/s, 16 L/s, 19 L/s and 30 L/s for the 2-, 5-, 10- and 100-year storm events respectively.

A Post-Development Drainage Area Plan and associated calculations have been enclosed in **Appendix C**.

8.5 PEAK FLOW RESULTS

The following tables provide a summary of the peak flow results for both pre- and post-development (uncontrolled) conditions. These results can also be found in **Appendix B and C** along with their associated supporting calculations.

Table 2: Pre-development peak flow results

Peak Flow (L/s) - 2-Year	60

Table 3: Post-development (uncontrolled) peak flow results

	B1	B2	B3
Peak Flow (L/s) - 2-Year	41	17	12
Peak Flow (L/s) - 5-Year	55	22	16
Peak Flow (L/s) - 10-Year	64	26	19
Peak Flow (L/s) - 100-Year	116	46	30

8.6 QUANTITY CONTROL

Quantity control measures have been proposed to limit post-development peak flow rates to the 2-year pre-development peak flow rate. This is proposed to be achieved through the implementation of a clearstone filled perimeter drain that would be constructed along most of the perimeter of the site, along with two 27,654L concrete storage tanks for added temporary retention. The entire system would flow into a manhole equipped with an oil-grit separator offering quality control; and ultimately the outlet would be equipped with an 83mm orifice plate, controlling the outflow of water from the site to the specified pre-development levels.

QUANTITY CONTROL B1

For post-development drainage area B1, a clearstone filled perimeter drain is proposed to be constructed along the majority of the perimeter of the site, which will include two 27,654L concrete storage tanks for additional retention. The perimeter drain will be a uniform 1.5m width offering temporary retention while peak flow rates are restricted to the 2-year pre-development peak flow rate by way of the outlet control. The total storage length in the clearstone filled perimeter drain is approximately 145m. The bottom elevation of the drain varies, with a 0.5% slope along the bottom of the drain, providing positive slope towards the outlet. It is acknowledged that an increased slope would be preferred, however this is not possible given site constraints. This reduced slope may require increased maintenance compared to a drain with a greater slope however on-going monitoring will determine if that is to be the case, as sediment accumulation varies from site to site. Monitoring wells have been proposed to assist in monitoring sediment accumulation, and sediment accumulation will easily be observable within the storage tanks. Information associated with operations and maintenance practices for the proposed stormwater measures has been included in Section 10 of this report.

The perimeter drain is to be lined with an impermeable geomembrane to prevent runoff from infiltrating prior to being treated through the end-of-pipe treatment unit. The perimeter drain is to be equipped with an outlet control structure comprised of an orifice outlet measuring 83mm; which will result in temporary ponding within the storage tanks and within the clearstone filled trench; and offer control of peak flow rates. The orifice is to be located on the downstream side of an oil-grit separator unit within a 1200mm diameter manhole. The oil-grit separator will address the required quality control objective for the site and has been discussed in further detail in Section 8.7 of this report.

Detailed calculations for the design of the quantity control for area B1 can be found in **Appendix D**.

QUANTITY CONTROL B2

No quantity control is proposed for area B2. Instead, runoff will flow uncontrolled, almost entirely over grassed surfaces, towards the Cardevco roadside ditch, consistent with conditions prior to the construction of the addition.

QUANTITY CONTROL B3

Runoff from post-development area B3 is to be controlled by way of two proposed infiltration galleries that have been sized to offer infiltration of runoff from the rooftop. Runoff will flow from half of the rooftop of the addition and half of the existing structure, onto the roof of the breezeway, and be conveyed towards scuppers to be located on the side of the building. The scuppers are to be connected to downspouts, which will connect by way of a pipe network into the proposed infiltration galleries. The downspouts will outlet to catchbasins equipped with filter cloths to allow for preliminary filtration of any potential sediment. The catchbasin filters can be removed to be flushed as part of on-going maintenance works – and should be immediately reinstated. The catchbasins will feature a 150mm diameter SDR 35 (or approved equivalent) outlet pipe that direct connects into 2-runs of 150mm diameter SDR 35 perforated pipe to disperse runoff within the infiltration gallery. The number of runs was limited to 2 runs as the depth of cover continues to reduce further away from the building. The west and east are to be direct connected by a 200mm diameter SDR 35 PVC pipe, which will serve as an overflow from the western infiltration gallery into the eastern infiltration gallery. This pipe would allow the systems to operate in equilibrium, offering capacity as a single system.

The combined capacity of the infiltration galleries is sufficient to capture and infiltrate the 100-year storm event. The infiltration design allows for the objective of 104 mm/yr for the site to be met.

The infiltration galleries serve only to offer infiltration from rooftop runoff. The top of the infiltration gallery is proposed to be capped with an impermeable membrane and further capped with compacted granular ‘A’ to allow the flow of traffic through the site to continue as per pre-addition conditions, without infiltrating parking lot runoff. This design prevents parking lot water (which is considered to be potentially contaminated) from entering the infiltration gallery, and instead directs such runoff towards the perimeter drain where it can be treated by the oil-grit separator. The cross-section is also proposed to include geogrid underneath the Granular ‘A’ which will allow for the dispersal of loading across the gallery from above. Compaction is not

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considered to be a concern given the media proposed for the infiltration gallery is to be clearstone – and clearstone maintains voids for conveyance of water even when compacted. The soils underneath the infiltration gallery are also not a concern for further compaction as the existing site has been in operation for over 20 years with the same use; and the testing results of the subsoil as obtained during the infiltration testing reflect the compacted soils present onsite. The proposed cross-section would not be expected to be a concern for operating as intended.

The infiltration galleries have been designed in reference to groundwater monitoring information from both the Phase II ESA which noted an elevation of 116.21m in March 2023; and the Groundwater Monitoring Program, which noted a maximum elevation of 115.94m in 2024. While the 2024 results would be generally considered more relevant as they were conducted in a closer proximity to the location of the proposed infiltration gallery; the results from the Phase II ESA in March 2023 have been used to provide an additional level of conservatism.

The proposed rooftops are all to be metal so contamination from asphalt shingles is not a concern and the runoff from the rooftops is expected to be free of contaminants. The addition of the catchbasins, which are to be equipped with filters, will offer a first line-of-defense against any particles within the raindrops, limiting sediment buildup or contamination of the gallery.

Design calculations associated with the design of the infiltration systems, which serve as quantity control for area B3, can be found in **Appendix D**. Runoff from area B3 has been designed to fully be captured within the infiltration galleries, for the 2- through 100-year storm events. Supporting information for the infiltration rate used, as obtained from MPCE, can be found in **Appendix E.**

SUMMARY – CONTROLLED PEAK FLOW RATES

The following table provides a summary of the peak flow results under post-developemnt controlled conditions. These results can also be found in **Appendix D**.

Table 4: Post-development (controlled) peak flow results

	B1 Controlled	B2 Uncontrolled	B3 Controlled	Total Outflow	Pre/ Allowable	Δ
Peak Flow (L/s) - 2-Year	1	17	0	**18**	60	**-42**
Peak Flow (L/s) - 5-Year	3	22	0	**25**		**-34**
Peak Flow (L/s) - 10-Year	5	26	0	**31**		**-28**
Peak Flow (L/s) - 100-Year	13	46	0	**59**		**-1**

8.7 QUALITY CONTROL

The employment of Best Management Practices (BMPs) serves as the primary method of quality control for the site. Stormwater BMPs are present at the conveyance and end-of-pipe levels.

The proposed clearstone filled perimeter drain (and storage tanks) will offer a means of temporary storage (end-of-pipe) and conveyance. Runoff is to enter the perimeter drain through overland sheet flow, where water will percolate down through the clearstone. The perimeter drain will then convey flow into the storage tanks before entering the treatment unit. The perimeter drain system will offer an opportunity for particle settlement and filtration within the clearstone.

An end-of-pipe oil-grit separator will serve to provide quality treatment of total suspended solids prior to outletting to the Cardevco Road roadside ditch. The outlet control structure for quality treatment has been designed by ADS and the calculations have been enclosed in **Appendix F**. Per the calculations from ADS, it is understood that the designed separator is expected to provide 90% total suspended solids (TSS) removal, which exceeds the requirements from the City (and that of the Carp River Watershed/Subwatershed Study) of 80% TSS removal. Applicable certification for the design of the quality control unit has also been enclosed in **Appendix F**.

8.8 DOWNSTREAM ROADSIDE DITCH REVIEW

Per the City's request, a review of the receiving Cardevco Road roadside ditch has been completed as part of this report and the results have been enclosed in **Appendix G**. In summary, based on the existing cross-section of the ditch as surveyed (by Annis, O'Sullivan, Vollebekk Ltd.) in front of 164 Cardevco Road, and an assumed runoff coefficient of 0.50 for the upstream properties, the available capacity of the roadside ditch is greater than the anticipated 100-year peak flow rate of the upstream contributing area.

8.9 SIDE YARD SWALE REVIEW

There is an existing side yard swale that straddles the property line between 158 and 164 Cardevco Road. Based on the topography of the surrounding lands, the side yard swale is intended to service 154, 158 and 164 Cardevco Road, however after the implementation of the perimeter drain, it is not anticipated that runoff from 158 Cardevco will enter the swale at all as runoff will be intercepted by the perimeter drain and directed towards the treatment unit. Per the City's request, the capacity of the drainage swale has been reviewed against the contributing area and associated 100-year peak flow rate and confirmed to have adequate capacity. A map delineating the approximate contributing area and the associated runoff and capacity calculations have been enclosed in **Appendix H**.

9.0 EROSION AND SEDIMENT CONTROL

As the site is an existing development, constructions works are anticipated to be limited to those required to erect the proposed addition and breezeway; and to implement the proposed stormwater management measures.

Silt fence is recommended for erection along the perimeter of the site where works are proposed. Silt fence is to be installed in accordance with the manufacturer's specifications and is to be monitored and maintained throughout the duration of the construction period. Additional measures may be required at the direction of the City, conservation authority or other agency, to ensure that the site is operating as intended and not causing the displacement of sediment. Inspection is recommended to be completed weekly and following rainfall events. When required, repairs and maintenance should be conducted as soon as possible, so as not to run the risk of sediment displacement or failure of the erosion and sediment control measure. When conducting maintenance, the removal of sediment should be done with care so as not to allow for sediment transport into the neighbouring ditches or swales.

An Erosion and Sediment Control Plan has been enclosed in **Appendix J**, with the remainder of the engineering design drawings.

10.0 OPERATIONS AND MAINTENANCE

All stormwater management measures require some level of inspection and maintenance throughout the duration of their lifespan. Sites with significant grass and natural vegetation generally require a lower level of on-going maintenance than those urban or industrial in nature as natural vegetation can offer pre-treatment. In this case, the subject property is comprised of approximately 84% impervious surface so pre-treatment is generally not available. The proposed stormwater management features have been designed to comply with the City's quality and quantity objectives for the site, but these measures are expected to require on-going monitoring (inspection), operations and maintenance.

The following routine inspection recommendations have been taken from the Stormwater Management Planning and Design Manual (March 2003):

Table 5: Inspection Recommendations for Stormwater Management Features

Stormwater Measure	Inspection Routine
Infiltration Gallery	1. Is the gallery draining? Review the observation well. If it is not drained in 48 hours, the gallery may need to be partially or wholly re-constructed to restore its performance. 2. Is the gallery always dry or relatively dry within less than 24 hours of a storm? This could indicate a blockage of the inlet (i.e. the downspouts). Inspect and perform maintenance as required to ensure runoff is being directed into the gallery as designed.
Perimeter Drain	1. Is the perimeter drain draining? Verify the water levels in the observation wells. If water is still sitting in the observation well days after a rainfall event, it could indicate excessive sediment buildup in the clearstone, preventing water from flowing through the system. This may indicate a need for maintenance of the system or removal/replacement of the clearstone to restore the intended function of the storage. 2. Is the OGS / stormwater storage tank receiving runoff? If not it could indicate a blockage in the inlet. Perform maintenance to

	remove any blockage from the inlet to restore the system to its intended design. 3. Is there sediment in the storage tank(s)? The level of sediment should be measured using a graduated pole with a flat plate attached to the bottom. The pole should be graduated such that the true bottom of the storage tank compared to the cover/grate is marked for comparison. Maintenance should be performed in accordance with the manufacturer's specifications, and would include removal of the sediment to restore the intended storage volume.
Oil-Grit Separator	1. Is there sediment in the separator? The level of sediment should be measured using a graduated pole with a flat plate attached to the bottom. The pole should be graduated such that the true bottom of the separator compared to the cover/grate is marked for comparison. Maintenance should be performed in accordance with the manufacturer's specifications. 2. Is there oil in the separator? A visual inspection of the contents should be made from the surface for trash/debris and the presence of oil/industrial spill. An oily sheen, frothing or unusual colouring of the water may indicate the occurrence of an oil or industrial spill. The separator should be cleaned in the event of a spill contamination. Refer to the manufacturer's specifications for further details.

11.0 CONCLUSIONS

11.1 STORMWATER MANAGEMENT

The site is proposed to address stormwater management quantity and quality objectives through the implementation of a perimeter drained constructed along the majority of the perimeter of the site. The perimeter drain is to be lined with an impermeable membrane and will serve as both a conveyance and temporary retention area for runoff, ultimately controlled via an 83 mm diameter orifice opening. The perimeter drain will be primarily comprised of a clearstone filled trench, with two 27,654L storage tank at the downstream limits for added storage. The downstream storage tank (Tank 1) will include a relatively small pump, intended solely for the purposes of allowing the tank to fully empty over time, rather than holding a permanent pool. Elevations of the outlet are such that – during larger storm events – when the capacity of the pump is exceeded – runoff will be able to pass through the system without the pump; controlled ultimately by the orifice on the outlet structure.

Prior to outletting to the Cardevco Road roadside ditch, runoff will enter an oil-grit separator unit, designed to offer a minimum treatment of 80% total suspended solids (TSS) removal. Based

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on calculations prepared by ADS (enclosed in **Appendix F**), the unit is anticipated to offer a removal of 90% TSS.

11.2 GRADING AND DRAINAGE

Grading and drainage changes are anticipated to be minimal given this is an existing developed site. Grading has been limited to that as required to accommodate the proposed addition and the required stormwater management measures. A copy of the Grading and Drainage Plan has been enclosed in **Appendix J**. A copy of the Site Plan has been enclosed in **Appendix I**.

12.0 CLOSING

This report is submitted for consideration in support of the proposed Site Plan Control Application for the subject property noted herein.

Should you have any questions or concerns, please do not hesitate to contact the undersigned at your earliest convenience.

Monica Shade, P. Eng.
Shade Group Inc.
T: 613-889-9733
E: monica@shadegroup.ca

13.0 LIMITATIONS

This report was prepared exclusively for Whelan Truck Repair in support of the proposed Site Plan Approval Application associated with the proposed building addition at 158 Cardevco Road, Ottawa. This report has been prepared to review, assess and provide recommendation relating to stormwater management on the site, in conformance with the guidelines from the Ministry of the Environment, Conservation and Parks, the City of Ottawa, and the Subdivision Agreement associated with the development in which the site is located.

This report has been prepared in reference to information and data prepared by others, including those reports as outlined in Section 3.0 of this Report. Conclusions, calculations and assessments have been made in this report in reliance to the information provided by others (Section 3.0); no field measurements or conformance testing has been performed by Shade Group to confirm the results concluded by others.

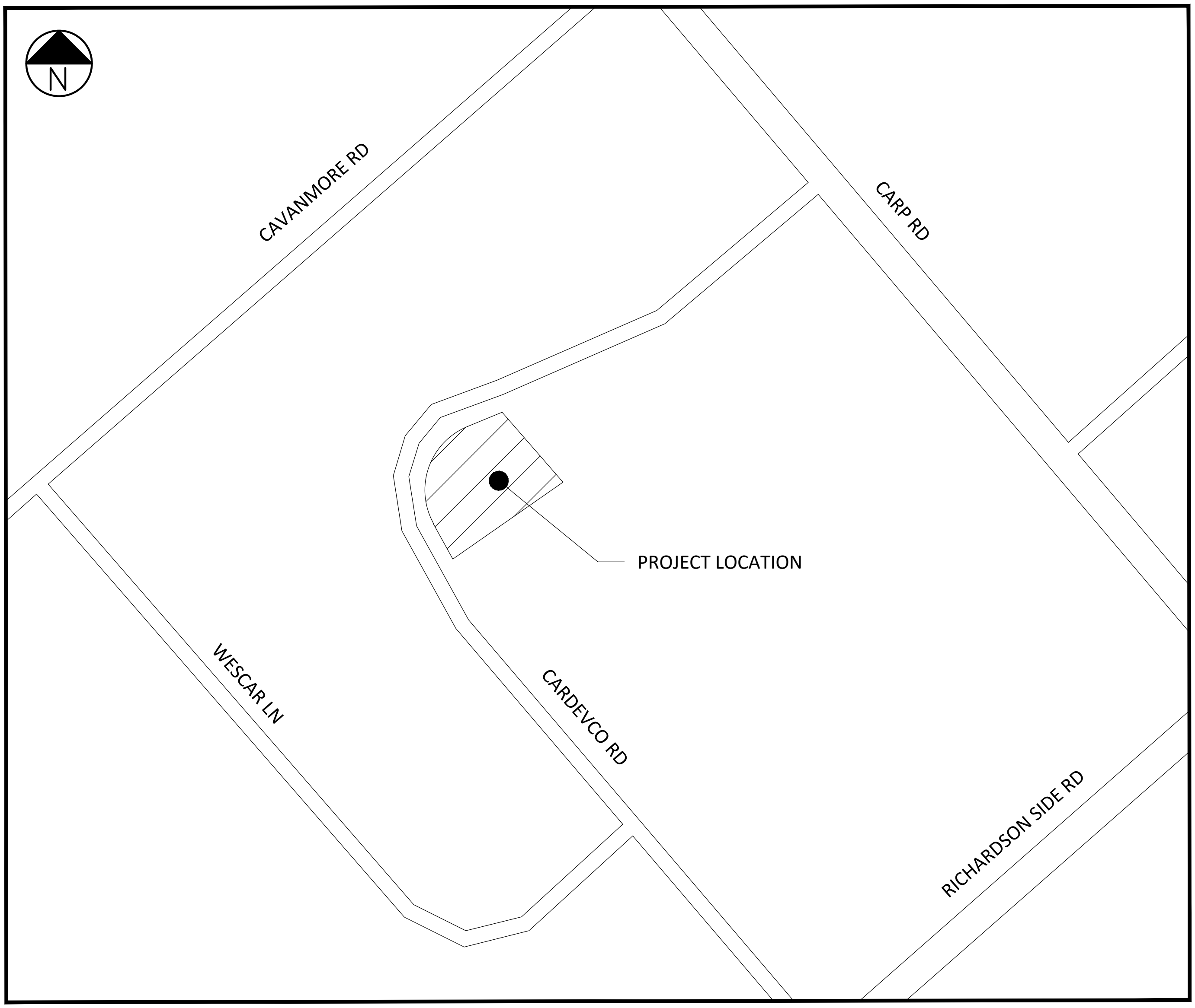
Any reliance on this report by a third party is strictly prohibited. This report reflects Shade Group Inc.'s professional judgement with respect to the scope, schedule and other limitations as noted in this document. The opinions formed in this report are based on data, conditions and information that was existing at the time of the document preparation.

The findings, conclusions and recommendations of this report are only valid as of the date of this report. No assurance can be made with respect to the changes in site conditions following the date of this report. If additional information is discovered or becomes available Shade Group Inc. shall be contacted to review and re-evaluate the conclusions presented; and provide amendments, if required.

Any use which a third party makes of this document remains the responsibility and liability of such third party. Shade Group Inc. shall not be responsible for damages of any kind suffered by a third party as a result of decisions made or actions taken based on the findings of this report.

APPENDIX A

LOCATION PLAN



LOCATION PLAN
N.T.S.

158 CARDEVCO ROAD
WHELAN TRUCK REPAIR

PROPOSED ADDITION

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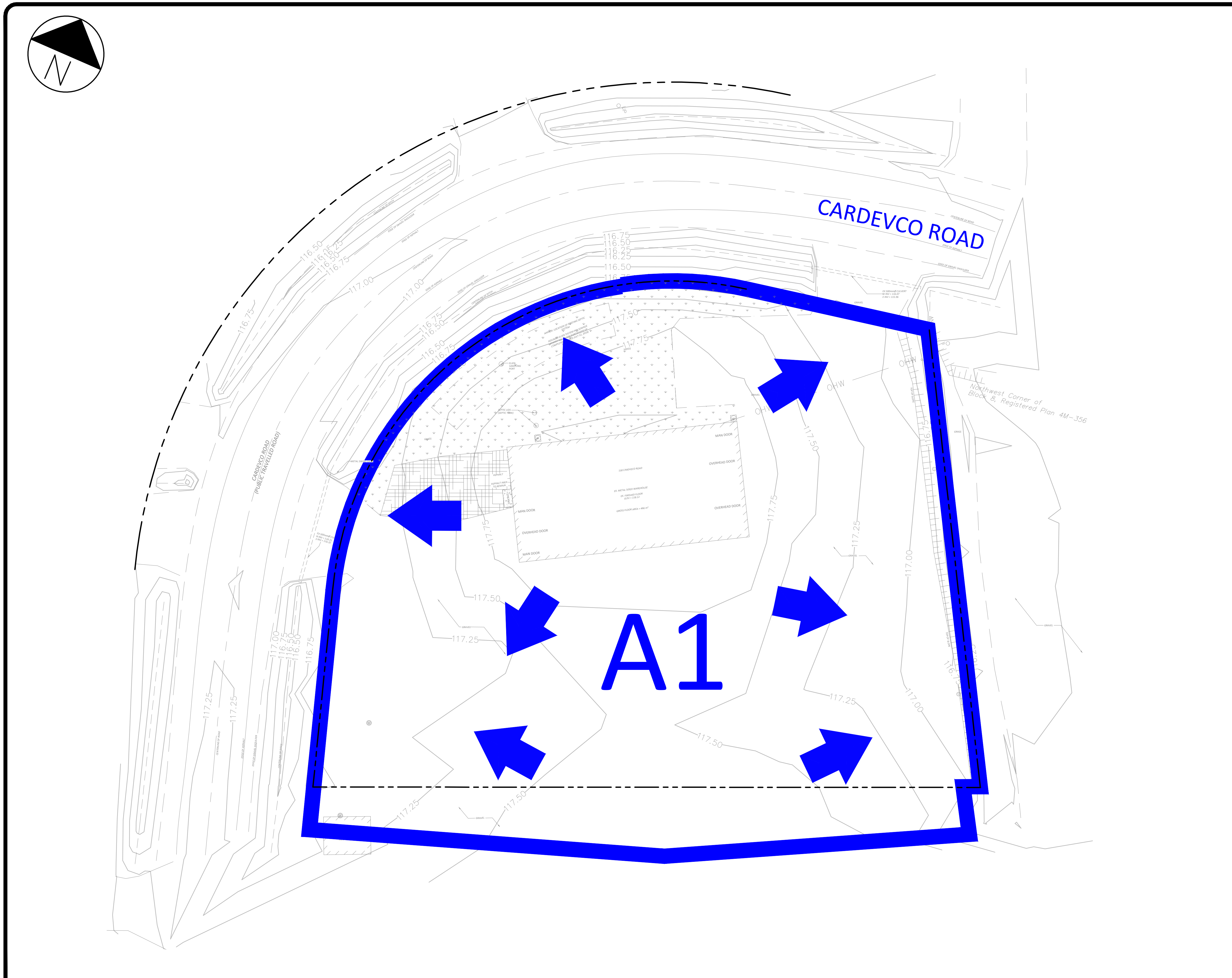
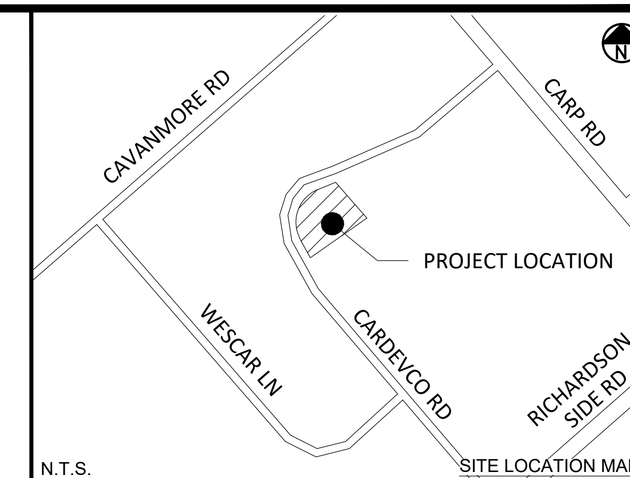
APPENDIX B

PRE-DEVELOPMENT DRAINAGE PLAN & CALCULATIONS





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PAGE SIZE	TABLOID	SCALE	1:500

SHADE GROUP INC.
PO BOX 1716
ALMONTE, ON
K0A 1A0

t: 613-889-9733 e:monica@shadegroup.ca

LEGEND

- PROPERTY LINE
- EASEMENT
- EX. CENTERLINE
- EX. EDGE OF ASPHALT
- EX. EDGE OF GRAVEL
- EX. OVERHEAD WIRES
- EX. TOP OF SLOPE
- EX. WELL
- PRE-DEVELOPMENT OVERLAND FLOW ROUTE

REV.	DESCRIPTION	DATE
06	REVISED PER CITY + MVCA COMMENTS	SEP 25, 2025
05	ISSUED WITH REVISED SUBMISSION	APR 1, 2025
04	ISSUED WITH REVISED SUBMISSION	JAN 27, 2025
03	ISSUED WITH REVISED SUBMISSION	NOV 25, 2024
02	REVISED PER CITY COMMENTS	NOV 30, 2023
01	REVISED PER CITY COMMENTS	AUG 17, 2023

CLIENT	WHELAN TRUCK REPAIR INC.
PROJECT ADDRESS	158 CARDEVCO ROAD CARP, ON K0A 1L0
PROJECT TITLE	PROPOSED BUILDING ADDITION
DRAWING TITLE	PRE-DEVELOPMENT DRAINAGE PLAN

Stormwater Management Calculations
Whelan Truck Repair Inc.
Pre-Development

Pre-Development - Runoff Coefficient

	Area ID
	A1
Total Area (m^2)	5598
Grass (m^2)	856
Runoff Coefficient (C)	0.20
Gravel (m^2)	4146
Runoff Coefficient (C)	0.60
Asphalt/Roof (m^2)	596
Runoff Coefficient (C)	0.90
Weighted Runoff Coefficient (C)*	**0.57**

**Pre-development conditions will be determined using the smaller of a runoff coefficient of 0.50 or the actual site runoff coefficient (City of Ottawa – Section 8.3.7.3)*

Therefor the pre-development conditions will be calculated using a runoff coefficient of 0.50.

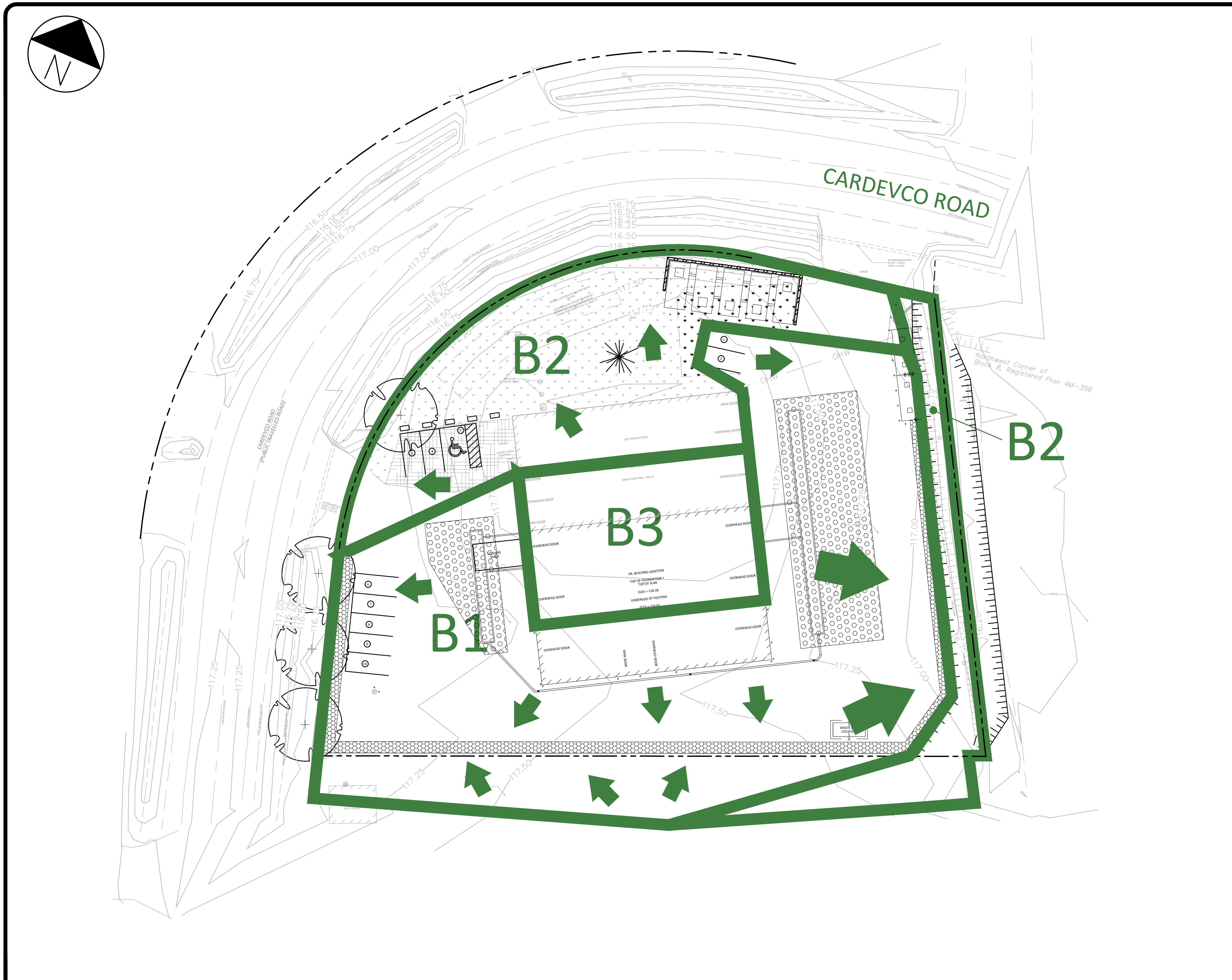
Post-Development - Peak Flow

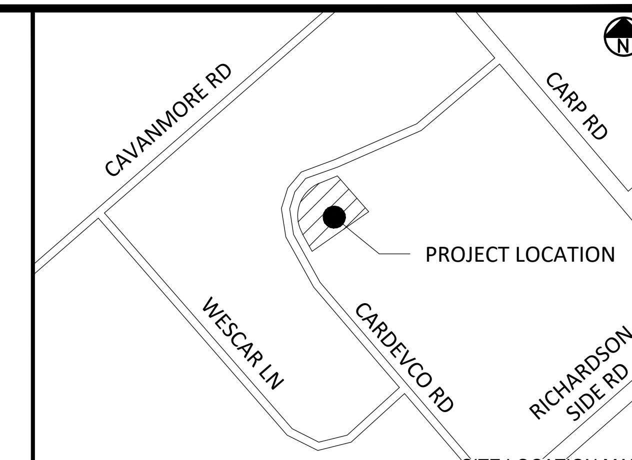
	Area ID
	B1
Weighted Runoff Coefficient (C)	0.50
Total Area (ha)	0.56
Time of Concentration (min)	10
Intensity (mm/hr) - 2-Year	77
Intensity (mm/hr) - 5-Year	104
Intensity (mm/hr) - 10-Year	122

Peak Flow (L/s) - 2-Year	60	**Max Allowable Outflow**

APPENDIX C

POST-DEVELOPMENT DRAINAGE PLAN & CALCULATIONS





N.T.S.

SITE LOCATION MAP

SCALE BAR 0 10 25m

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE DRAWING

PAGE SIZE	TABLOID	SCALE	1:500

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LEGEND

- PROPERTY LINE
- EASEMENT
- EX. CENTERLINE
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- EX. TOP OF SLOPE
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CLIENT	WHELAN TRUCK REPAIR INC.
PROJECT ADDRESS	158 CARDEVCO ROAD CARP, ON K0A 1L0
PROJECT TITLE	PROPOSED BUILDING ADDITION
DRAWING TITLE	POST-DEVELOPMENT DRAINAGE PLAN

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Stormwater Management Calculations
Whelan Truck Repair Inc.
Post-Development

Post-Development - Runoff Coefficient

	Area ID					
	B1		B2		B3	
	2-10 Year	100-Year	2-10 Year	100-Year	2-10 Year	100-Year
Total Area (m^2)	3206		1778		614	
Grass (m^2)	117		956		0	
Runoff Coefficient (C)	0.20	0.25	0.20	0.25	0.20	0.25
Gravel (m^2)	2367		295		0	
Runoff Coefficient (C)	0.60	0.75	0.60	0.75	0.60	0.75
Offsite Area (m^2)	489		164		0	
Runoff Coefficient (C)	0.50	0.63	0.50	0.63	0.50	0.63
Asphalt/Roof (m^2)	233		363		614	
Runoff Coefficient (C)	0.90	1.00	0.90	1.00	0.90	1.00
Weighted Runoff Coefficient (C)	**0.59**	**0.73**	**0.44**	**0.52**	**0.90**	**1.00**

Post-Development - Peak Flow - Input Data

	Area ID					
	B1		B2		B3	
	2-10 Year	100-Year	2-10 Year	100-Year	2-10 Year	100-Year
Weighted Runoff Coefficient (C)	0.59	0.73	0.44	0.52	0.90	1.00
Total Area (ha)	0.32		0.18		0.06	
Time of Concentration (min)	10		10		10	
Intensity (mm/hr) - 2-Year	77		77		77	
Intensity (mm/hr) - 5-Year	104		104		104	
Intensity (mm/hr) - 10-Year	122		122		122	
Intensity (mm/hr) - 100-Year	179		179		179	

Post-Development - Peak Flow - Results

	B1	B2	B3
Peak Flow (L/s) - 2-Year	41	17	12
Peak Flow (L/s) - 5-Year	55	22	16
Peak Flow (L/s) - 10-Year	64	26	19
Peak Flow (L/s) - 100-Year	116	46	30

APPENDIX D

QUANTITY CONTROL CALCULATIONS

Stormwater Management Calculations
Whelan Truck Repair Inc.
Quantity Control Summary

Pre-Development - Peak Flow

Peak Flow (L/s) - 2-Year	60	**Max Allowable Outflow**

Post-Development - Peak Flow

Uncontrollable Flow

	B2
Peak Flow (L/s) - 2-Year	17
Peak Flow (L/s) - 5-Year	22
Peak Flow (L/s) - 10-Year	26
Peak Flow (L/s) - 100-Year	46

Controllable Flow (Without Restriction)

	B1	B3
Peak Flow (L/s) - 2-Year	41	12
Peak Flow (L/s) - 5-Year	55	16
Peak Flow (L/s) - 10-Year	64	19
Peak Flow (L/s) - 100-Year	116	30

Controlled Flow (With Restriction)

	B1 Contrld	B2 Unctrld	B3 Contrld	Total Outflow	Allowable	Δ *
Peak Flow (L/s) - 2-Year	1	17	0	**18**	60	**-42**
Peak Flow (L/s) - 5-Year	3	22	0	**25**	60	**-34**
Peak Flow (L/s) - 10-Year	5	26	0	**31**	60	**-28**
Peak Flow (L/s) - 100-Year	13	46	0	**59**	60	**-1**

*A negative number suggests the post-development peak flow is less than pre-development or allowable levels for the applicable storm event.

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Stormwater Management Calculations
Whelan Truck Repair Inc.
Storage Requirements - B1

2-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	77	33	1	31	19
40	33	14	1	13	30
60	25	10	1	9	33
80	20	8	1	7	34
100	17	7	1	6	35
120	15	6	1	5	35
150	12	5	1	4	35
180	11	5	1	3	34
210	9	4	1	3	34
240	8	4	1	2	33

Peak Storage Requirement - 2-Year (m^3)	35

5-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	104	44	3	41	25
15	84	35	3	32	29
20	70	30	3	27	32
25	61	26	3	23	34
40	44	19	3	16	37
55	35	15	3	12	39
70	29	12	3	9	39
85	25	11	3	8	39
100	22	10	3	6	38
115	20	9	3	5	37

Peak Storage Requirement - 5-Year (m^3)	39

Stormwater Management Calculations
Whelan Truck Repair Inc.
Storage Requirements - B1

10-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	122	52	5	47	28
15	98	42	5	37	33
20	82	35	5	30	36
25	71	30	5	25	38
40	52	22	5	17	41
55	41	17	5	13	42
70	34	15	5	10	41
85	30	13	5	8	40
100	26	11	5	6	38
115	23	10	5	5	36

Peak Storage Requirement - 10-Year (m^3)	42

100-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	179	116	13	104	62
15	143	93	13	81	72
30	92	60	13	47	85
45	69	45	13	32	87
60	56	36	13	24	86
75	47	31	13	18	82
90	41	27	13	14	77
105	36	24	13	11	71
120	33	21	13	9	64
135	30	20	13	7	56

Peak Storage Requirement - 100-Year (m^3)	87

Stormwater Management Calculations
Whelan Truck Repair Inc.
Stage-Storage-Dischage - B1

Storage

Minimum Bottom of Trench Elevation (m)	116.25
Max. Ponding Elev. (m)	117.10
Max. Depth (m)	0.85
Slope (%)	0.50
Trench Width (m)	1.50
Trench Length (m)	145
Porosity	0.40

Bottom of Tank Storage (m)	114.87
Tank Width	2.39
Tank Length	5.85
Max Height	2.26
# of Tanks	2.00

Elevation (m)	Trench Ponding Depth (m)	Ponding Length (m)	Trench Volume (m^3)	Tank Ponding Depth (m)	Tank Volume (m^3)*	Storage Volume (m^3)
114.87	0.00	0.00	0.0	0.00	0	**0**
116.00	0.00	0.00	0.0	1.14	32	**32**
116.25	0.00	0.00	0.0	1.39	39	**39**
116.26	0.01	2.00	0.0	1.40	39	**39**
116.30	0.05	10.00	0.1	1.44	40	**40**
116.36	0.11	22.00	0.7	1.50	42	**43**
117.02	0.77	145.00	33.3	2.15	54	**87**
117.10	0.85	145.00	37.0	2.24	54	**91**

*The tank storage has been calculated up to a maximum available "working storage" of the manufacturer's specified "working volume"

Stormwater Management Calculations
Whelan Truck Repair Inc.
Stage-Storage-Dischage - B1

Discharge through an Orifice

$$Q = cA(2gh)^{1/2}\ (m^3/s)$$

Invert Elevation (m)	116.21
Centroid Elevation (m)	116.25
Orifice Size (m)	0.083
Orifice Area (m^2)	0.005
C	0.60

Elevation (m)	Head (m)	Q (l/s)
114.87	0.00	0
116.00	0.00	0
116.25	0.00	0
116.26	0.01	1
116.30	0.05	3
116.36	0.11	5
117.02	0.76	13
117.10	0.85	13

Stage-Storage-Discharge

Elevation (m)	Storage Volume (m^3)	Q (l/s)	
114.87	0	0	
116.00	32	0	
116.25	39	0	
116.26	39	1	2-Year
116.30	40	3	5-Year
116.36	43	5	10-Year
117.02	87	13	100-Year
117.10	91	13	

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Stormwater Management Calculations
Whelan Truck Repair Inc.
Infiltration Design - Rooftop Water

Infiltration Target

Total Site Area	4961 m^2	**
Design Target	104 mm/yr	
Target	**516 m^3/yr**	

Contributing Rooftop Area	614 m^2
Annual Precipitation	944 mm/yr
Anticipated Infiltration	580 **m^3/yr**

**The total site area includes only the area within the property boundary

Rooftop Peak Flow Calculations

	2-10 Year	**100-Year**
Weighted Runoff Coefficient (C)	0.90	1.00
Total Area (ha)	0.06	
Time of Concentration (min)	10	
Intensity (mm/hr) - 2-Year	77	
Intensity (mm/hr) - 5-Year	104	
Intensity (mm/hr) - 10-Year	122	
Intensity (mm/hr) - 100-Year	179	

Peak Flow (L/s) - 2-Year	12
Peak Flow (L/s) - 5-Year	16
Peak Flow (L/s) - 10-Year	19
Peak Flow (L/s) - 100-Year	30

SHADE GROUP INC

Stormwater Management Calculations
Whelan Truck Repair Inc.
Storage Requirements - Infiltration Design

2-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	77	12	0.68	11	7
30	40	6	0.68	5	10
60	25	4	0.68	3	11
120	15	2	0.68	2	11
240	8	1	0.68	1	9
480	5	1	0.68	0	2
960	3	0	0.68	0	-14
1320	2	0	0.68	0	-27
1680	2	0	0.68	0	-40
2880	1	0	0.68	0	-86

Peak Storage Requirement - 2-Year (m^3)	11

5-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	104	16	0.68	15	9
30	54	8	0.68	8	14
60	33	5	0.68	4	16
120	19	3	0.68	2	17
240	11	2	0.68	1	15
480	6	1	0.68	0	9
960	4	1	0.68	0	-6
1320	3	0	0.68	0	-19
1680	2	0	0.68	0	-32
2880	2	0	0.68	0	-76

Peak Storage Requirement - 5-Year (m^3)	17

SHADE GROUP INC

Stormwater Management Calculations
Whelan Truck Repair Inc.
Storage Requirements - Infiltration Design

10-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	122	19	0.68	18	11
30	63	10	0.68	9	16
60	38	6	0.68	5	19
120	23	3	0.68	3	20
240	13	2	0.68	1	19
480	8	1	0.68	0	14
960	4	1	0.68	0	-1
1320	3	1	0.68	0	-13
1680	3	0	0.68	0	-26
2880	2	0	0.68	0	-70

Peak Storage Requirement - 10-Year (m^3)	20

100-Year Storm Event

Tc (min)	Intensity (mm/hr)	Flow (L/s)	Controlled Outflow (L/s)	Peak Flow to be Stored (L/s)	Volume of Storage Required (m^3)
10	179	30	0.68	30	18
30	92	16	0.68	15	27
60	56	10	0.68	9	32
120	33	6	0.68	5	36
240	19	3	0.68	3	37
480	11	2	0.68	1	34
960	6	1	0.68	0	22
1320	5	1	0.68	0	11
1680	4	1	0.68	0	-1
2880	3	0	0.68	0	-42

Peak Storage Requirement - 100-Year (m^3)	37

Stormwater Management Calculations
Whelan Truck Repair Inc.
Infiltration Design - Rooftop Water

Storage Required

Volume (m^3) - 2-Year	11
Volume (m^3) - 5-Year	17
Volume (m^3) - 10-Year	20
Volume (m^3) - 100-Year	37

Maximum Depth

Low Impact Development Stormwater Management Planning & Design Guidelines (Version 1.0 - Page 4-57)

d = i x t / Vr

d= 5 mm/hr x 24 hr / 0.4
d= 0.3 m
Design depth = 0.2 m

d= maximum allowable depth (mm)
i= Infiltration rate for native soils (mm/hr)
Vr= Void ratio of stone
Ts= Time to drain (24 hours)

Storage Provided

West Infiltration Gallery

Surface Area (m^2)	123
Depth (m)	0.2
Void Ratio	0.4
Available Storage (m^3)	**10**

East Infiltration Gallery

Surface Area (m^2)	363
Depth (m)	0.2
Void Ratio	0.4
Available Storage (m^3)	**29**

APPENDIX E

MPCE INFILTRATION RESULTS

158 Cardevco Road - Infiltration Values

1 message

Rebecca Leduc <r.leduc@mcintoshperry.com>
To: Monica Shade <monica@shadegroup.ca>
Cc: Jordan Bowman <j.bowman@mcintoshperry.com>

Thu, Jul 13, 2023 at 10:48 AM

Hi Monica,

As discussed in our meeting this morning, we have calculated the following infiltration rates based on the infiltration testing which took place on June 29th, 2023 at 158 Cardevco Road:

Area **southwest/west** of the building on-Site:

Hole ID	Depth of Hole (cm)	Infiltration Rate (mm/hour)	Infiltration Rate (with safety factor of 3.5)
Hole 1A	100	22.15	6.33
Hole 1B	200	17.49	5.00
Hole 1C	60	17.77	5.08

Area **northeast/east** of the building on-Site:

Hole ID	Depth of Hole (cm)	Infiltration Rate (mm/hour)	Infiltration Rate (with safety factor of 3.5)
Hole 2A	200	17.38	4.97
Hole 2B	100	34.07	9.74

These values and corresponding calculations are available in the attached excel spreadsheet (and PDF).

Let me know if you need anything else.

Thanks!

Rebecca

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Turning Possibilities Into Reality

2 attachments

GuelphPermeameterKfsCalculator_158 Cardevco Rd.pdf
592K

GuelphPermeameterKfsCalculator_158 Cardevco Rd.xls
844K

Hole 1A

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0048

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	0.005
Q	0.003
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.803154

$Q =$ 0.002818

$K_{fs} =$ 5.12E-06 cm/sec; 3.07E-04 cm/min; 5.12E-08 m/sec; 1.21E-04 inch/min; 2.02E-06 inch/sec

$\Phi_m =$ 4.27E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	10
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0120

Res Type	35.22
H	10
a	3
H/a	3.33333
a*	0.12
C0.01	1.21841
C0.04	1.29023
C0.12	1.28754
C0.36	1.28754
C	1.28754
R	0.012
Q	0.00704
pi	3.1415

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.287543

$Q =$ 0.007044

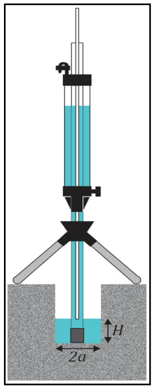
$K_{fs} =$ 7.63E-06 cm/sec; 4.58E-04 cm/min; 7.63E-08 m/ses; 1.80E-04 inch/min; 3.00E-06 inch/sec

$\Phi_m =$ 6.36E-05 (cm^2/min)

Average

$K_{fs} =$ 6.38E-06 cm/sec; 3.83E-04 cm/min; 6.38E-08 m/s; 1.51E-04 inch/min; 2.51E-06 inch/sec

$\Phi_m =$ 5.32E-05 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter the first water Head Height ("H1" in cm):	5
Enter the second water Head Height ("H2" in cm):	10
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.12 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 0.0048

Steady State Rate of Water Level Change ("R2" in cm/min): 0.0120

$Q_1 =$ 0.000173

$Q_2 =$ 0.000432

$C_1 =$ 0.803154

$C_2 =$ 1.287543

$G_1 =$ 0.004956

$G_2 =$ 0.003972

$G_3 =$ 0.055692

$G_4 =$ 0.024148

$K_{fs} =$ 8.60E-07 cm/sec; 5.16E-05 cm/min; 8.60E-09 m/sec; 2.03E-05 inch/min; 3.38E-07 inch/sec

$\Phi_m =$ -8.08E-07 (cm^2/min)

Res Type:	2.16
H1/a:	1.666667
H2/a:	3.333333
C1-0.01:	0.809485
C2-0.01:	1.21841
C1-0.04:	0.842059
C2-0.04:	1.290234
C1-0.12:	0.803154
C2-0.12:	1.287543
C1-0.36:	0.803154
C2-0.36:	1.287543

E

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $K_{fs} = G_2 Q_2 - G_1 Q_1$ $G_3 = \frac{(2H_2^2 + a^2 C_2)C_1}{2\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $G_4 = \frac{(2H_1^2 + a^2 C_1)C_2}{2\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $\Phi_m = G_3 Q_1 - G_4 Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Hole 1B

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0042

Res Type	35.22
H	10
a	3
H/a	3.333
a*	0.12
C0.01	1.218
C0.04	1.29
C0.12	1.288
C0.36	1.288
C	1.288
R	0.004
Q	0.002
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.287543

$Q =$ 0.002465

$K_{fs} =$ 2.67E-06 cm/sec; 1.60E-04 cm/min; 2.67E-08 m/sec; 6.31E-05 inch/min; 1.05E-06 inch/sec

$\Phi_m =$ 2.23E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 15
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0060

Res Type	35.22
H	15
a	3
H/a	5
a*	0.12
C0.01	1.51827
C0.04	1.62914
C0.12	1.66689
C0.36	1.66689
C	1.66689
R	0.006
Q	0.00352
pi	3.1415

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.666893

$Q =$ 0.003522

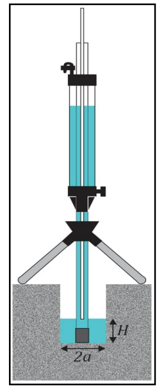
$K_{fs} =$ 2.61E-06 cm/sec; 1.57E-04 cm/min; 2.61E-08 m/ses; 6.17E-05 inch/min; 1.03E-06 inch/sec

$\Phi_m =$ 2.18E-05 (cm^2/min)

Average

$K_{fs} =$ 2.64E-06 cm/sec; 1.59E-04 cm/min; 2.64E-08 m/s; 6.24E-05 inch/min; 1.04E-06 inch/sec

$\Phi_m =$ 2.20E-05 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 10
Enter the second water Head Height ("H2" in cm): 15

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.12 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 0.0042

Steady State Rate of Water Level Change ("R2" in cm/min): 0.0060

$Q_1 =$ 0.000151

$Q_2 =$ 0.000216

$C_1 =$ 1.287543

$C_2 =$ 1.666893

$G_1 =$ 0.003988

$G_2 =$ 0.003442

$G_3 =$ 0.064551

$G_4 =$ 0.038026

$K_{fs} =$ 1.40E-07 cm/sec; 8.43E-06 cm/min; 1.40E-09 m/sec; 3.32E-06 inch/min; 5.53E-08 inch/sec

$\Phi_m =$ 1.55E-06 (cm^2/min)

Res Type:	2.16
H1/a:	3.333333
H2/a:	5
C1-0.01:	1.21841
C2-0.01:	1.518269
C1-0.04:	1.290234
C2-0.04:	1.629144
C1-0.12:	1.287543
C2-0.12:	1.666893
C1-0.36:	1.287543
C2-0.36:	1.666893

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(\mathrm{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $K_{fs} = G_2 Q_2 - G_1 Q_1$ $G_3 = \frac{(2H_2^2 + a^2 C_2)C_1}{2\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $G_4 = \frac{(2H_1^2 + a^2 C_1)C_2}{2\pi(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1))}$ $\Phi_m = G_3 Q_1 - G_4 Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Hole 1C

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0030

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.04
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.842
R	0.003
Q	0.002
pi	3.142

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 0.842059
$Q =$ 0.001761

$K_{fs} =$
1.53E-06 cm/sec
9.21E-05 cm/min
1.53E-08 m/sec
3.63E-05 inch/min
6.04E-07 inch/sec

$\Phi_m =$ 3.84E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0120

Res Type	35.22
H	10
a	3
H/a	3.33333
a*	0.04
C0.01	1.21841
C0.04	1.29023
C0.12	1.28754
C0.36	1.28754
C	1.29023
R	0.012
Q	0.00704
pi	3.1415

$\alpha^* =$ 0.04 (cm^{-1})

$C =$ 1.290234
$Q =$ 0.007044

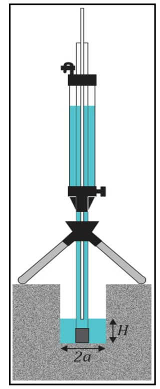
$K_{fs} =$
4.07E-06 cm/sec
2.44E-04 cm/min
4.07E-08 m/ses
9.60E-05 inch/min
1.60E-06 inch/sec

$\Phi_m =$ 1.02E-04 (cm^2/min)

Average

$K_{fs} =$
2.80E-06 cm/sec
1.68E-04 cm/min
2.80E-08 m/s
6.61E-05 inch/min
1.10E-06 inch/sec

$\Phi_m =$ 7.00E-05 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 10
Enter the second water Head Height ("H2" in cm): 15

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 2

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.04 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 0.0030

Steady State Rate of Water Level Change ("R2" in cm/min): 0.0120

$Q_1 =$ 0.000108

$Q_2 =$ 0.000432

$C_1 =$ 1.290234

$C_2 =$ 1.629144

$G_1 =$ 0.003999

$G_2 =$ 0.003366

$G_3 =$ 0.064804

$G_4 =$ 0.037264

Res Type:	2.16
H1/a:	3.333333
H2/a:	5
C1-0.01:	1.21841
C2-0.01:	1.518269
C1-0.04:	1.290234
C2-0.04:	1.629144
C1-0.12:	1.287543
C2-0.12:	1.666893
C1-0.36:	1.287543
C2-0.36:	1.666893

$K_{fs} =$
1.02E-06 cm/sec
6.13E-05 cm/min
1.02E-08 m/sec
2.42E-05 inch/min
4.03E-07 inch/sec

$\Phi_m =$ -9.10E-06 (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(\mathrm{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Hole 2A

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 15
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0030

Res Type	35.22
H	15
a	3
H/a	5
a*	0.12
C0.01	1.518
C0.04	1.629
C0.12	1.667
C0.36	1.667
C	1.667
R	0.003
Q	0.002
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.666893

$Q =$ 0.001761

$K_{fs} =$ 1.31E-06 cm/sec; 7.84E-05 cm/min; 1.31E-08 m/sec; 3.09E-05 inch/min; 5.15E-07 inch/sec

$\Phi_m =$ 1.09E-05 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 20
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0120

Res Type	35.22
H	20
a	3
H/a	6.66667
a*	0.12
C0.01	1.7546
C0.04	1.90307
C0.12	1.98019
C0.36	1.98019
C	1.98019
R	0.012
Q	0.00704
pi	3.1415

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.980192

$Q =$ 0.007044

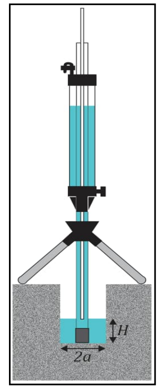
$K_{fs} =$ 3.86E-06 cm/sec; 2.31E-04 cm/min; 3.86E-08 m/ses; 9.11E-05 inch/min; 1.52E-06 inch/sec

$\Phi_m =$ 3.21E-05 (cm^2/min)

Average

$K_{fs} =$ 2.58E-06 cm/sec; 1.55E-04 cm/min; 2.58E-08 m/s; 6.10E-05 inch/min; 1.02E-06 inch/sec

$\Phi_m =$ 2.15E-05 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 15
Enter the second water Head Height ("H2" in cm): 20

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.12 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 0.0030

Steady State Rate of Water Level Change ("R2" in cm/min): 0.0120

$Q_1 =$ 0.000108

$Q_2 =$ 0.000432

$C_1 =$ 1.666893

$C_2 =$ 1.980192

$G_1 =$ 0.003452

$G_2 =$ 0.003075

$G_3 =$ 0.073121

$G_4 =$ 0.04939

Res Type:	2.16
H1/a:	5
H2/a:	6.666667
C1-0.01:	1.518269
C2-0.01:	1.754604
C1-0.04:	1.629144
C2-0.04:	1.903071
C1-0.12:	1.666893
C2-0.12:	1.980192
C1-0.36:	1.666893
C2-0.36:	1.980192

$K_{fs} =$ 9.56E-07 cm/sec; 5.73E-05 cm/min; 9.56E-09 m/sec; 2.26E-05 inch/min; 3.76E-07 inch/sec

$\Phi_m =$ -1.34E-05 (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(\mathrm{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Hole 2B

Guelph Permeameter

Input
Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0240

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	0.024
Q	0.014
pi	3.142

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 0.803154
$Q =$ 0.014088

$K_{fs} =$ 2.56E-05 cm/sec
1.54E-03 cm/min
2.56E-07 m/sec
6.05E-04 inch/min
1.01E-05 inch/sec

$\Phi_m =$ 2.14E-04 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 0.0600

Res Type	35.22
H	10
a	3
H/a	3.33333
a*	0.12
C0.01	1.21841
C0.04	1.29023
C0.12	1.28754
C0.36	1.28754
C	1.28754
R	0.060
Q	0.03522
pi	3.1415

$\alpha^* =$ 0.12 (cm^{-1})

$C =$ 1.287543
$Q =$ 0.03522

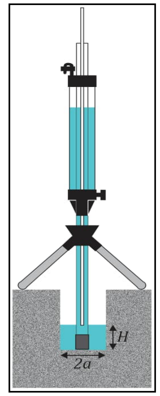
$K_{fs} =$ 3.82E-05 cm/sec
2.29E-03 cm/min
3.82E-07 m/ses
9.01E-04 inch/min
1.50E-05 inch/sec

$\Phi_m =$ 3.18E-04 (cm^2/min)

Average

$K_{fs} =$ 3.19E-05 cm/sec
1.91E-03 cm/min
3.19E-07 m/s
7.53E-04 inch/min
1.26E-05 inch/sec

$\Phi_m =$ 2.66E-04 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 5
Enter the second water Head Height ("H2" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 3

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.12 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 0.0240

Steady State Rate of Water Level Change ("R2" in cm/min): 0.0600

$Q_1 =$ 0.000864

$Q_2 =$ 0.00216

$C_1 =$ 0.803154

$C_2 =$ 1.287543

$G_1 =$ 0.004956

$G_2 =$ 0.003972

$G_3 =$ 0.055692

$G_4 =$ 0.024148

Res Type:	2.16
H1/a:	1.666667
H2/a:	3.333333
C1-0.01:	0.809485
C2-0.01:	1.21841
C1-0.04:	0.842059
C2-0.04:	1.290234
C1-0.12:	0.803154
C2-0.12:	1.287543
C1-0.36:	0.803154
C2-0.36:	1.287543

$K_{fs} =$ 4.30E-06 cm/sec
2.58E-04 cm/min
4.30E-08 m/sec
1.02E-04 inch/min
1.69E-06 inch/sec

$\Phi_m =$ -4.04E-06 (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(\mathrm{cm}^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

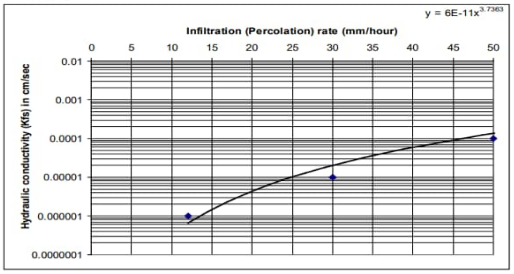
One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Location	Depth of hole (cm)	Refusal (inches)	5 cm head	10 cm head	15 cm head	20 cm head	K_{fs} (cm/s)	Φ_m (cm^2/min)	Infiltration Rate (mm/hour)	Infiltration Rate (with safety factor 3.5)
Hole1A	100	N/A	X				6.38E-06	5.32E-05	22.15	6.33
Hole 1A	100	N/A		X						
Hole1B	200	N/A		X			2.64E-06	2.20E-05	17.49	5.00
Hole 1B	200	N/A			X					
Hole 1C	60	N/A	X				2.80E-06	7.00E-07	17.77	5.08
Hole 1C	60	N/A		X						
Hole 2A	200	N/A			X		2.58E-06	2.15E-05	17.38	4.97
Hole 2A	200	N/A				X				
Hole 2B	100	N/A	X				3.19E-05	2.66E-04	34.07	9.74
Hole 2B	100	N/A		X						

(total extent of hole + auger depth), cm
120
120
220
220
70
70
220
220
110
110

Notes*
Only used Kfs readings from the 'Average' column for all

Figure C 11: Approximate relationship between infiltration rate and hydraulic conductivity



Ratio of Mean Measured Infiltration Rates[1]	Safety Correction Factor[2]
≤ 1	2.5
1.1 to 4.0	3.5
4.1 to 8.0	4.5
8.1 to 16.0	6.5
16.1 or greater	8.5

Source: Wisconsin Department of Natural Resources. 2004. Conservation Practice Standards. Site Evaluation for Stormwater Infiltration (1002). Madison, WI.

Ratio	1.62
Corresponding Safety F	3.5

APPENDIX F

QUALITY CONTROL CALCULATIONS

ADS OGS Sizing Summary

Project Name:	158 Cardevco Road		
Consulting Engineer:	Shade Group Inc.		
Location:	Carp, Ontario		
Sizing Completed By:	Haider Nasrullah	**Email:**	haider.nasrullah@adspipe.com

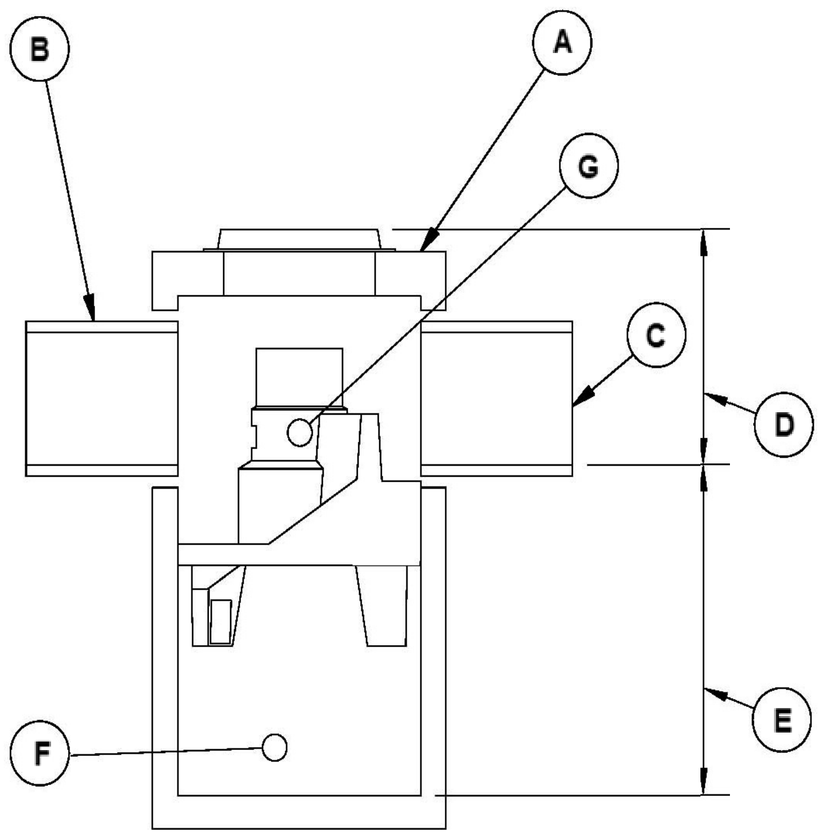
Treatment Requirements		
Treatment Goal:	Enhanced (MOE)	
Selected Parameters:	80% TSS	90% Volume
Selected Unit:	**FD-4HC**	

Site Details	
Site Area:	0.5598 ha
% Impervious:	88%
Rational C:	0.83
Rainfall Station:	Ottawa, ONT
Particle Size Distribution:	Fine
Peak Flowrate:	510 L/s

Summary of Results

Model	TSS Removal	Volume Treated
FD-4HC	90.0%	>90%
FD-5HC	93.0%	>90%
FD-6HC	95.0%	>90%
FD-8HC	97.0%	>90%

FD-4HC Specification	
Unit Diameter (A):	1,200 mm
Inlet Pipe Diameter (B):	300 mm
Outlet Pipe Diameter (C):	300 mm
Height, T/G to Outlet Invert (D):	-
Height, Outlet Invert to Sump (E):	1515 mm
Sediment Storage Capacity (F):	0.78 m³
Oil Storage Capacity (G):	723 L
Recommended Sediment Depth for Maintenance:	440 mm
Max. Pipe Diameter:	600 mm
Peak Flow Capacity:	510 L/s

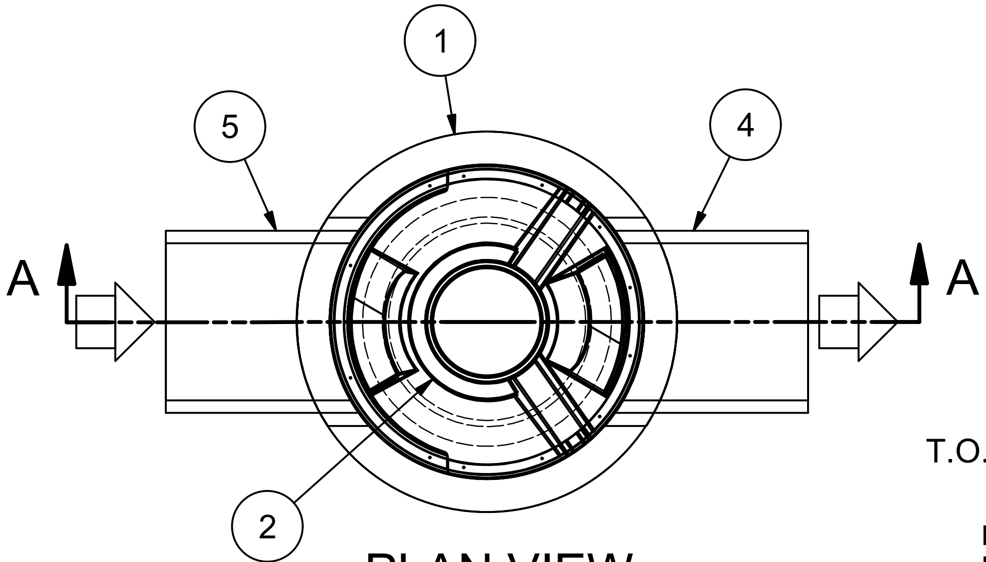


Site Elevations:	
Rim Elevation:	Per Site Plan
Inlet Pipe Elevation:	Per Site Plan
Outlet Pipe Elevation:	Per Site Plan

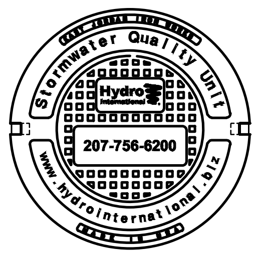
Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

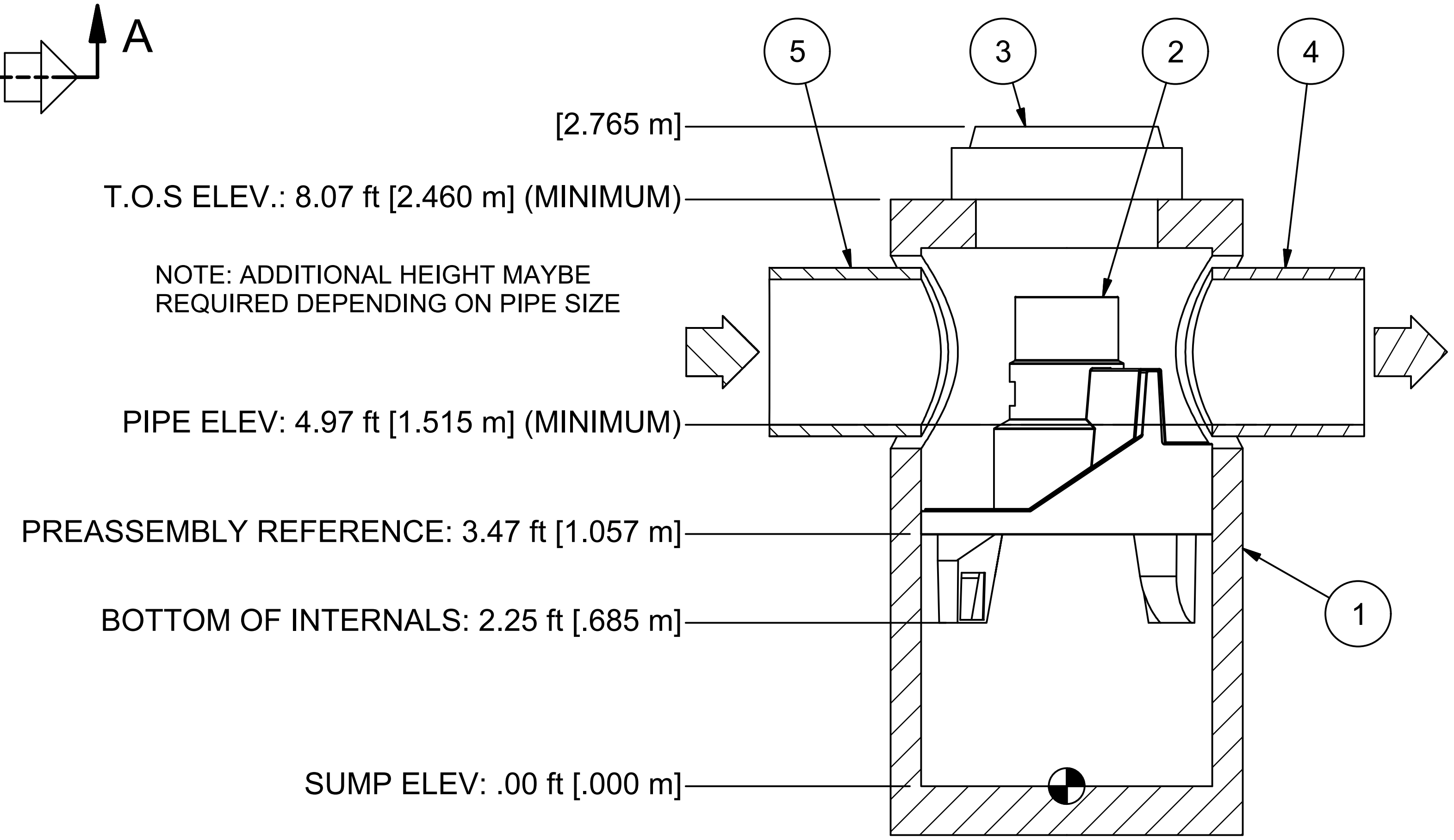


PLAN VIEW



HYDRO FRAME AND COVER (INCLUDED)

GRADE RINGS BY OTHERS AS REQUIRED



SECTION A-A

PRODUCT SPECIFICATION:

1. PEAK HYDRAULIC FLOW: 18.0 cfs (510 l/s)
2. MIN SEDIMENT STORAGE CAPACITY: 0.7 cu. yd. (0.5 cu. m.)
3. OIL STORAGE CAPACITY: 191 gal. (723 liters)
4. MAXIMUM INLET/OUTLET PIPE DIAMETERS: 24 in. (600 mm)
5. THE TREATMENT SYSTEM SHALL USE AN INDUCED VORTEX TO SEPARATE POLLUTANTS FROM STORMWATER RUNOFF.
6. FOR MORE PRODUCT INFORMATION INCLUDING REGULATORY ACCEPTANCES, PLEASE VISIT https://hydro-int.com/en/products/first-defense

GENERAL NOTES:
1. General Arrangement drawings only. Contact Hydro International for site specific drawings.
2. The diameter of the inlet and outlet pipes may be no more than 24".
3. Multiple inlet pipes possible (refer to project plan).
4. Inlet/outlet pipe angle can vary to align with drainage network (refer to project plan.s)
5. Peak flow rate and minimum height limited by available cover and pipe diameter.
6. Larger sediment storage capacity may be provided with a deeper sump depth.

PARTS LIST

ITEM	QTY	SIZE (in)	SIZE (mm)	DESCRIPTION
1	1	48	1200	I.D. PRECAST MANHOLE
2	1			INTERNAL COMPONENTS (PRE-INSTALLED)
3	1	30	750	FRAME AND COVER (ROUND)
4	1	24 (MAX)	600 (MAX)	OUTLET PIPE (BY OTHERS)
5	1	24 (MAX)	600 (MAX)	INLET PIPE (BY OTHERS)

PROJECTION

IF IN DOUBT ASK

COMMENTS:

1. MANHOLE WALL AND SLAB THICKNESSES ARE NOT TO SCALE.

2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING FIRST DEFENSE MANHOLE.

3. CONTRACTOR TO CONFIRM RIM, PIPE INVERTS, PIPE DIA. AND PIPE ORIENTATION PRIOR TO RELEASE OF UNIT TO FABRICATION.

DATE: 11/8/2019	SCALE: 1:30	
DRAWN BY: JLL3	CHECKED BY: -	APPROVED BY

Title

4-ft DIAMETER

FIRST DEFENSE HIGH CAPACITY

GENERAL ARRANGEMENT

Hydro International

hydro-int.com

HYDRO INTERNATIONAL

DO NOT SCALE DRAWING

STEEL FABRICATION TOLERANCES

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.

LINEAR
000 - 012in = ±0.04in
012 - 024in = ±0.06in
024 - 048in = ±0.08in
048 - 120in = ±0.12in
120in >>>> = ±0.20in

ANGULAR
000 - 120in = ±1°
120 - 240in = ±0.5°
240in >>>> = ±0.25°

WEIGHT: N/A	MATERIAL:

STOCK NUMBER:

DRAWING NO.: 4FDHC_FDHC GA STD

SHEET SIZE: B	SHEET: 1 OF 1	Rev: -

Project Name:	158 Cardevco Road
Consulting Engineer:	Shade Group Inc.
Location:	Carp, Ontario

Net Annual Removal Efficiency Summary: FD-4HC

Rainfall Intensity[1]	Fraction of Rainfall[1]	FD-4HC Removal Efficiency[2]	Weighted Net-Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.1%	100.0%	0.1%
1.00	14.1%	100.0%	14.1%
1.50	14.2%	97.8%	13.9%
2.00	14.1%	95.2%	13.4%
2.50	4.2%	93.3%	3.9%
3.00	1.5%	91.7%	1.4%
3.50	8.5%	90.4%	7.7%
4.00	5.4%	89.3%	4.8%
4.50	1.2%	88.3%	1.0%
5.00	5.5%	87.5%	4.8%
6.00	4.3%	86.0%	3.7%
7.00	4.5%	84.8%	3.8%
8.00	3.1%	83.7%	2.6%
9.00	2.3%	82.8%	1.9%
10.00	2.6%	82.0%	2.1%
20.00	9.2%	76.9%	7.1%
30.00	2.6%	74.0%	1.9%
40.00	1.2%	72.1%	0.8%
50.00	0.5%	70.6%	0.4%
100.00	0.7%	66.2%	0.5%
150.00	0.1%	63.7%	0.0%
200.00	0.0%	62.1%	0.0%
		Total Net Annual Removal Efficiency:	90.0%
		Total Runoff Volume Treated:	>90%

Notes:

(1) Rainfall Data: 1960:2007, HLY03, Ottawa, ONT, 6105976 & 6105978.

(2) Based on third party verified data and appoximating the removal of a PSD similar to the STC Fine distribution

(3) Rainfall adjusted to 5 min peak intensity based on hourly average.

Verification Statement

Hydro International First Defense® HC Oil Grit Separator
Registration number: (V-2018-10-01)
Date of issue: 2018-October-15 (rev 2019-02-01)

Technology type	Oil Grit Separator	
Application	Technology to remove oil, sediment, trash and debris from stormwater and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals	
Company	Hydro International	
Address	94 Hutchins Drive, Portland, Maine USA 04102	**Phone** +1-207-756 6200
Website	https://www.hydro-int.com	
E-mail	dscott@hydro-int.com	

Verified Performance Claims

The Hydro International First Defense® High Capacity (HC) Oil Grit Separator (OGS) was tested by Good Harbour Laboratories Inc. (GHL), Mississauga, Ontario, Canada in 2018. The performance test results were verified by Toronto and Region Conservation Authority (TRCA), Vaughan, Ontario, Canada following the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The following performance claims were verified:

<u>Capture test[1]:</u>
With a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and an influent test sediment concentration of 200 mg/L, the First Defense® HC OGS device removes 67, 60, 55, 50, 45, 45, and 41 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

<u>Scour test[1]:</u>
With 10.2 cm (4 inches) of test sediment pre-loaded onto a false floor reaching 50% of the manufacturer's recommended maximum sediment storage depth, the First Defense® HC OGS device generates adjusted effluent[2] concentrations of 0, 0, 11, 2, and 0 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

[1] The claims can be applied to other units smaller or larger than the tested unit as long as the untested units meet the scaling rule specified in the Procedure for Laboratory of Testing of Oil Grit Separators (Version 3.0, June 2014)
[2] The effluent suspended sediment concentration is adjusted based on the background concentration and the smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test (see Table 2)

Technology Application

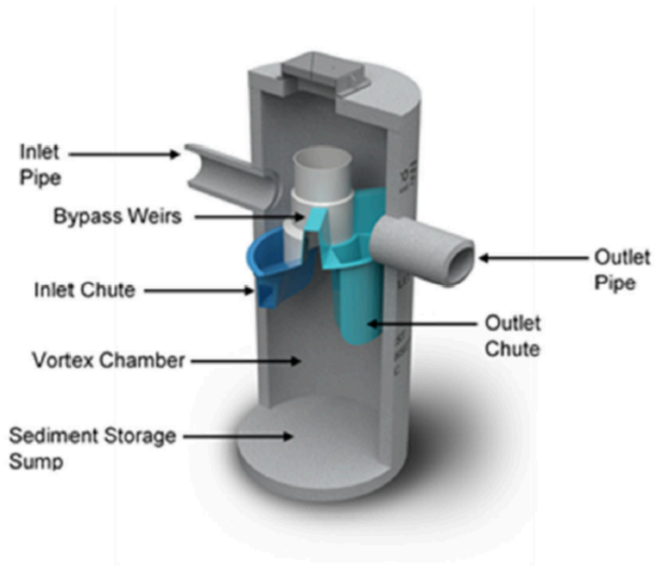
The First Defense® HC (FDHC) Oil Grit Separator can be used as a stand-alone stormwater treatment technology, depending on water quality objectives, or as a pretreatment component in a treatment train when higher TSS removals are required and polishing or volume reduction best management practices (BMPs), such as infiltration or bio-infiltration, are installed downstream. FDHC applications include: stormwater treatment at the point of entry into the drainage line; sites constrained by space, topography or drainage profiles with limited slope and depth of cover; retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line; pre-treatment for filters, infiltration, other sedimentation BMPs and storage.

Technology Description

The Hydro International First Defense® HC (FDHC) is an Oil Grit Separator designed to remove oil, sediment, trash and debris from stormwater and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals. The patented flow modifying internal components are designed to be inserted into standard precast concrete manholes where they collect and treat runoff as part of the drainage system (Figure 1).

Flow entering the manhole via an inlet pipe or inlet grate is diverted into a vortex chamber beneath a separation module that includes both inlet/outlet chutes and bypass weirs. The internal bypass weirs divert flows greater than the maximum design treatment flow rate over the separation module and away from the vortex chamber where oil, sediment, debris and attached pollutants are accumulating. This function prevents high velocities from re-suspending previously captured pollutants during large storm events. The FDHC can be designed and sized to function effectively in either online or offline configurations.

Figure 1: Hydro International First Defense® HC Oil Grit Separator



The test unit was 1.2 m (4 foot) in diameter with a 1.51 m (59 5/8 inches) sump depth measured from the outlet invert to the floor of the unit. The effective treatment area (also known as the effective sedimentation area) is 1.2 m^2 (12.6 ft^2). The maximum sediment storage depth is 0.457 m (18 inches).

Description of Test Procedure

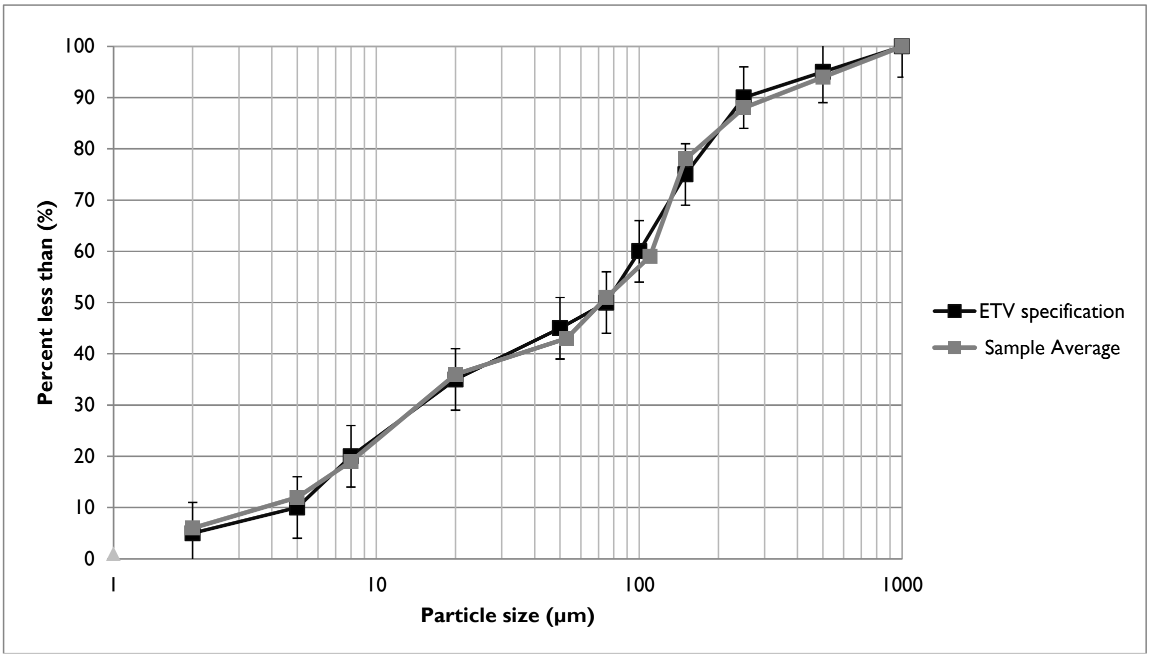
The test data and results for this verification were obtained from independent testing conducted on a 1.2 m (48 inch) diameter Hydro International First Defense® HC OGS device, in accordance with the *Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014)*. The laboratory test procedure was originally prepared by the Toronto and Region Conservation Authority (TRCA) in association with a 31 member advisory committee from various stakeholder groups.

Verification Results

Toronto and Region Conservation Authority verified the performance test data and other information pertaining to the First Defense® HC Oil Grit Separator. A Verification Plan was prepared to guide the verification process based on the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol.

The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the testing procedure. The *Procedure for Laboratory Testing of Oil Grit Separators* requires that the three sample average of the test sediment particle size distribution (PSD) meet the specified PSD percent less than values within a boundary threshold of 6%, and a median particle size no greater than 75 µm. Comparison of the individual sample and average test sediment PSD to the specified PSD shown in Figure 2 indicates that the test sediment used for the capture and scour tests met this condition. The median particle size was 73 µm. Samples from test sediment batches used for each run met the specified PSD within the required tolerance thresholds.

Figure 2 - The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD



The capacity of the device to retain sediment was determined at seven surface loading rates using the modified mass balance method. This method involved measuring the mass and particle size distribution of the injected and retained sediment for each test run. Performance was evaluated with a false floor simulating the technology filled to 50% of the manufacturer's recommended maximum sediment storage depth. The test was carried out with clean water that maintained a sediment concentration below 20 mg/L. Based on these conditions, removal efficiencies for individual particle size classes and for the test sediment as a whole were determined for each of the tested surface loading rates (Table 1).

In some instances, the removal efficiencies were above 100% for certain particle size fractions. These discrepancies are not unique to any one test laboratory and are attributed to errors relating to the blending of sediment, collection of representative samples for laboratory submission, and laboratory analysis of PSD. Due to these errors, caution should be exercised in applying the removal efficiencies by particle size fraction for the purposes of sizing the tested device (see Bulletin # CETV 2016-11-0001). The results for "all particle sizes by mass balance" (see Table 1) are based on measurements of the total injected and retained sediment mass, and are therefore not subject to blending, sampling or PSD analysis errors.

Table 1 - Removal efficiencies (%) of the First Defence HC at specified surface loading rates

Particle size fraction (µm)	Surface loading rate (L/min/m²)						
	40	80	200	400	600	1000	1400
>500	100*	100*	100*	81	72	86	80
250 - 500	100*	97	99	100*	100*	59	88
150 - 250	100*	91	95	93	47	100*	84
105 - 150	96	89	94	89	90	70	75
75 - 105	100*	90	95	77	-20**	100	51
53 - 75	74	100*	97	62	100*	46	37
20 - 53	60	33	10	5	4	0	0
8 - 20	29	16	8	3	3	1	1
5 – 8	8	5	8	4	4	4	3
<5	5	3	0	0	0	3	3
All particle sizes By mass balance	**66.5**	**59.9**	**55.4**	**50.2**	**44.9**	**45.2**	**40.5**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 184% (average 115%). See text and Bulletin # CETV 2016-11-0001 for more information.
** An outlier in the retained sediment sample sieve data resulted in negative removal for this size fraction. The outlier at the 75 um particle size is shown in Figure 3.

Figure 3 - Particle size distribution of sediment retained in the First Defense HC in relation to the injected test sediment average

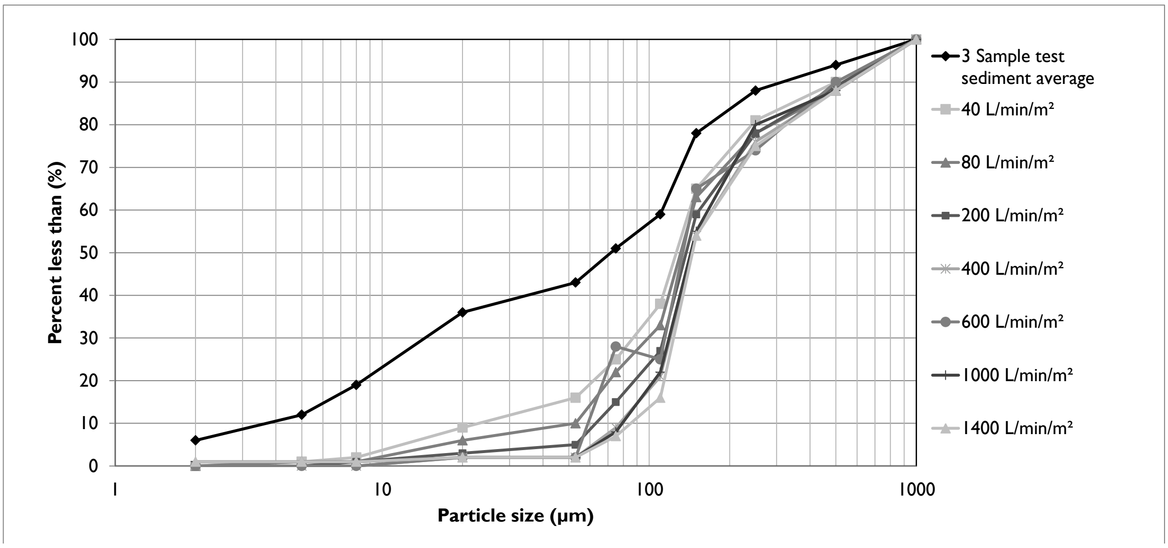


Figure 3 compares the particle size distribution (PSD) of the three sample average of the test sediment to the PSD of the sediment retained by the FDHC device at each of the tested surface loading rates. As expected, the capture efficiency for fine particles was generally found to decrease as surface loading rates increased, particularly in the 40 to 400 L/min/m² range.

Table 2 shows the results of the sediment scour and re-suspension test for the First Defense® HC unit. The scour test involved preloading 10.2 cm (4 inches) of fresh test sediment into the sedimentation sump of the device. The sediment was placed on a false floor to mimic a device filled to 50% of the maximum recommended sediment storage depth. Clean water was run through the device at five surface loading rates over a 30 minute period. Each flow rate was maintained for 5 minutes with a one minute transition time between flow rates. Effluent samples were collected at one minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC) and PSD by recognized methods. The effluent samples were subsequently adjusted based on the background concentration of the influent water. The smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test (13.5 μm in this case) was used to further adjust the effluent sediment concentrations, as per the method described in Bulletin # CETV 2016-09-0001. Results showed average adjusted effluent sediment concentrations below 11 mg/L at all surface loading rates. Effluent concentrations would be expected to decrease at higher flow rates since bypass over the insert bypass weirs was observed to begin at 1,032 L/min/m^2.

Table 2 - Scour test adjusted effluent sediment concentration at each surface loading rate

Run	Surface loading rate (L/min/m^2)	Run time (min)	Background sample concentration (mg/L)	Average adjusted effluent suspended sediment concentration (mg/L)*
1	200	1:00 – 6:00	0.8	0
2	800	7:00 – 12:00	1.0	0
3	1400	13:00 – 18:00	1.1	10.6
4	2000	19:00 – 24:00	2.8	2.4
5	2600	25:00 – 30:00	6.6	0

*The effluent suspended sediment concentration is adjusted based on the background concentration and the smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test, as per the method described in Bulletin # CETV 2016-09-0001.

Variances from the Procedure

Minor variances from the *Procedure for Laboratory Testing of Oil-Grit Separators* used as the basis of testing for this verification were as follows:

1. The *Procedure* states that the tested device "must be a full scale commercially available device with the same configuration and components as would be typical for an actual installation." The unit tested for this verification had the same internal components as would be typical for a commercial installation, but the internal components were placed inside a structure constructed of composite materials, rather than a manhole made of concrete, the latter of which is typical for most installations. The dimensions of the structure were the same as would have been the case had the manhole been concrete. The use of alternate materials for the structure was not believed to significantly affect system performance.

2. As part of the capture test, evaluation of the 40 and 80 L/min/m^2 surface loading rate was split into 3 and 2 parts, respectively. The test was conducted in parts because of the long duration (i.e. over 10 hours) needed to feed the required minimum 11.3 kg of test sediment into the unit. At the end of the first and second parts of the test, the flow rates were gradually decreased to prevent capture of particles that would have been washed out under normal circumstances. The requirement to split the test into parts was not anticipated in the *Procedure for Laboratory Testing of Oil-Grit Separators*, but has been a common feature of testing at the 40 L/min/m^2 surface loading rate. Conducting the test in two parts for the 80 L/ min/m^2 surface loading rate is less common. The testing did not assess the significance of the breaks, however, the test laboratory and verifier do not believe that the breaks significantly affected the test results.

3. During the sediment scour test, the flow rate coefficient of variation (COV) at the 200 L/min/m^2 surface loading rate of 0.045 slightly exceeded the target COV of 0.04. The average flow rate during the test remained within ±10% of the target flow rate.

Quality assurance

Performance testing and verification of the First Defense® HC Oil Grit Separator were performed in accordance with the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The verifier, Toronto and Region Conservation Authority, has confirmed that quality assurance requirements were addressed throughout the performance testing process and in the generation of performance test results. This includes reviewing all data sheets and data downloads, as well as overall management of the test system, quality control and data integrity.

Verification Summary

In summary, the First Defense® HC Oil Grit Separator is designed to remove oil, sediment, trash and debris from stormwater and snowmelt runoff as well as other pollutants that attach to sediment particles, such as nutrients and metals. Verification of performance claims for the Hydro International First Defense® HC Oil Grit Separator was conducted by Toronto and Region Conservation Authority based on independent third-party performance test results provided by Good Harbour Laboratories, as well as additional information provided by Hydro International. Table 3 summarizes the verification results in relation to the technology performance parameters that were identified to determine the efficacy of the First Defense® HC Oil Grit Separator.

Table 3 - Summary of Verification Results Against Performance Parameters

Performance Parameter	Verified Performance
Sediment Removal Rate	The sediment removal rate of the FDHC is dependent upon flow rate, particle density and particle size. Removal efficiency decreased with increasing surface loading rate from 67% at 40 L/min/m^2 to 41% at 1400 L/min/m^2. The weighted average removal efficiency achieved by the unit will vary depending on the rainfall distribution of the jurisdiction in which it is installed, and site characteristics.
Sediment Scour	When pre-loaded with sediment with a particle size distribution matching that of the feed sediment used in the sediment capture test, the FDHC generated effluent suspended solids concentrations of less than 11 mg/L at surface loading rates ranging from 200 to 2600 L/min/m^2.
Bypass flow rate	The flow rate at which bypass occurs will vary based on model size. For the 1.2 m (4 foot) diameter test unit, the flow rate at which bypass occurred over the insert bypass weirs was 1238 L/min (327 gpm).
Head loss	The loss of hydraulic head across the FDHC was determined by measuring the water elevation difference between the inlet and outlet sides of the insert. Head loss may vary based on model size. For the tested unit the head loss ranged from 2 mm (0.08 inches) at 93.5 L/min (12.3 gpm) to 100 mm (3.94 inches) at 1238 L/min (327 gpm) when bypass was observed to occur. At 327 gpm, when bypass occurred, the depth of the water was 177 mm upstream and 77 mm downstream for a difference of 100 mm (3.94 inches). The highest water elevation difference was 111mm (4.37 inches) at a flow rate of 1635 L/min (431.8 gpm), after which head loss declined up to the maximum measured flow rate of 3036 L/min (801.9 gpm).

What is ISO 14034?

The purpose of environmental technology verification is to provide a credible and impartial account of the performance of environmental technologies. Environmental technology verification is based on a number of principles to ensure that verifications are performed and reported accurately, clearly, unambiguously and objectively. The International Organization for Standardization (ISO) standard for environmental technology verification (ETV) is ISO 14034, which was published in November 2016.

Benefits of ETV

ETV contributes to protection and conservation of the environment by promoting and facilitating market uptake of innovative environmental technologies, especially those that perform better than relevant alternatives. ETV is particularly applicable to those environmental technologies whose innovative features or performance cannot be fully assessed using existing standards. Through the provision of objective evidence, ETV provides an independent and impartial confirmation of the performance of an environmental technology based on reliable test data. ETV aims to strengthen the credibility of new, innovative technologies by supporting informed decision-making among interested parties.

For more information on the First Defense® HC Oil Grit Separator, contact:	For more information on VerifiGlobal, contact:
Hydro International 94 Hutchins Drive, Portland, Maine USA 04102 t +1-207-756 6200 e: dscott@hydro-int.com w: www.hydro-int.com	VerifiGlobal c/o ETA-Danmark A/S Göteborg Plads 1, DK-2150 Nordhaven t +45 7224 5900 e: info@verifiglobal.com w: www.verifiglobal.com
Signed for Hydro International: *Original signed by:* *David Scott* David Scott Technical Product Manager, Americas Stormwater	Signed for VerifiGlobal: *Original signed by:* *Thomas Bruun* Thomas Bruun, Managing Director *Original signed by:* *John Neate* John Neate, Managing Director

APPENDIX G

DOWNSTREAM ROADSIDE DITCH CAPACITY REVIEW

Downstream Roadside Ditch Capacity Review
Whelan Truck Repair Inc.

Runoff Coefficient

Total Area (m^2)	22092	
Industrial Lots (m^2)	17092	
Runoff Coefficient (C)	0.50	
Road (m^2)	2000	*500m x 4m wide
Runoff Coefficient (C)	0.90	
Gravel Shoulder (m^2)	750	*500m x 1.5m wide
Runoff Coefficient (C)	0.60	
Grass Lined Ditch (m^2)	2250	*500m x (10m - 4m - 1.5m)
Runoff Coefficient (C)	0.20	
Weighted Runoff Coefficient (C)*	**0.51**	

Time of Concentration

Overland Flow Length	57	m	
Overland Slope	2	%	(Assumed)
Time of Concentration (Tc)	12	min	(Airport Formula)

Ditch Flow Length	500	m	
Ditch Slope	0.5	%	(Assumed)
Velocity	0.35	m/s	
Time of Concentration (Tc)	24	min	

Cumulative Tc	**36**	**min**

Peak Flow

Weighted Runoff Coefficient (C)	0.51	
Total Area (ha)	2.21	
Time of Concentration (min)	36	
Intensity (mm/hr) - 100-Year	82	
Peak Flow (L/s) - 100-Year	**315**	*Includes restricted runoff rate for 158 Cardevco

Downstream Roadside Ditch Capacity Review
Whelan Truck Repair Inc.

Ditch Capacity - Front of 164 Cardevco Road

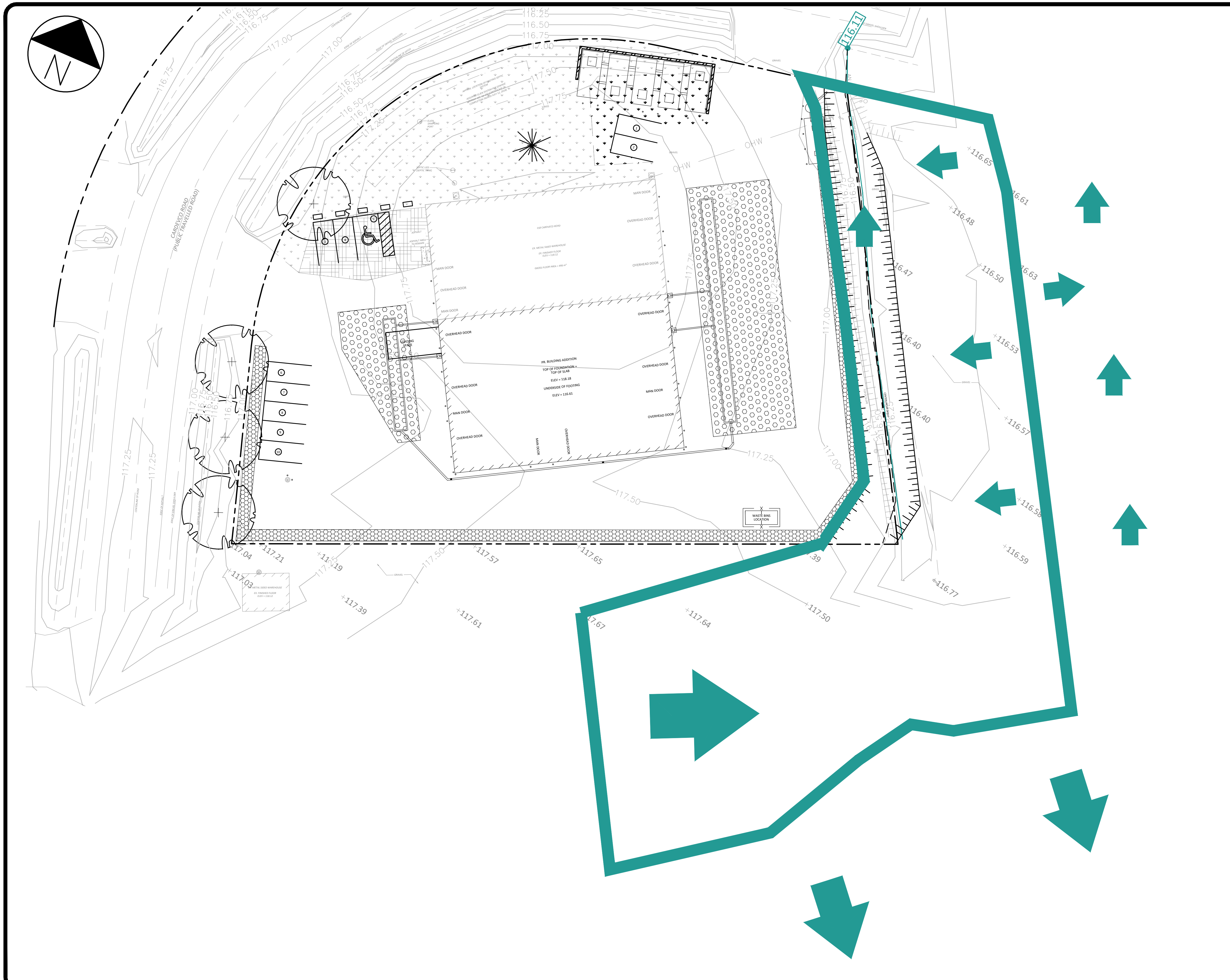
Ditch Invert =	116.06	m	
Edge of Shoulder Elev =	116.82	m	
Top of Slope Elev =	116.35	m	*backslope at PL
Max available ponding =	0.29	m	*Per backslope elevation at PL
Fore Slope =	21	%	
Back Slope =	6	%	*Calculated to PL

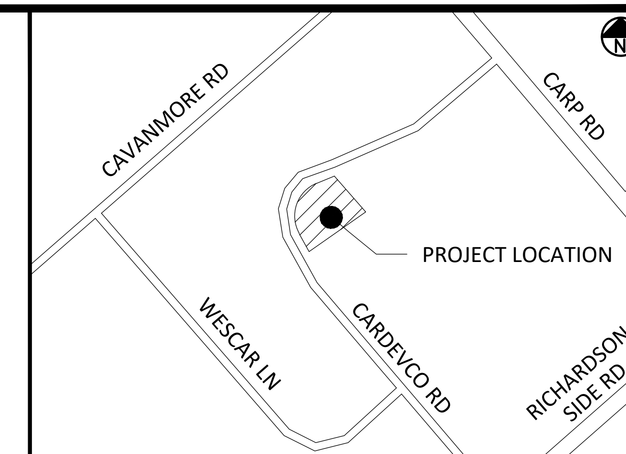
Rougness Coeff	0.03	
Channel Slope	0.52	%
Area	0.92	m^2
Wetted Perimeter	6.41	m
R	0.14	m
Q	611	L/s

As the maximum available capacity of the roadside ditch in front of 164 Cardevco Road is greater than the anticipated 100-year peak flow, capacity of the immediate downstream system is not anticipated to be a concern.

APPENDIX H

SIDEYARD SWALE CAPACITY REVIEW





N.T.S.

SITE LOCATION MAP

SCALE BAR 0 10 25m

ALL DIMENSIONS ARE IN METRES. DO NOT SCALE DRAWING

PAGE SIZE	TABLOID	SCALE	1:500

SHADE GROUP INC.
PO BOX 1716
ALMONTE, ON
K0A 1A0

t: 613-889-9733 e:monica@shadegroup.ca

SHADE GROUP INC

LEGEND

- PROPERTY LINE
- EASEMENT
- EX. CENTERLINE
- EX. EDGE OF ASPHALT
- EX. EDGE OF GRAVEL
- EX. TOP OF SLOPE
- PR. TOP OF SLOPE
- EX. OVERHEAD WIRES
- EX. WELL
- OVERLAND FLOW ROUTE

REV.	DESCRIPTION	DATE
03	ISSUED WITH REVISED SUBMISSION	SEPT 25, 2025
02	ISSUED WITH REVISED SUBMISSION	APR 1, 2025
01	ISSUED WITH REVISED SUBMISSION	JAN 27, 2025
00	ISSUED W. REVISED SUBMISSION	NOV 25, 2024

CLIENT	WHELAN TRUCK REPAIR INC.
PROJECT ADDRESS	158 CARDEVCO ROAD CARP, ON K0A 1L0
PROJECT TITLE	SIDE YARD SWALE ANALYSIS
DRAWING TITLE	DRAINAGE PLAN

SHADE GROUP INC

Side Yard Swale - 158/164 Cardevco Road
Peak Flow Rate Analysis

Runoff Coefficient

	2-10 Year	100-Year
Total Area (m^2)	3261	
Grass (m^2)	538	
Runoff Coefficient (C)	0.20	0.25
Gravel (m^2)	2415	
Runoff Coefficient (C)	0.60	0.75
Asphalt/Roof (m^2)	308	
Runoff Coefficient (C)	0.90	1.00
Weighted Runoff Coefficient (C)	**0.56**	**0.69**

Peak Flow - Input Data

	2-10 Year	100-Year
Weighted Runoff Coefficient (C)	0.56	0.69
Total Area (ha)	0.33	
Time of Concentration (min)	10	
Intensity (mm/hr) - 2-Year	77	
Intensity (mm/hr) - 5-Year	104	
Intensity (mm/hr) - 10-Year	122	
Intensity (mm/hr) - 100-Year	179	

Peak Flow - Results

Peak Flow (L/s) - 2-Year	39
Peak Flow (L/s) - 5-Year	53
Peak Flow (L/s) - 10-Year	62
Peak Flow (L/s) - 100-Year	112

SHADE GROUP INC

Side Yard Swale - 158/164 Cardevco Road
Full Flow Capacity Analysis

U/S Limits of 158/164 Cardevco

Ditch Invert =	116.42	m
Top of Slope Elev 158 Cardevco =	117.10	m
Top of Slope Elev 164 Cardevco =	116.60	m
Max available ponding =	0.18	m
Side Slope 158 =	10.7	%
Side Slope 164 =	5.6	%

Rougness Coeff	0.03	
Channel Slope	0.52	%
Area	0.41	m^2
Wetted Perimeter	4.59	m
R	0.09	m
Q	197	L/s

Midpoint of 158/164 Cardevco

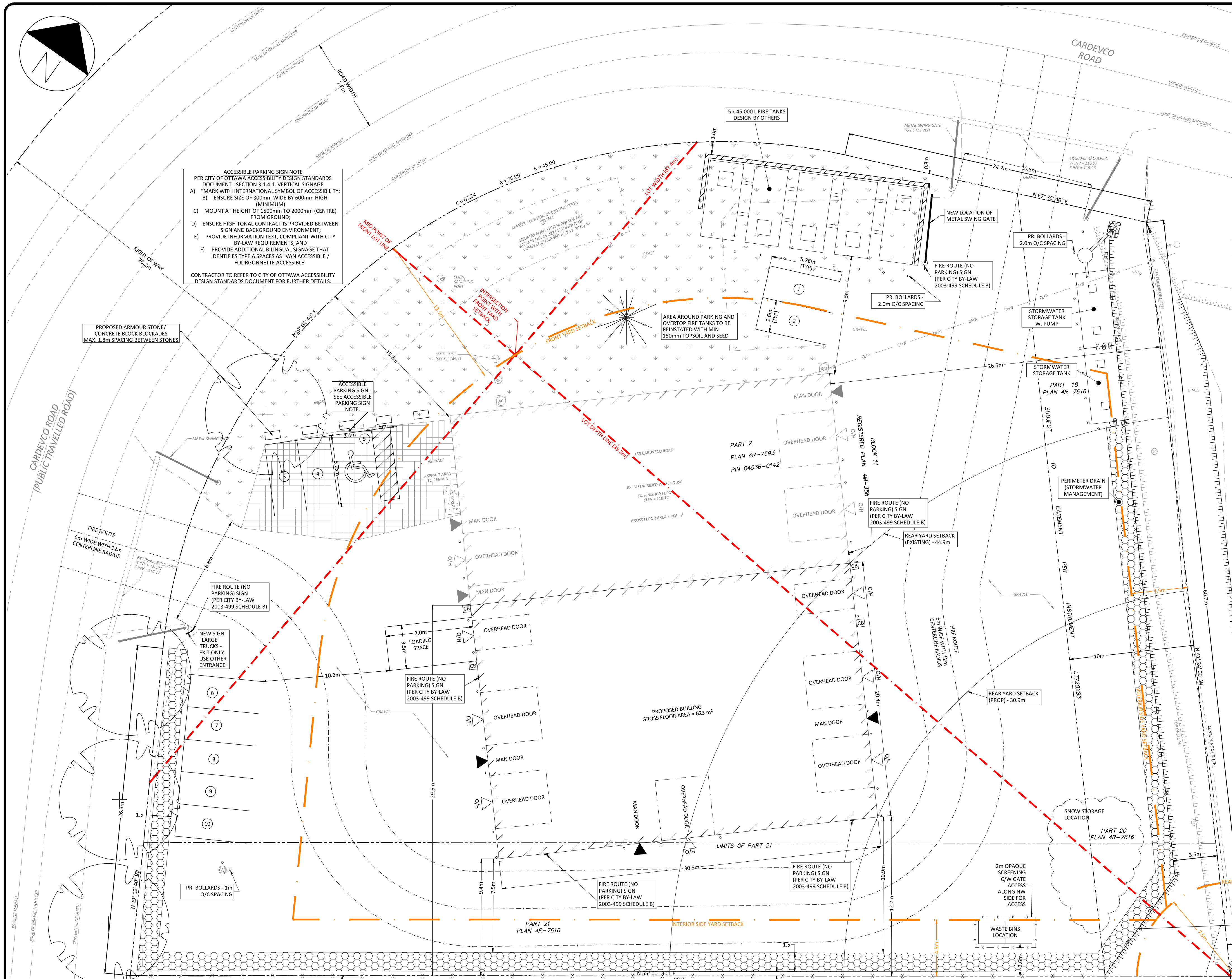
Ditch Invert =	116.29	m
Top of Slope Elev 158 Cardevco =	117.25	m
Top of Slope Elev 164 Cardevco =	116.50	m
Max available ponding =	0.21	m
Side Slope 158 =	33.0	%
Side Slope 164 =	5.7	%

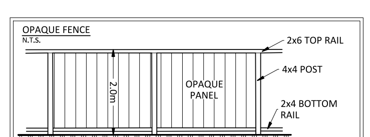
Rougness Coeff	0.03	
Channel Slope	0.52	%
Area	0.47	m^2
Wetted Perimeter	4.56	m
R	0.10	m
Q	253	L/s

As the full flow capacity of the side yard swale between 164 and 158 Cardevco Road is greater than the anticipated 100-year peak flow from the contributing area, the swale is considered to have adequate conveyance capacity.

APPENDIX I

SITE PLAN





LICENSED PROFESSIONAL ENGINEER
M. K. SHADE
100170995
SEP 25, 2025
PROVINCE OF ONTARIO

LIST OF CONSULTANTS		
CIVIL ENGINEERING (SITE PLAN DRAFTING; GRADING & DRAINAGE; STORMWATER MANAGEMENT)	SHADE GROUP INC.	4625 MARCH ROAD, ALMONTE, ON K0A 1A0
INFILTRATION TESTING	McINTOSH PERRY CONSULTING ENGINEERS LTD.	115 WALGREEN ROAD, R. R. 3 CARP, ON K0A 1L0
TRUCK TURNING ANALYSIS	NOVATECH ENGINEERS, PLANNERS & LANDCSCAPE ARCHITECTS	240 MICHAEL COPELAND DRIVE SUITE 101, KANATA, ON K2M 1P6
ENVIRONMENTAL PHASE 1	PINCHIN LTD.	1 HINES ROAD #200, KANATA, ON K2K 3C7
ENVIRONMENTAL PHASE 2	PATERSON GROUP INC. CONSULTING ENGINEERS	9 AURIGA DRIVE, NEPEAN, ON K2E 7T9
GEOTECHNICAL	PATERSON GROUP INC. CONSULTING ENGINEERS	9 AURIGA DRIVE, NEPEAN, ON K2E 7T9
SITE SERVICING REPORT	PATERSON GROUP INC. CONSULTING ENGINEERS	9 AURIGA DRIVE, NEPEAN, ON K2E 7T9
SURVEYOR	ANNIS, O'SULLIVAN, VOLLENBEKK LTD.	136 CONCOURSE GATE SUITE 500, NEPEAN, ON K2E 7S6
ARCHITECT	OM PRAKASH MADAN ARCHITECT	7 SPLINTER CRES, OTTAWA, ON K2B 1B3
STRUCTURAL ENGINEER	DAIDO STRUCTURAL ENGINEERS, TRENCH TAI, P. ENG.	UNIT #11 - 300 EARL GREY DRIVE, SUITE 213, OTTAWA, ON K2T 1C1
MECHANICAL AND ELECTRICAL + FIRE TANKS	EVEREST ENGINEERING	6861 FALLOWFIELD ROAD, STITTSVILLE, ON K2S 1B8
BUILDING DESIGNER/PLANNER	P2 CONCEPTS INC.	739 RIDGEWOOD AVENUE UNIT 201, OTTAWA, ON K1V 6MB

GENERAL NOTES

DESCRIPTION	PERMITTED	EXISTING	PROPOSED
ZONING	RG5		
LAND USE	LIGHT INDUSTRIAL		
LOT WIDTH	30 m	65.3 m	
LOT AREA	MIN. 0.40 ha	±0.487 ha	
SETBACKS			
FRONT YARD	MIN. 12m	12.7m	12.7m
INTERIOR SIDE YARD	MIN. 4.5m	29.6m	26.5m & 9.6m
REAR YARD	MIN. 7.5m	44.5m	30.6m
MAX LOT COVERAGE	50%	9%	22%
MAX BUILDING HEIGHT	15m	6.57 m	6.89 m
REQUIRED PARKING SPACES	0.8 PER 100m²	>4 spaces	10 spaces
LOADING SPACE	1 PER 1000-1999m²	0	1

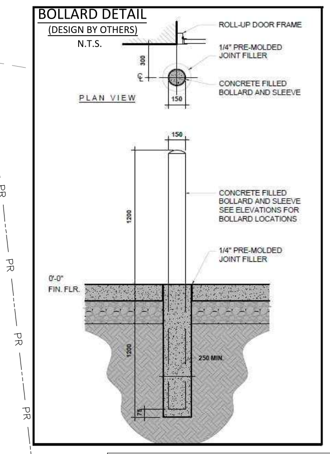
NOTES

THIS PLAN HAS BEEN PREPARED IN REFERENCE TO THE PLAN OF SURVEY AS COMPLETED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. A SIGNED COPY WAS NOT AVAILABLE, BUT NOTES PROVIDED ON THE SUPPLIED PLAN SPECIFY THE SURVEY WAS COMPLETED ON JULY 12, 2022.

BUILDING AREA CALCULATIONS
EXISTING BUILDING = 466 m²
PROPOSED ADDITION = 614 m²
TOTAL = 1080 m²

LEGAL DESCRIPTION

PART OF BLOCK 11
REGISTERED PLAN 4M-356
CITY OF OTTAWA



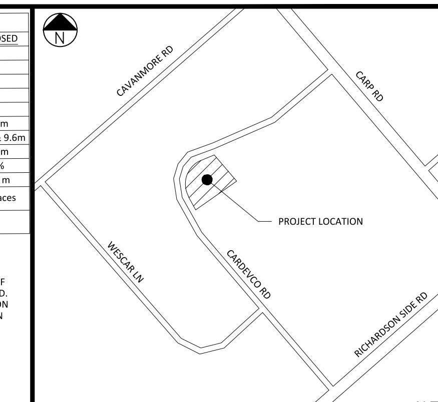
FIRE ROUTE NOTE:

FIRE ROUTE AND ASSOCIATED SIGNAGE PER BYLAW NO. 2003-499
SIGNAGE SHALL BE PER SCHEDULE B-AUTHORIZED SIGNS

"UNLESS OTHERWISE SPECIFICALLY REQUIRED PURSUANT TO AN APPROVAL OF A FIRE ROUTE IN ACCORDANCE WITH THE FIRE PROTECTION AND PREVENTION ACT OR THE FIRE CODE, THE BUILDING CODE ACT OR THE ONTARIO BUILDING CODE OR A SITE PLAN CONTROL BY-LAW UNDER THE PLANNING ACT, THE FOLLOWING REQUIREMENTS SHALL APPLY TO SIGNS FOR FIRE ROUTES:

a. A SIGN PROHIBITING PARKING IN A FIRE ROUTE SHALL,
1. BE NOT LESS THAN 45 CENTIMETRES IN HEIGHT AND NOT LESS THAN 30 CENTIMETRES IN WIDTH;
2. BEAR THE MARKINGS AND MESSAGE THAT THE AREA IS A FIRE ROUTE WHERE PARKING IS PROHIBITED AND INCLUDE DOUBLE ARROWS, EXCEPT AT THE ENDS OF A FIRE ROUTE WHERE SINGLE ARROWS SHALL BE INCLUDED;
3. INCLUDE, IN BLACK LETTERS OF A MINIMUM HEIGHT OF 4.0 CM, THE ENGLISH LANGUAGE MESSAGE "FIRE ROUTE" AND THE FRENCH LANGUAGE MESSAGE "ITINÉRAIRE DES POMPIERS", BELOW THE MESSAGE "FIRE ROUTE", AND
4. HAVE THE DESIGN AND DIMENSIONS AS DESCRIBED IN THE FOLLOWING FIGURE:

DESPITE SUBSECTION (A), SIGNS OF A LARGER SIZE AND PAVEMENT OR CURB MARKINGS MAY BE REQUIRED WHERE CONSIDERED NECESSARY BY THE FIRE CHIEF TO MORE CLEARLY DELINEATE A FIRE ROUTE."



SITE LOCATION MAP N.T.S.

SCALE BAR — DO NOT SCALE DRAWING

0 5 10 15m

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE MARKED.

PAGE SIZE ARCH D | SCALE 1:150

SHADE GROUP INC.
4625 MARCH ROAD
ALMONTE, ON
K0A 1A0

SITE BENCHMARK: MAG NAIL AND WASHER IN UTILITY POLE ON NORTH SIDE OF CARDEVCO ROAD, DIRECTLY EAST OF ENTRANCE TO HARRIS REBAR. ELEVATION=117.72

LEGEND

(IF APPLICABLE)

- PROPERTY BOUNDARY
- EX. LEGAL FABRIC
- PR. EASEMENT
- EX. ROAD CENTRE LINE
- EX. EDGE OF ASPHALT
- EX. EDGE OF SHOULDER
- EX. DITCH
- EX. OVERHEAD UTILITIES
- SETBACK FROM PROPERTY LINES
- LOT WIDTH CALCULATION LINES
- PR. FENCE LINE
- EX. TOP OF SLOPE
- PR. TOP OF SLOPE
- EX. BUILDING
- PR. BUILDING
- FIRE ROUTE
- PR. CLEARSTONE FILLED PERIMETER DRAIN
- PR. RETAINING WALL
- EX. UTILITY POLE
- EX. WELL
- EX. GAS METER
- EXISTING AIR CONDITIONING
- PR. CATCHBASIN
- EX./PR. MAN DOOR
- EX./PR. OVERHEAD DOOR
- PR. TREES
- GRASS COVER
- ASPHALT

REV. #	REVISION DESCRIPTION	DATE
08	REVISED PER CITY+MVCA COMMENTS	SEP 25, 2025
07	ISSUED FOR BUILDING PERMIT	JUL. 23, 2025
06	ISSUED FOR CONSTRUCTION	APR. 1, 2025
05	REVISED PER CITY COMMENTS	JAN 27, 2025
04	REVISIONS TO FIRE TANKS + EASEMENT	NOV 25, 2024
03	REVISION TO FIRE TANKS	APRIL 2024
02	REVISED PER CITY COMMENTS	NOV 30, 2023
01	REVISED PER CITY COMMENTS	AUG 17, 2023
00	REV. 00 SITE PLAN BY OTHERS	

SITE OWNER: WHELAN TRUCK REPAIR INC.

PROJECT TITLE: WHELAN TRUCK REPAIR - BUILDING ADDITION

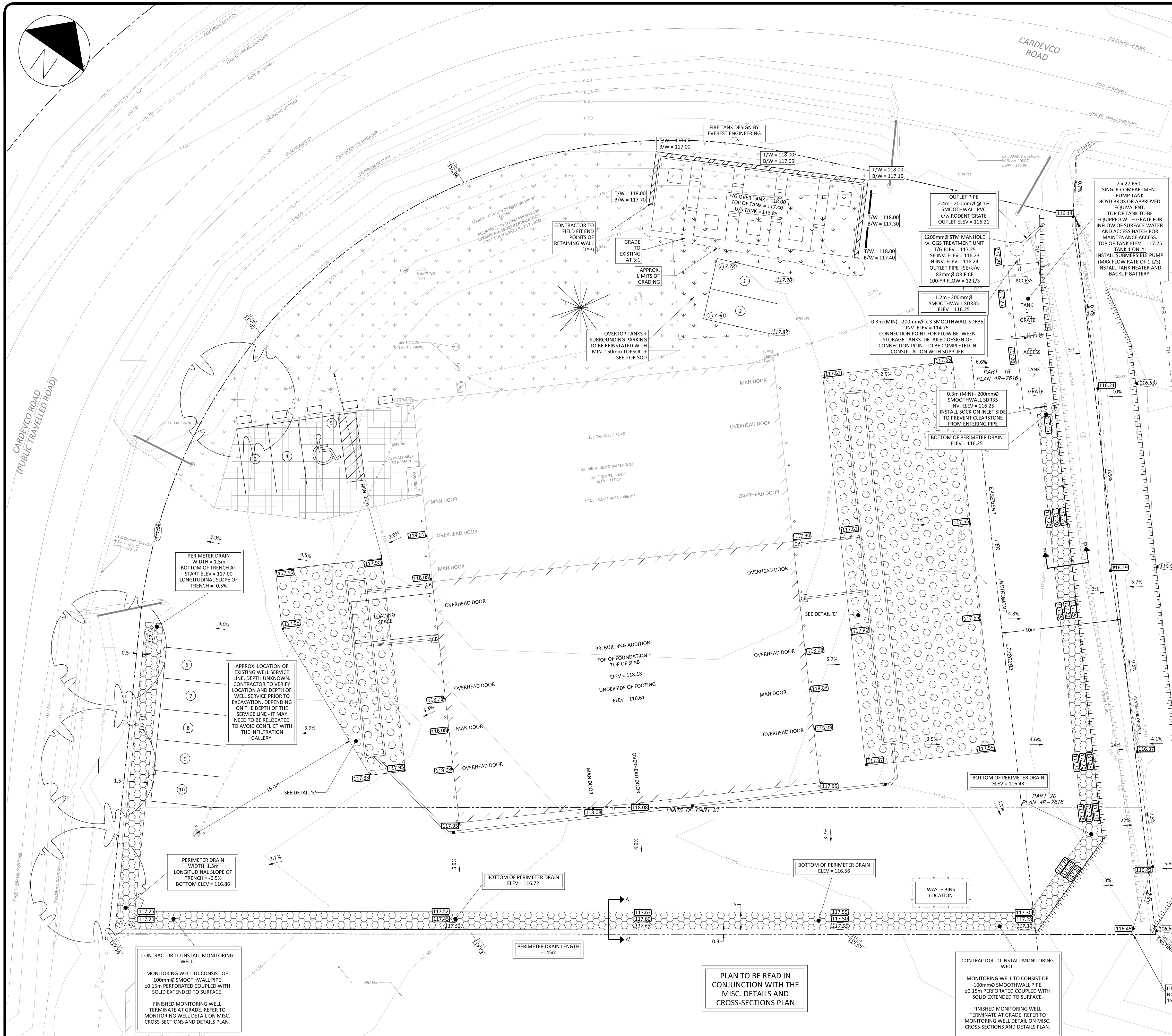
PROJECT ADDRESS: 158 CARDEVCO ROAD CARP, ON K0A 1L0

DRAWING TITLE: SITE PLAN

DRAWING NO. 1 OF 1

APPENDIX J

ENGINEERING DESIGN DRAWINGS



GENERAL NOTES

1. ALL TOPOGRAPHY, GROUND ELEVATIONS AND SURVEY DATA ARE SHOWN FOR INFORMATION PURPOSES ONLY AND IMPLY NO GUARANTEE OF ACCURACY. ALL DIMENSIONS AND ELEVATIONS TO BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
2. THIS PLAN HAS BEEN PREPARED IN REFERENCE TO THE PLAN OF SURVEY AS COMPLETED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. A SIGNED COPY WAS NOT AVAILABLE, BUT NOTES PROVIDED ON THE SUPPLIED PLAN SPECIFY THE SURVEY WAS COMPLETED ON JULY 12, 2022.
3. THE OWNER IS RESPONSIBLE FOR ALL PERMITS AND APPROVALS FROM THE APPLICABLE AGENCIES PRIOR TO CONSTRUCTION.
4. LAYOUT BY OTHERS.
7. ALL DISTURBED AREAS ARE TO BE SEEDED AS SOON AS FEASIBLE. NO BARE TOPSOIL SHALL REMAIN. ALL DISTURBED AREAS INTENDED TO BE FINISHED AS GRASS ARE TO BE TREATED WITH A MIN. 100mm TOPSOIL AND SEED (OR SOD).
8. ALL DISTURBED AREAS TO BE RESTORED TO ORIGINAL CONDITION OR BETTER UNLESS OTHERWISE SPECIFIED.
9. DISTURBED AREAS WITHIN THE CITY ROAD ALLOWANCE ARE TO BE RESTORED TO THE SATISFACTION OF THE CITY.
10. GRADING NOT TO EXTEND BEYOND PROPERTY LINES.
11. SUITABILITY OF SUBGRADE CONDITIONS TO BE VERIFIED BY A GEOTECHNICAL ENGINEER (OR SUITABLE PROFESSIONAL) PRIOR TO FOOTING INSTALLATION. FROST PROTECTION REQUIRED WHERE DEPTH OF COVER <1.5m. FROST PROTECTION DESIGN BY OTHERS.
12. ALL PARKING LOT AND GRADING WORKS ARE TO BE COMPLETED IN ACCORDANCE WITH THE CITY STANDARDS AND SPECIFICATIONS. THE CONTRACTOR IS TO ENSURE POSITIVE DRAINAGE AWAY FROM ALL BUILDINGS.
13. CONTACT THE CITY FOR INSPECTION AT KEY MILESTONES. REFERENCE SHALL BE MADE TO THE SITE PLAN AGREEMENT AND/OR BUILDING PERMIT FOR INSPECTION MILESTONES.
14. ALL WORKS ARE TO BE PERFORMED IN ACCORDANCE WITH CURRENT CODES AND STANDARDS.
15. ANY CHANGES MADE TO THIS PLAN ARE TO BE VERIFIED AND APPROVED BY SHADE GROUP INC. AND ARE SUBJECT TO APPROVAL FROM THE APPROPRIATE APPROVAL AGENCIES.
16. THE LOCATION OF THE WELL AND SEPTIC HAS BEEN SHOWN FOR ILLUSTRATION PURPOSES ONLY. THE SUITABILITY OF THE WELL LOCATION IS TO BE VERIFIED BY OTHERS, WHILE THE DESIGN OF THE SEPTIC IS TO BE COMPLETED BY OTHERS. WELL IS TO BE MIN. 15m FROM ANY SEPTIC SYSTEM (BOTH ON-SITE AND ON ADJACENT PROPERTIES).

EROSION AND SEDIMENT CONTROL NOTES

1. REFER TO EROSION AND SEDIMENT CONTROL PLAN.

INFILTRATION GALLERY NOTES

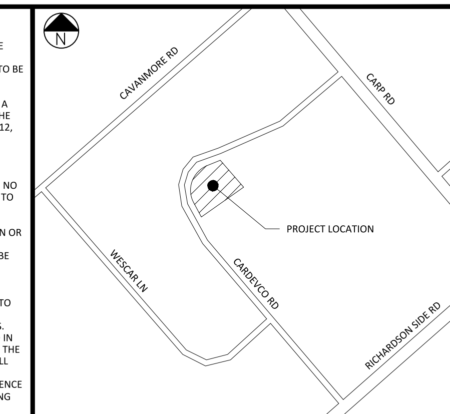
1. INFILTRATION GALLERY TO BE EXCAVATED TO SPECIFIED BOTTOM ELEVATION.
2. CONTRACTOR TO BACKFILL WITH 50mm CLEARSTONE TO SPECIFIED ELEVATION.
3. CONTRACTOR TO CAP CLEARSTONE WITH 40mil HDPE GEOMEMBRANE INSTALLED PER MANUFACTURER'S SPECIFICATIONS (TITAN 40HD- 40mil SMOOTH HDPE GEOMEMBRANE OR APPROVED EQUIVALENT).
4. CAP WITH GRANULAR 'A'. PLACEMENT OF GRANULAR 'A' AND ANY COMPACTION REQUIREMENTS TO BE COMPLETED IN CONSULTATION WITH GEOTECHNICAL ENGINEER.

PERIMETER CONVEYANCE DRAIN NOTES

1. PERIMETER CONVEYANCE DRAIN TO BE EXCAVATED TO SPECIFIED BOTTOM ELEVATIONS.
2. CONTRACTOR TO LINE EXCAVATED TRENCH WITH 40mil HDPE GEOMEMBRANE INSTALLED PER MANUFACTURER'S SPECIFICATIONS (TITAN 40HD- 40mil SMOOTH HDPE GEOMEMBRANE OR APPROVED EQUIVALENT).
3. CONTRACTOR TO BACKFILL TRENCH WITH 50mm CLEARSTONE TO SPECIFIED ELEVATION.

ELEVATION NOTES

1. ELEVATIONS SHOWN ARE GEODETIC AND ARE REFERENCED TO CGVD28 GEODETIC DATUM.
2. BEARINGS ARE GRID, DERIVED FROM CANNET 2016 REAL TIME NETWORKS GPS OBSERVATIONS AND ARE REFERENCED TO THE CENTRAL MERIDIAN OF MTM ZONE 9 (76°30' WEST LONGITUDE) NAD-83 CSRS 2010.



SITE LOCATION MAP N.T.S.

SCALE BAR — DO NOT SCALE DRAWING

0 5 10 15m

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE MARKED.

PAGE SIZE ARCH D | SCALE 1:150

SHADE GROUP INC.
4625 MARCH ROAD
ALMONTE, ON
K0A 1A0

SHADE GROUP INC

SITE BENCHMARK: MAG NAIL AND WASHER IN UTILITY POLE ON NORTH SIDE OF CARDEVCO ROAD, DIRECTLY EAST OF ENTRANCE TO HARRIS REBAR. ELEVATION=117.72

LEGEND *(IF APPLICABLE)*

PROPERTY BOUNDARY
EX. LEGAL FABRIC
PR. EASEMENT
EX. ROAD CENTRE LINE
EX. EDGE OF ASPHALT
EX. EDGE OF SHOULDER
EX. DITCH
EX. OVERHEAD UTILITIES
EX. CONTOUR AND ELEVATION
EX. BUILDING
EX. SPOT ELEVATION
EX. TOP OF SLOPE
PR. TOP OF SLOPE
EX. DRAINAGE DIRECTION & SLOPE
EX. UTILITY POLE
PR. BUILDING
PR. DESIGN ELEVATION
PR. DRAINAGE DIRECTION & SLOPE
MATCH EXISTING SPOT ELEVATION
LOT CORNER GRADES
PR. STORMWATER TRENCH
PR. RETAINING WALL
T/W - TOP OF WALL
B/W - BOTTOM OF WALL
PR. TREES
GRASS COVER
ASPHALT

REV. #	REVISION DESCRIPTION	DATE
06	REVISED PER CITY+MVCA COMMENTS	SEP 25, 2025
05	ISSUED FOR CONSTRUCTION	APR 1, 2025
04	REVISED PER CITY COMMENTS	JAN 27, 2025
03	REVISIONS TO FIRE TANKS + EASEMENT	NOV 25, 2024
02	REVISED PER CITY COMMENTS	NOV 30, 2023
01	REVISED PER CITY COMMENTS	AUG 17, 2023

STAMP

LICENSED PROFESSIONAL ENGINEER
M. K. SHADE
100170995
SEP 25, 2025
PROVINCE OF ONTARIO

PROJECT TITLE: WHELAN TRUCK REPAIR - BUILDING ADDITION

PROJECT ADDRESS: 158 CARDEVCO ROAD CARP, ON K0A 1L0

DRAWING TITLE: SITE GRADING AND DRAINAGE PLAN

DRAWING NO.: 1 OF 3

GENERAL NOTES

1. ALL TOPOGRAPHY, GROUND ELEVATIONS AND SURVEY DATA ARE SHOWN FOR INFORMATION PURPOSES ONLY AND IMPLY NO GUARANTEE OF ACCURACY. ALL DIMENSIONS AND ELEVATIONS TO BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
2. THIS PLAN HAS BEEN PREPARED IN REFERENCE TO A SITE PLANS PREPARED BY CHRISTOPHER A. LEGGETT ARCHITECT INC. DATED 09.22.21
3. THIS PLAN HAS BEEN PREPARED IN REFERENCE TO THE PLAN OF SURVEY AS COMPLETED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. A SIGNED COPY WAS NOT AVAILABLE, BUT NOTES PROVIDED ON THE SUPPLIED PLAN SPECIFY THE SURVEY WAS COMPLETED ON JULY 12, 2022.
4. THE OWNER IS RESPONSIBLE FOR ALL PERMITS AND APPROVALS FROM THE APPLICABLE AGENCIES PRIOR TO CONSTRUCTION.
5. LAYOUT BY OTHERS.
7. ALL DISTURBED AREAS ARE TO BE SEEDED AS SOON AS FEASIBLE. NO BARE TOPSOIL SHALL REMAIN. ALL DISTURBED AREAS INTENDED TO BE FINISHED AS GRASS ARE TO BE TREATED WITH A MIN. 100mm TOPSOIL AND SEED (OR SOD).
8. ALL DISTURBED AREAS TO BE RESTORED TO ORIGINAL CONDITION OR BETTER UNLESS OTHERWISE SPECIFIED.
9. DISTURBED AREAS WITHIN THE CITY ROAD ALLOWANCE ARE TO BE RESTORED TO THE SATISFACTION OF THE CITY.
10. GRADING NOT TO EXTEND BEYOND PROPERTY LINES.
11. SUITABILITY OF SUBGRADE CONDITIONS TO BE VERIFIED BY A GEOTECHNICAL ENGINEER (OR SUITABLE PROFESSIONAL) PRIOR TO FOOTING INSTALLATION. FROST PROTECTION REQUIRED WHERE DEPTH OF COVER <1.5m. FROST PROTECTION DESIGN BY OTHERS.
12. ALL PARKING LOT AND GRADING WORKS ARE TO BE COMPLETED IN ACCORDANCE WITH THE CITY STANDARDS AND SPECIFICATIONS. THE CONTRACTOR IS TO ENSURE POSITIVE DRAINAGE AWAY FROM ALL BUILDINGS.
13. CONTACT THE CITY FOR INSPECTION AT KEY MILESTONES. REFERENCE SHALL BE MADE TO THE SITE PLAN AGREEMENT AND/OR BUILDING PERMIT FOR INSPECTION MILESTONES.
14. ALL WORKS ARE TO BE PERFORMED IN ACCORDANCE WITH CURRENT CODES AND STANDARDS.
15. ANY CHANGES MADE TO THIS PLAN ARE TO BE VERIFIED AND APPROVED BY SHADE GROUP INC. AND ARE SUBJECT TO APPROVAL FROM THE APPROPRIATE APPROVAL AGENCIES.
16. THE LOCATION OF THE WELL AND SEPTIC HAS BEEN SHOWN FOR ILLUSTRATION PURPOSES ONLY. THE SUITABILITY OF THE WELL LOCATION IS TO BE VERIFIED BY OTHERS, WHILE THE DESIGN OF THE SEPTIC IS TO BE COMPLETED BY OTHERS. WELL IS TO BE MIN. 15m FROM ANY SEPTIC SYSTEM (BOTH ON-SITE AND ON ADJACENT PROPERTIES).

EROSION AND SEDIMENT CONTROL NOTES

1. BEST MANAGEMENT PRACTICES SHALL BE IMPLEMENTED BY THE CONTRACTOR/OWNER TO PROTECT THE SITE AND SURROUNDING PROPERTIES DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES PRACTICES SUCH AS LIMITING THE AMOUNT OF DISTURBED LANDS, AND INSTALLATION OF SILT FENCE BARRIERS.
2. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE PROJECT MANAGER, OWNER, MTO, CONSERVATION AUTHORITY, MECP, MUNICIPALITY OR OTHER APPLICABLE REGULATORY AGENCY.
3. DISTURBED AREAS ARE TO BE TOPSOILED, SEEDED AND/OR STABILIZED UPON COMPLETION, OR THROUGH LONG PERIODS OF WORK STOP (E.G. DURING WINTER MONTHS).
4. REGROWTH OF VEGETATION SHALL BE A PRIORITY UPON SITE COMPLETION. VEGETATION OF THE SITE SERVES AS A KEY EROSION AND SEDIMENT CONTROL PRACTICE FOR THE LONG TERM PERFORMANCE OF THE SITE.
5. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED PRIOR TO THE START OF CONSTRUCTION. ALL MEASURES ARE TO BE MONITORED AND MAINTAINED THROUGHOUT THE DURATION OF CONSTRUCTION, INCLUDING UPON COMPLETION, UP UNTIL THE SITE IS DEEMED STABLE.
6. ALL EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE INSTALLED AS PER MANUFACTURER SPECIFICATIONS. WHERE NO SUCH SPECIFICATION IS AVAILABLE, REFERENCE SHALL BE MADE TO THE APPROPRIATE OPSD OR OPSS.
7. THE OWNER AND/OR CONTRACTOR IS RESPONSIBLE FOR DEVELOPING A MAINTENANCE AND MONITORING PLAN FOR EROSION AND SEDIMENT CONTROL UP TO PROJECT COMPLETION - AND UPON COMPLETION UNTIL THE SITE IS DEEMED STABLE. THIS SHALL INCLUDE CONSIDERATION FOR INSPECTION, AND DUE CONSIDERATION FOR MAINTENANCE, INCLUDING REMOVAL OF ACCUMULATED SEDIMENT AND REMOVAL IN SUCH A MANNER THAT SEDIMENT IS NOT DISCHARGED DOWNSTREAM.
8. REFER TO THE MTO EROSION AND SEDIMENT CONTROL GUIDE ON PROPER PRACTICE IN MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES.

INFILTRATION GALLERY NOTES

1. INFILTRATION GALLERY TO BE EXCAVATED TO SPECIFIED BOTTOM ELEVATION.
2. CONTRACTOR TO BACKFILL WITH 50mm CLEARSTONE TO SPECIFIED ELEVATION.
3. CONTRACTOR TO CAP CLEARSTONE WITH 40mil HDPE GEOMEMBRANE INSTALLED PER MANUFACTURER'S SPECIFICATIONS (TITAN 40HD - 40mil SMOOTH HDPE GEOMEMBRANE OR APPROVED EQUIVALENT).
4. CAP WITH GRANULAR 'A'. PLACEMENT OF GRANULAR 'A' AND ANY COMPACTION REQUIREMENTS TO BE COMPLETED IN CONSULTATION WITH GEOTECHNICAL ENGINEER.

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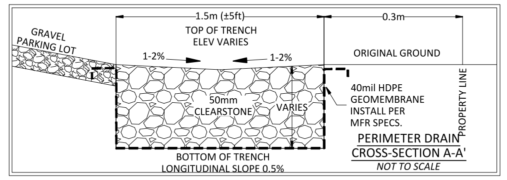
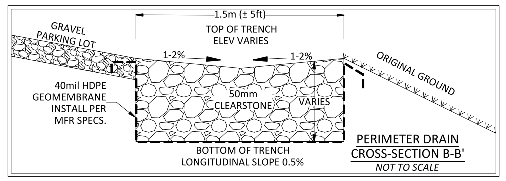
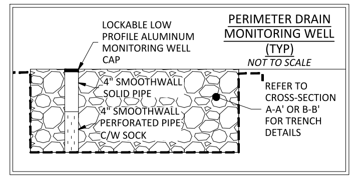


PERIMETER DRAIN CROSS-SECTION A-A'
NOT TO SCALE

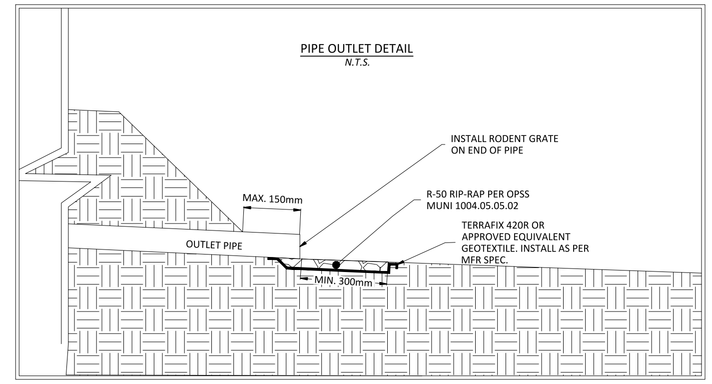


PERIMETER DRAIN CROSS-SECTION B-B'
NOT TO SCALE

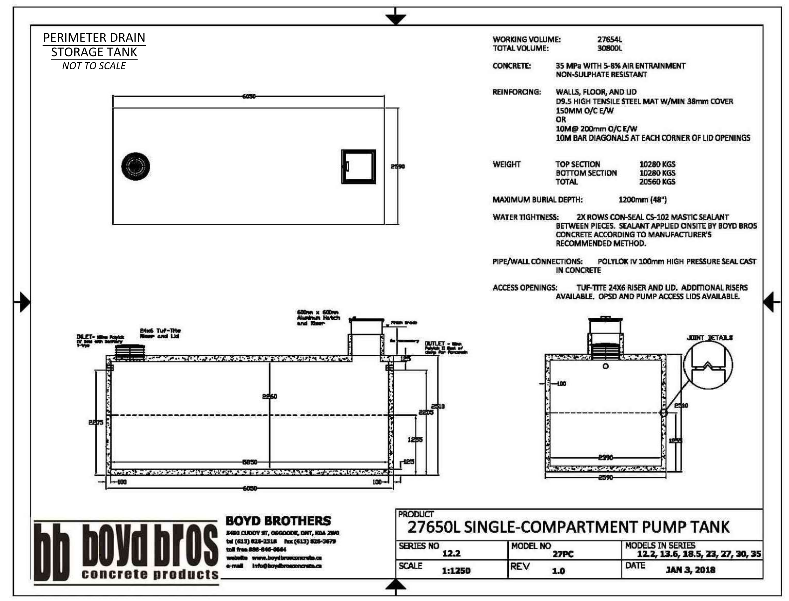


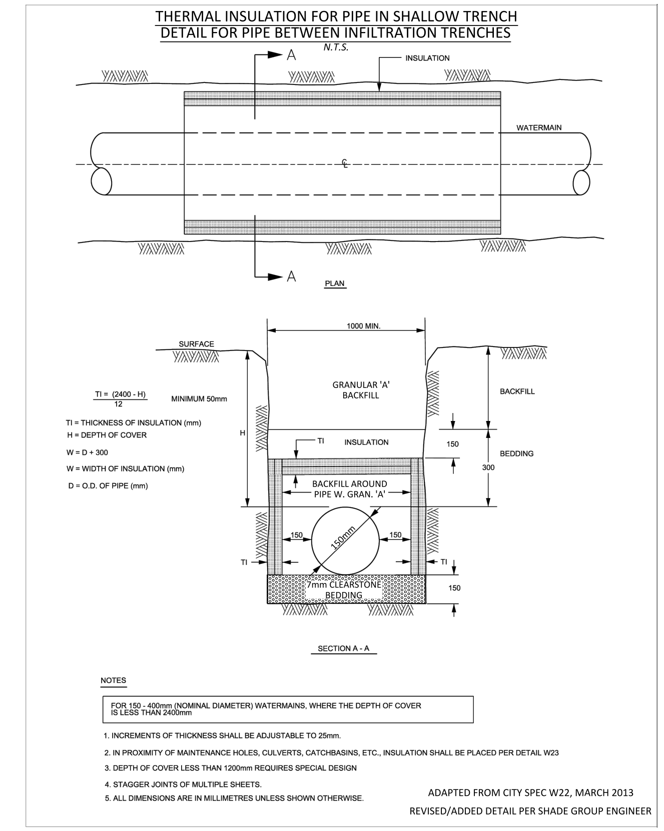
PERIMETER DRAIN MONITORING WELL (TYP)
NOT TO SCALE

PERIMETER DRAIN DETAILS
N.T.S.



PIPE OUTLET DETAIL
N.T.S.

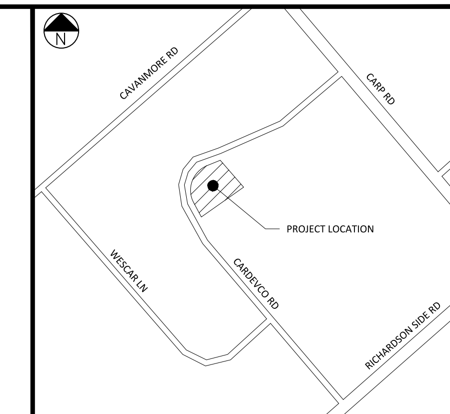




THERMAL INSULATION DEPTH
ADAPTED FROM CITY SPEC W21, MAY 2001

INSULATION REFERENCE TABLE

EFFECTIVE EARTH COVER (H)	REQUIRED THICKNESS (T)
2400 - 1800 mm	50 mm
1800 - 1500 mm	75 mm
1500 - 1200 mm	100 mm

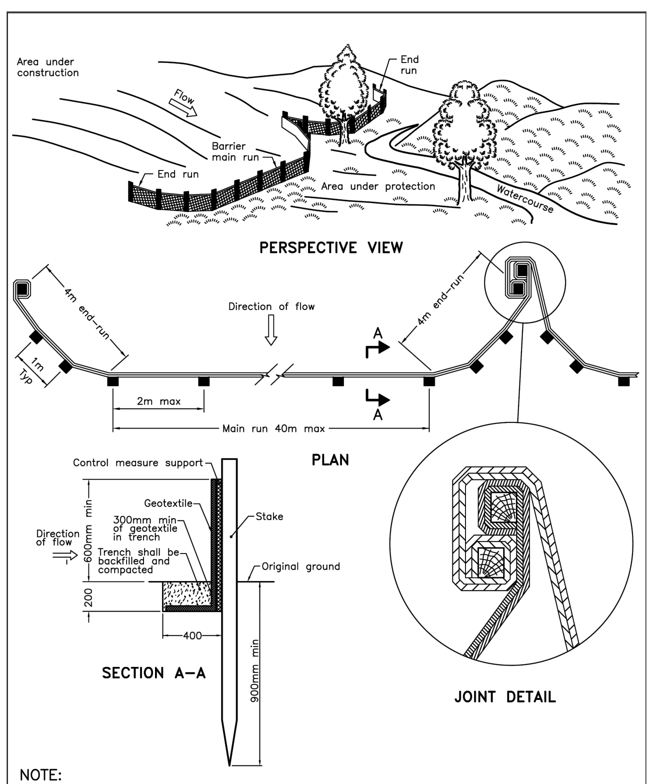


SITE LOCATION MAP N.T.S.

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE MARKED.

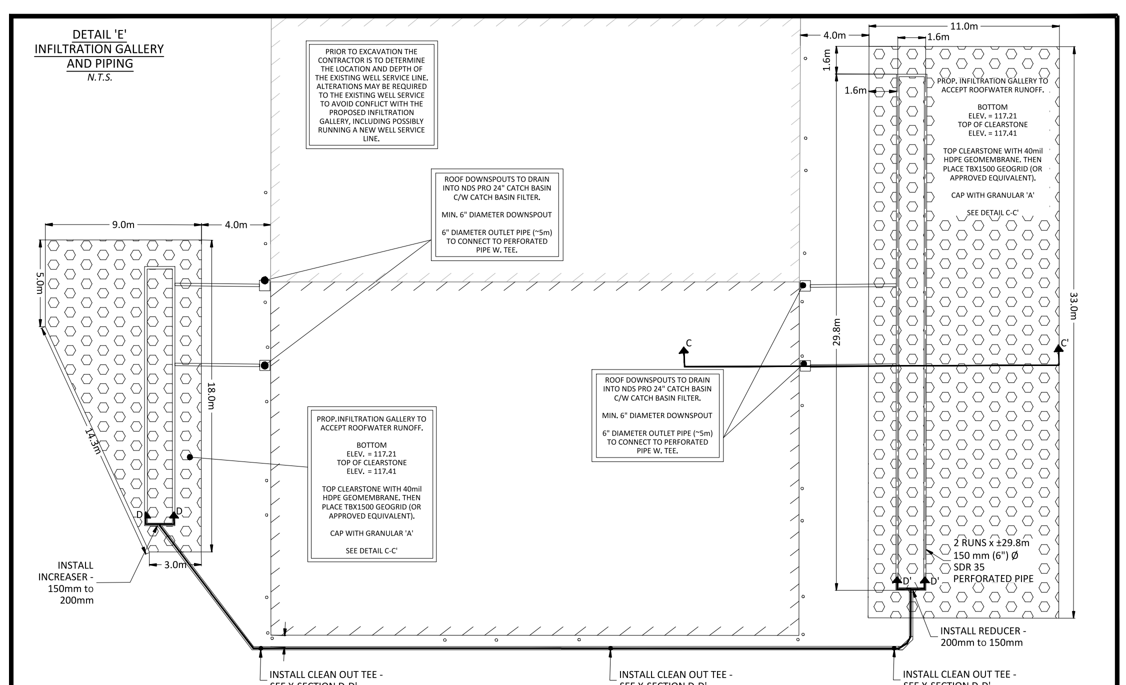
PAGE SIZE	ARCH D	SCALE	N.T.S.

SHADE GROUP INC.
4625 MARCH ROAD
ALMONTE, ON
K0A 1A0

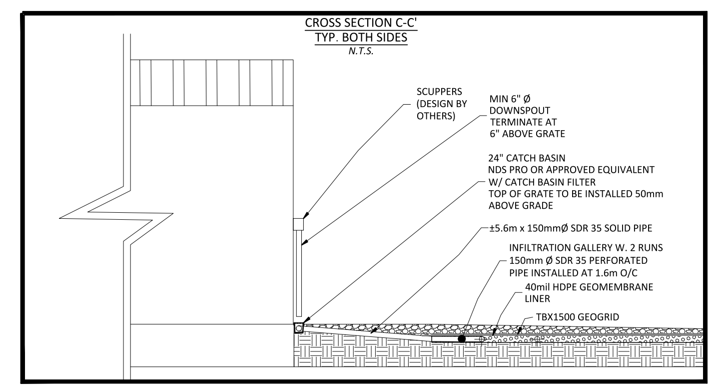


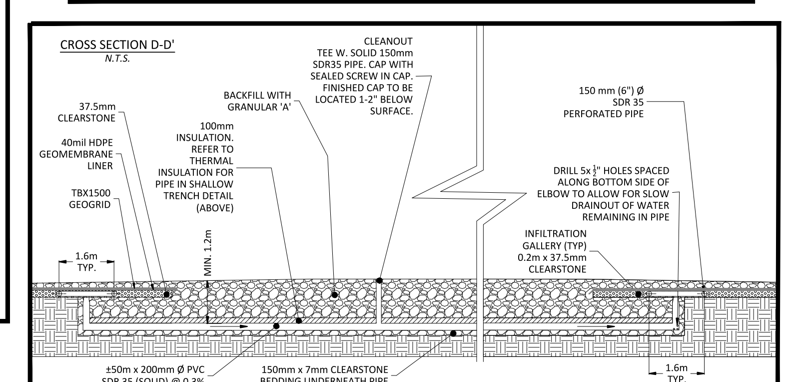
NOTE:
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2021	Rev 3
HEAVY-DUTY SILT FENCE BARRIER		OPSD 219.130



INFILTRATION GALLERY DETAILS
N.T.S.





REV. #	REVISION DESCRIPTION	DATE
04	REVISED PER CITY + MVCA COMMENTS	SEP 25, 2025
03	ISSUED FOR CONSTRUCTION	APR 1, 2025
02	SUBMITTED W. REVISED PLANS	JAN 27, 2025
01	SUBMITTED W. REVISED PLANS	NOV 25, 2024
00	SUBMITTED W. REVISED PLANS	NOV 30, 2023

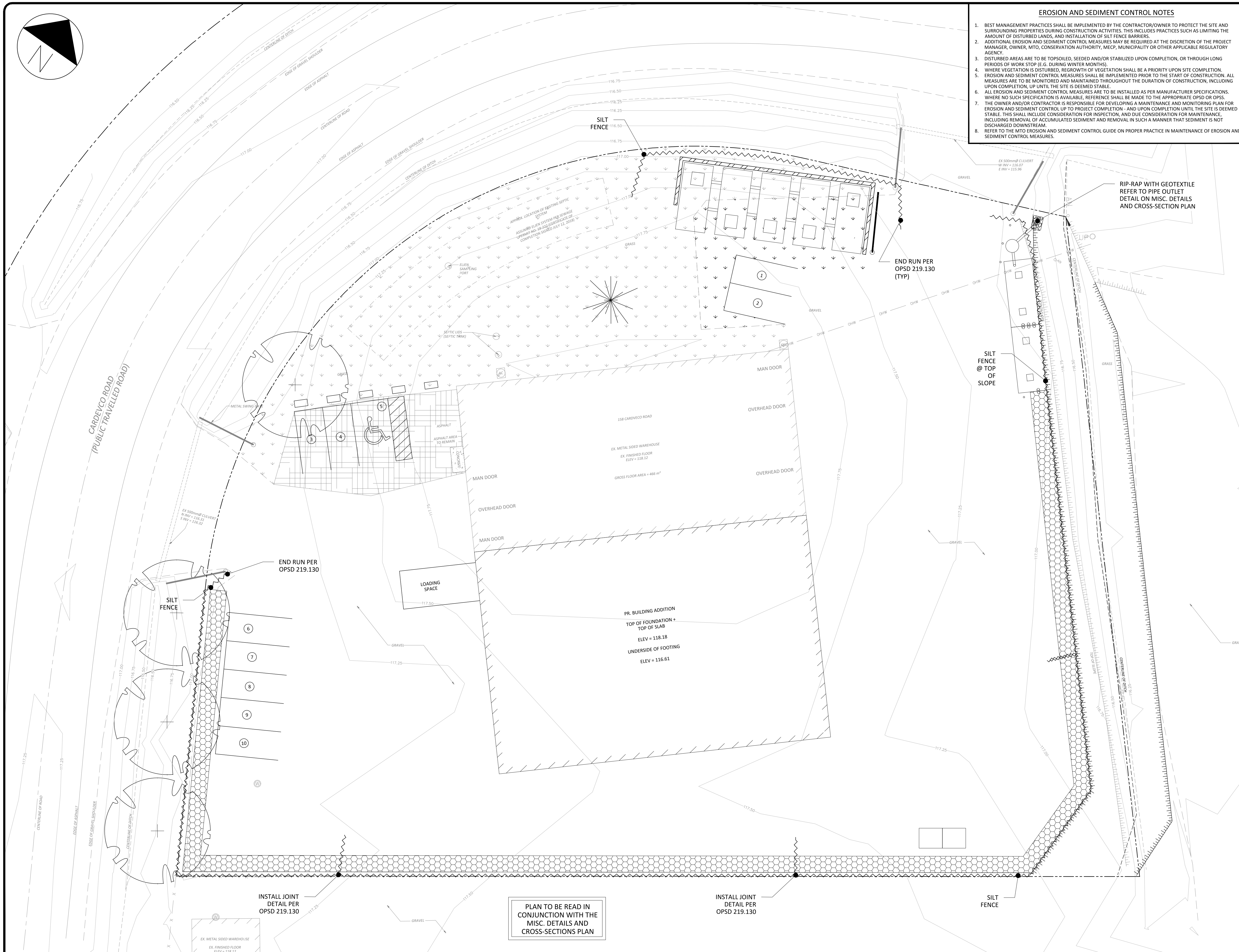
STAMP

LICENSED PROFESSIONAL ENGINEER
M. K. SHADE
100170995
SEP 25, 2025
PROVINCE OF ONTARIO

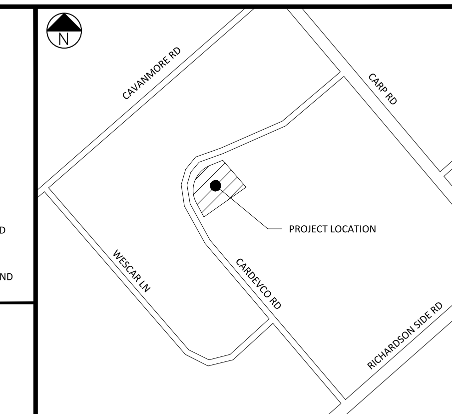
PROJECT TITLE	WHELAN TRUCK REPAIR - BUILDING ADDITION
PROJECT ADDRESS	158 CARDEVCO ROAD CARP, ON K0A 1L0
DRAWING TITLE	MISC. DETAILS & CROSS-SECTIONS
DRAWING NO.	2 OF 3

EROSION AND SEDIMENT CONTROL NOTES

1. BEST MANAGEMENT PRACTICES SHALL BE IMPLEMENTED BY THE CONTRACTOR/OWNER TO PROTECT THE SITE AND SURROUNDING PROPERTIES DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES PRACTICES SUCH AS LIMITING THE AMOUNT OF DISTURBED LANDS, AND INSTALLATION OF SILT FENCE BARRIERS.
2. ADDITIONAL EROSION AND SEDIMENT CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE PROJECT MANAGER, OWNER, MTO, CONSERVATION AUTHORITY, MECP, MUNICIPALITY OR OTHER APPLICABLE REGULATORY AGENCY.
3. DISTURBED AREAS ARE TO BE TOPSOILED, SEEDED AND/OR STABILIZED UPON COMPLETION, OR THROUGH LONG PERIODS OF WORK STOP (E.G. DURING WINTER MONTHS).
4. WHERE VEGETATION IS DISTURBED, REGROWTH OF VEGETATION SHALL BE A PRIORITY UPON SITE COMPLETION.
5. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE IMPLEMENTED PRIOR TO THE START OF CONSTRUCTION. ALL MEASURES ARE TO BE MONITORED AND MAINTAINED THROUGHOUT THE DURATION OF CONSTRUCTION, INCLUDING UPON COMPLETION, UP UNTIL THE SITE IS DEEMED STABLE.
6. ALL EROSION AND SEDIMENT CONTROL MEASURES ARE TO BE INSTALLED AS PER MANUFACTURER SPECIFICATIONS. WHERE NO SUCH SPECIFICATION IS AVAILABLE, REFERENCE SHALL BE MADE TO THE APPROPRIATE OPSD OR OPSS.
7. THE OWNER AND/OR CONTRACTOR IS RESPONSIBLE FOR DEVELOPING A MAINTENANCE AND MONITORING PLAN FOR EROSION AND SEDIMENT CONTROL UP TO PROJECT COMPLETION - AND UPON COMPLETION UNTIL THE SITE IS DEEMED STABLE. THIS SHALL INCLUDE CONSIDERATION FOR INSPECTION, AND DUE CONSIDERATION FOR MAINTENANCE, INCLUDING REMOVAL OF ACCUMULATED SEDIMENT AND REMOVAL IN SUCH A MANNER THAT SEDIMENT IS NOT DISCHARGED DOWNSTREAM.
8. REFER TO THE MTO EROSION AND SEDIMENT CONTROL GUIDE ON PROPER PRACTICE IN MAINTENANCE OF EROSION AND SEDIMENT CONTROL MEASURES.



PLAN TO BE READ IN CONJUNCTION WITH THE MISC. DETAILS AND CROSS-SECTIONS PLAN



SITE LOCATION MAP N.T.S.

SCALE BAR — DO NOT SCALE DRAWING

0 5 10 15m

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE MARKED.

PAGE SIZE	ARCH D	SCALE	1:150

SHADE GROUP INC.
4625 MARCH ROAD
ALMONTE, ON
K0A 1A0

SHADE GROUP INC

SITE BENCHMARK: MAG NAIL AND WASHER IN UTILITY POLE ON NORTH SIDE OF CARDEVCO ROAD, DIRECTLY EAST OF ENTRANCE TO HARRIS REBAR. ELEVATION=117.72

LEGEND
(IF APPLICABLE)

- PROPERTY BOUNDARY
- EASEMENT
- EX. ROAD CENTRE LINE
- EX. EDGE OF ASPHALT
- EX. EDGE OF SHOULDER
- EX. DITCH
- EX. OVERHEAD UTILITIES
- EX. CONTOUR AND ELEVATION (117.00)
- EX. TOP OF SLOPE
- PR. TOP OF SLOPE
- EX. BUILDING
- EX. UTILITY POLE (UPO)
- PR. BUILDING
- PR. PERIMETER DRAIN
- PR. RIP-RAP W. GEOTEXTILE SEE DETAIL ON MISC. DETAILS AND CROSS-SECTIONS PLAN
- PR. SILT FENCE BARRIER AS PER OPSD 219.130

REV. #	REVISION DESCRIPTION	DATE
06	REVISED PER CITY + MVCA COMMENTS	SEP 25, 2025
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04	SUBMITTED WITH REVISED PLANS	JAN 27, 2025
03	SUBMITTED WITH REVISED PLANS	NOV 25, 2024
02	REVISED PER CITY COMMENTS	NOV 30, 2023
01	REVISED PER CITY COMMENTS	AUG 17, 2023
00	60% DESIGN ISSUED FOR REVIEW AND COMMENT	DEC 2, 2022

STAMP

LICENSED PROFESSIONAL ENGINEER
M. K. SHADE
100170995
SEP 25, 2025
PROVINCE OF ONTARIO

PROJECT TITLE	WHELAN TRUCK REPAIR - BUILDING ADDITION
PROJECT ADDRESS	158 CARDEVCO ROAD CARP, ON K0A 1L0
DRAWING TITLE	EROSION AND SEDIMENT CONTROL PLAN
DRAWING NO.	3 OF 3