CAMBIUM

Environmental

Geotechnical

Building Sciences

Construction Testing & Inspections

Telephone
(866) 217.7900
(705) 742.7900

Facsimile
(705) 742.7907

Website
cambium-inc.com

Mailing Address
P.O. Box 325,
Peterborough, Ontario
Canada, K9J 6Z3

Locations
Peterborough
Kingston
Barrie
Ottawa
Whitby

Laboratory
Peterborough

Professional Engineers Ontario

APGO

June 27, 2025

725 Lake Road,
Bowmanville, Ontario

Attn:Jass Gill

Re: Infiltration Testing Report, 725 Lake Road, Bowmanville, Ontario
Cambium Reference: 19211-001

Dear Jass Gill,

Cambium Inc. (Cambium) has completed in-situ soil infiltration testing at 725 Lake Road, Oshawa, Ontario (the Site). This in-situ testing letter report should be read in conjunction with the Hydrogeological Assessment for the Site prepared by Cambium March 13, 2025[1].

Infiltration testing using the Guelph Permeameter was required to determine in-situ soil conditions such as soil texture, understand existing groundwater conditions and infiltration rates. In-situ soil infiltration conditions were required to obtain the necessary information for stormwater management planning and design.

SITE DESCRIPTION

The total area of the Site is approximately 15,900 m^2 or 1.59 hectares and it is slightly rectangular in shape. The Site has a rolling topography with a gradual west-southwest slope towards Lake Ontario, located approximately 0.5 km south of Site. The Site is bordered to the north by Lake Road, to the south and east by open agricultural land, to the west is open land with one industrial building that is interpreted to be under development.

The location of the Site is outlined on attached Figure 1. A copy of the proposed Site servicing plan is appended.

D.G. Biddle & Associates (Biddle) were retained by the Client to design the Low Impact Development (LID) measures that will be included in the proposed

[1] Cambium. (2025). *Hydrogeological Assessment – 725 Lake Road, Bowmanville, Ontario.*

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development. Biddle intends on designing a Stormtech™ SC-800 System 1 with an impermeable liner on the southwest part of the Site. Biddle also intends on having two Stormtech™ SC-800 infiltration reservoirs (Systems 2 and 3) on the southern part of the Site as LID measures. According to the Site servicing plan attached, the infiltration reservoir inverts are proposed to be 94.77 and 95.45 masl, for Systems 2 and 3, respectively; Therefore, given the site grading, the invert depths will be approximately 1.5 to 1.75 mbgs.

SCOPE OF WORK

Cambium staff were on-site on June 18, 2025, to complete two in-situ infiltration tests in the area of the proposed infiltration features using a Soil Moisture Equipment 2800K1 Guelph Permeameter. The Guelph Permeameter is used to accurately measure in-situ hydraulic conductivity or the field saturated hydraulic conductivity (K_{fs}) of the native soils.

Guelph Permeameter infiltration tests referenced as GP101-25 and GP102-25 were located within the infiltration features footprint at the Site (Figure 1). The testing was completed at 0.75 metres below ground surface (mbgs) for both tests. The test depth was higher than the invert elevations of the two infiltration features (~1.5 to 1.75 mbgs) because the groundwater levels measured in the closest on-site monitoring wells BH104 and BH105 were 1.21 and 1.32 m below ground surface (mbgs), respectively (i.e., higher than the proposed inverts). The testing depth chosen was the deepest depth that could be achieved while still having around adequate separation with the groundwater table.

RESULTS

To carry out the infiltration tests, shallow test holes were excavated using a hand auger to complete a test hole approximately 0.06 m in diameter to the target depth of 0.75 mbgs. Subsurface conditions encountered at two GP test locations (GP101-25 and GP102-25) generally consisted of topsoil, underlain by brown, silty clay with trace to some sand, trace gravel. This soil unit was described as drier than the plastic limit, with a firm relative density, extending to depths

between 0.55 and 0.75 (mbgs). A light brown, silty sandy clay, some gravel was encountered under the silty clay in the GP101-25.

The tested native soils at the testing depth of 0.75 mbgs within each infiltration test location were described as follows:

- GP101-25 – Light brown, silty sandy clay, some gravel, soft, dry to moist. The hole was open and dry upon completion.
- GP102-25 – Brown, silty clay, some sand, drier than plastic limit, firm. The hole was open and dry upon completion.

Bedrock was not encountered within the depths of the test pit investigation. Groundwater was not encountered at the hand auger depths.

- ***INFILTRATION TESTING***

The field results of the in-situ infiltration testing were processed using SOILMOISTURE ® excel based calculation models which yield the saturated hydraulic conductivity of the tested soils (in m/s). The saturated hydraulic conductivity results are then cross-referenced against established relationships between hydraulic conductivity (m/s) and infiltration rate (mm/hr), as outlined in the *Supplementary Guidelines to the Ontario Building Code: SG-6 Percolation Time and Soil Descriptions* (Ontario Ministry of Municipal Affairs and Housing, 1997)

A summary of the infiltration testing results is outlined in Table 1 below. The calculations for the Guelph Permeameter testing at GP101-25 and GP102-25 are appended to this document.

Table 1: Summary of Infiltration Testing Results

GP Test Identifier	Testing Interval/ Depth (mbgs)	Test #	Hydraulic Conductivity (m/sec)	Infiltration Rate (mm/hr)	Average Infiltration Rate (mm/hr)	Average Percolation Rate (min/cm)
GP101-25	0.75	1 (2)	1.87×10^{-7}	30	39	15
		2 (3)	8.69×10^{-7}	45		
GP102-25	0.75	1 (1)	2.62×10^{-8}	18	21	29
		2 (2)	7.80×10^{-8}	24		

1. *5 cm head test; 2. 10 cm head test; 3. 20 cm head test*

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As shown above, the percolation times ranged from 29 to 15 min/cm, while the infiltration rates ranged between 21 and 39 mm/hour. The calculated percolation rates and infiltration rates indicate a moderate drainage capacity at the tested locations and would be suitable for the implementation of proposed infiltration features. These infiltration rates should be accounted for during the design of LID features by a stormwater engineer, after an appropriate safety factor is applied.

CLOSING

We trust that the information in this submission meets your current requirements. If you have any questions regarding the contents of this report, please contact the undersigned

Best regards,

Cambium Inc.

DocuSigned by:
6C8CA15FD6B4444...

Warren Young, P.Eng.
Coordinator – Hydrogeologist

DS

PROFESSIONAL GEOSCIENTIST
SUDHAKAR KURLI
PRACTISING MEMBER
2794
ONTARIO

Signed by:
3611EDDBEA134BF...

Sudhakar Kurli, M.Sc., P.Geo.
Project Manager – Hydrogeologist

2025-06-27

WY/SK/knh

Encl. *Cambium Qualifications & Limitations*
Figure 1 – Site Plan
Site Development Plans
GP Testing Calculations

\\cambiumincstorage.file.core.windows.net\projects\19200 to 19299\19211-001 Jass Gill - GEO - 725 Lake Rd\Deliverables\REPORT - Infiltration Testing Letter\Final\2025-06-27 LTR - Infiltration Testing - 725 Lake Road.docx

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CAMBIUM QUALIFICATIONS AND LIMITATIONS

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

Facts, conditions, information and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

Reliance

Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

HYDROGEOLOGICAL ASSESSMENT

JASS GILL
725 Lake Road
Bowmanville, Ontario

LEGEND

- (97.19) Groundwater Elevation June 20 2022
- Benchmark
- Borehole
- Monitoring Well
- Guelph Permeameter Test Location
- Groundwater Contour June 20 2022
- Inferred Groundwater Contour June 20 2022
- Site (approximate)
- Groundwater Flow Direction June 20 2022

Notes:
Imagery obtained from Digital Raster Acquisition Project Eastern Ontario (DRAPE) 2024. Source: Ontario Ministry of Natural Resources and Forestry.

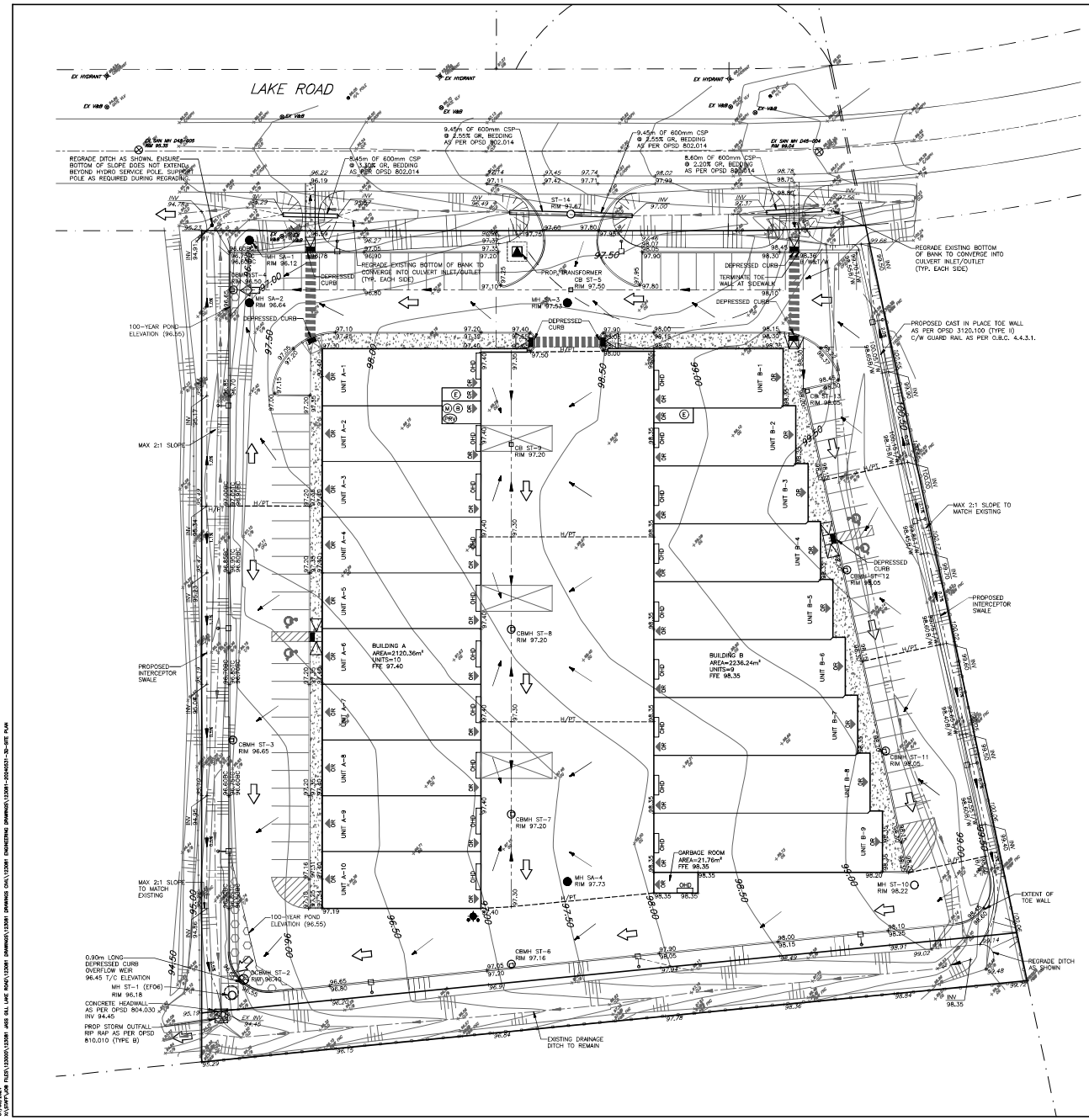
- Overlay plan provided by D.G. Biddle & Associates. Project No.: 123081, 2024/06/04.
- This document contains information licensed under the Open Government License - Ontario.
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

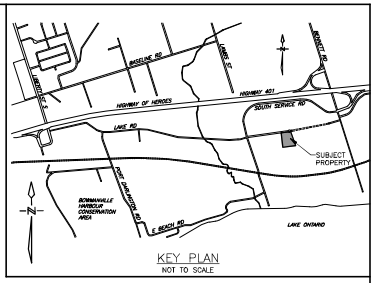
CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

SITE PLAN

Project No.: 19211-001		Date: June 2025	
		Rev.:	
Scale: 1:1,000		Projection: NAD 1983 UTM Zone 17N	
Created by: DBB	Checked by: SK	Figure:	1

O:\GIS\MXDs\19200-19299\19211-001 Jass Gill - GEO - 725 Lake Rd Clarington Industrial Building\2025-06-20 Hydro G 19211 Fig1 Only.aprx





BENCH MARK

BENCHMARK 0011925U176A: BOWMANVILLE– C.N.R.Y., STONE ARCH SUBWAY FOR SOUTH SERVICE ROAD, 1.9 KM EAST OF STATION, BOLT IN NORTHWEST FACE OF WEST WING WALL AT NORTH END OF SUBWAY, THIRD COURSE BELOW COPING.
ELEVATION: 84.479

SITE GRADING NOTES

1. THE LOCATION AND ELEVATION OF ALL EXISTING UTILITIES AND SERVICES TO BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCING CONSTRUCTION. CONCERNED UTILITIES TO BE GIVEN ADVANCED NOTICE FOR STAKE OUT. THE CONSULTANT ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OF THE UTILITIES SHOWN ON THE DRAWINGS.
2. QUANTITIES, DIMENSIONS AND ELEVATIONS TO BE VERIFIED BY THE CONTRACTOR PRIOR TO ORDERING MATERIALS OR COMMENCING CONSTRUCTION.
3. ALL SLOPES SHALL BE CONSTRUCTED AT 3:1 (MAXIMUM) UNLESS OTHERWISE NOTED ON THE DRAWINGS.
4. ALL SWALES SHALL BE CONSTRUCTED WITH 2% MINIMUM GRADE UNLESS OTHERWISE NOTED ON THE DRAWINGS.
5. ALL SLOPES, SWALES AND OPEN SPACE AREAS SHALL BE SODDED ON A MINIMUM OF 300mm OF TOPSOIL.
6. ALL DISTURBED AREAS WITHIN ABUTTING MUNICIPAL RIGHT OF WAYS SHALL BE SODDED ON A MINIMUM OF 300mm OF TOPSOIL.
7. ALL MONITORING WELLS WITHIN DEVELOPMENT AREA TO BE DECOMMISSIONED AS PER MECP CRITERIA.
8. PARKING AREA SHALL CONSIST OF THE FOLLOWING UNLESS OTHERWISE APPROVED BY THE ENGINEER:
   - 200mm GRANULAR 'B'
   - 150mm GRANULAR 'A'
   - 50mm HL3 ASPHALT
9. HEAVY DUTY PAVEMENT AREA SHALL CONSIST OF THE FOLLOWING UNLESS OTHERWISE APPROVED BY THE ENGINEER:
   - 300mm GRANULAR 'B'
   - 150mm GRANULAR 'A'
   - 75mm HL8 ASPHALT
   - 40mm HL3 ASPHALT
10. PROPOSED ENTRANCE WITHIN LAKE ROAD RIGHT OF WAY SHALL CONSIST OF:
    - 375mm GRANULAR 'B'
    - 150mm GRANULAR 'A'
    - 80mm HL8 ASPHALT
    - 40mm HL3 ASPHALT

GENERAL NOTES

1. RESPECTING ALL WORK IN THE MUNICIPAL RIGHT OF WAY, THE CONTRACTOR IS TO PROVIDE AT LEAST 48 HOURS NOTICE TO THE CLARINGTON PUBLIC WORKS DEPARTMENT STAFF AT (905)-263-2291.
2. A ROAD OCCUPANCY PERMIT WILL BE REQUIRED FOR ANY WORK DONE IN THE MUNICIPAL ROAD ALLOWANCE. EXCAVATION OF THE ROAD SURFACE IS NOT PERMITTED BETWEEN DECEMBER 1ST AND APRIL 30TH.
3. ALL RESTORATION OR WORK DONE IN THE ROAD ALLOWANCE MUST BE COMPLETED AS PER MUNICIPAL FIELD STAFF DIRECTION.
4. THE PERFORMANCE GUARANTEE WILL NOT BE REFUNDED BY THE MUNICIPALITY OF CLARINGTON UNLESS THE WORKS HAVE BEEN INSPECTED BY MUNICIPAL FORCES AND DEEMED TO BE COMPLETED AND SATISFACTORY.

LEGEND

- ORIGINAL SURVEY ELEVATION — 101.35
- ORIGINAL ELEVATION TO REMAIN — 101.35
- PROPOSED ELEVATIONS — 101.35
- PROPOSED SWALE
- DIRECTION OF DRAINAGE
- LIMIT OF PONDING
  MAX PONDING ELEVATION 96.55
- DIRECTION OF OVERLAND FLOW

PRELIMINARY NOT FOR CONSTRUCTION

NO.	SUBMISSION	DATE

725 LAKE ROAD, BOWMANVILLE
MUNICIPALITY OF CLARINGTON

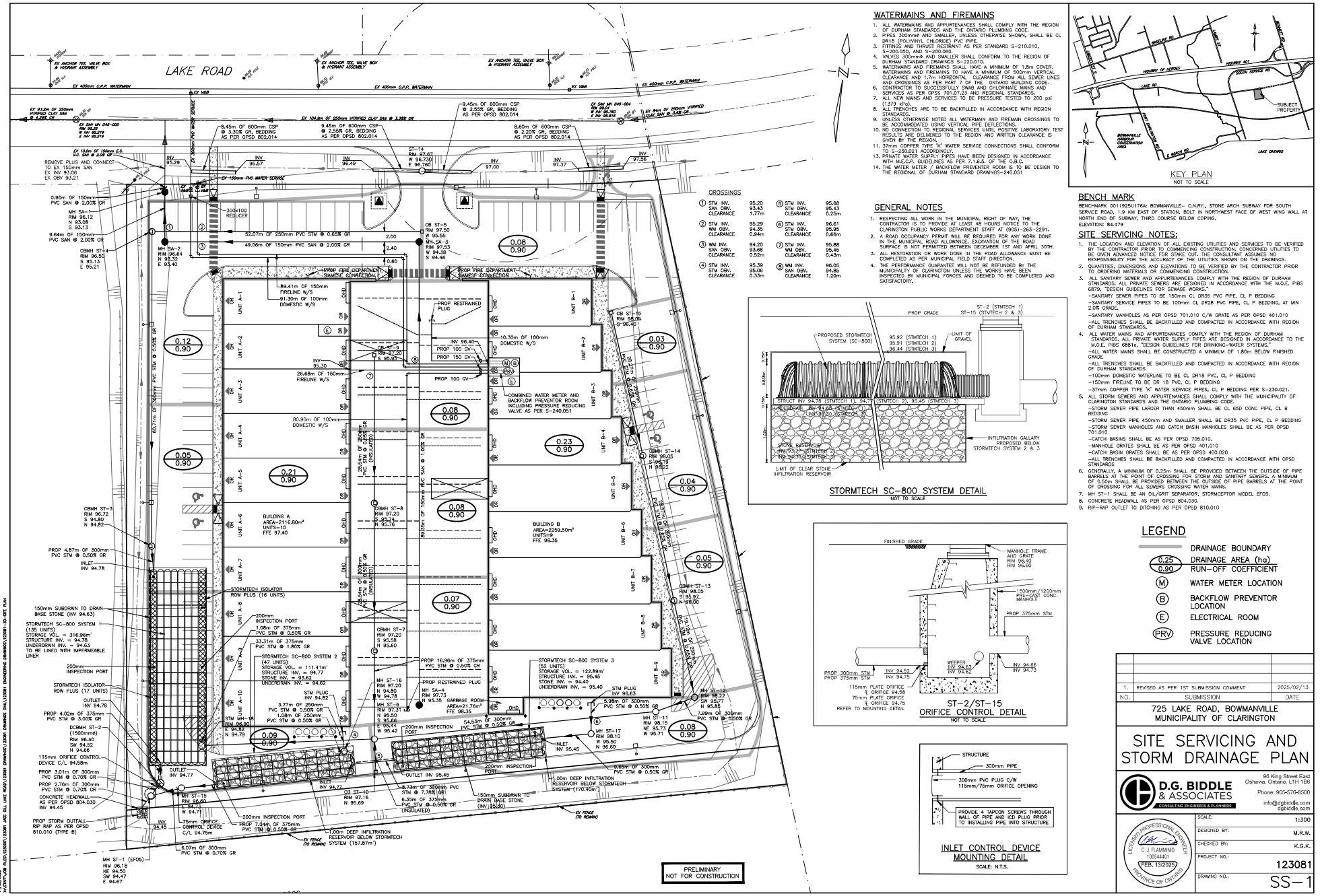
SITE GRADING PLAN

D.G. BIDDLE & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
96 King Street East
Oshawa, Ontario, L1H 1B6
Phone: 905-578-8500
info@dgbiddle.com
dgbiddle.com

LICENSED PROFESSIONAL ENGINEER
K. G. KEUNING
100500501
2024/06/04
PROVINCE OF ONTARIO

SCALE:	1:300
DESIGNED BY:	M.R.W.
CHECKED BY:	K.G.K.
PROJECT NO.:	123081
DRAWING NO.:	SG-1

31/05/2024
N:\PROJECTS\123081 LAKE ROAD\123081 DRAWINGS\123081 DRAWINGS CIVIL\123081 ENGINEERING DRAWINGS\123081-20240531-SG-SITE PLAN



WATERMAINS AND FIREMAINS

1. ALL WATERMAINS AND APPURTENANCES SHALL COMPLY WITH THE REGION OF DURHAM STANDARDS AND THE ONTARIO PLUMBING CODE.
2. PIPES 300mm∅ AND SMALLER, UNLESS OTHERWISE SHOWN, SHALL BE CL DR18 (POLYVINYL CHLORIDE) PVC PIPE.
3. FITTINGS AND THRUST RESTRAINT AS PER STANDARD S-210.010, S-200.050, AND S-200.060.
4. VALVES 300mm∅ AND SMALLER SHALL CONFORM TO THE REGION OF DURHAM STANDARD DRAWINGS S-220.010.
5. WATERMAINS AND FIREMAINS SHALL HAVE A MINIMUM OF 1.8m COVER. WATERMAINS AND FIREMAINS TO HAVE A MINIMUM OF 500mm VERTICAL CLEARANCE AND 1.7m HORIZONTAL CLEARANCE FROM ALL SEWER LINES AND CROSSINGS AS PER PART 7 OF THE ONTARIO BUILDING CODE.
6. CONTRACTOR TO SUCCESSFULLY SWAB AND CHLORINATE MAINS AND SERVICES AS PER OPSS 701.07.23 AND REGIONAL STANDARDS.
7. ALL NEW MAINS AND SERVICES TO BE PRESSURE TESTED TO 200 psi (1379 kPa).
8. ALL TRENCHES ARE TO BE BACKFILLED IN ACCORDANCE WITH REGION STANDARDS.
9. UNLESS OTHERWISE NOTED ALL WATERMAIN AND FIREMAIN CROSSINGS TO BE ACCOMMODATED USING VERTICAL PIPE DEFLECTIONS.
10. NO CONNECTION TO REGIONAL SERVICES UNTIL POSITIVE LABORATORY TEST RESULTS ARE DELIVERED TO THE REGION AND WRITTEN CLEARANCE IS GIVEN BY THE REGION.
11. 37mm COPPER TYPE 'K' WATER SERVICE CONNECTIONS SHALL CONFORM TO S-230.021 ACCORDINGLY.
12. PRIVATE WATER SUPPLY PIPES HAVE BEEN DESIGNED IN ACCORDANCE WITH M.E.C.P. GUIDELINES AS PER 7.1.6.5. OF THE O.B.C.
13. THE WATER METER / BACKFLOW PREVENTER ROOM IS TO BE DESIGN TO THE REGIONAL OF DURHAM STANDARD DRAWINGS-240.051

CROSSINGS

① STM INV.	95.20	⑤ STM INV.	95.68		
SAN OBV.	93.43	STM OBV.	95.43		
CLEARANCE	1.77m	CLEARANCE	0.25m		
② STM INV.	95.29	⑥ STM INV.	96.61		
WM OBV.	94.35	STM OBV.	95.95		
CLEARANCE	0.94m	CLEARANCE	0.66m		
③ WM INV.	94.20	⑦ STM INV.	95.88		
SAN OBV.	93.68	WM OBV.	95.45		
CLEARANCE	0.52m	CLEARANCE	0.43m		
④ STM INV.	95.39	⑧ WM INV.	96.05		
STM OBV.	95.06	SAN OBV.	94.85		
CLEARANCE	0.33m	CLEARANCE	1.20m		

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4. THE PERFORMANCE GUARANTEE WILL NOT BE REFUNDED BY THE MUNICIPALITY OF CLARINGTON UNLESS THE WORKS HAVE BEEN INSPECTED BY MUNICIPAL FORCES AND DEEMED TO BE COMPLETED AND SATISFACTORY.

STORMTECH SC-800 SYSTEM DETAIL
NOT TO SCALE

ST-2/ST-15 ORIFICE CONTROL DETAIL
NOT TO SCALE

INLET CONTROL DEVICE MOUNTING DETAIL
SCALE: N.T.S.

KEY PLAN
NOT TO SCALE

BENCH MARK

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ELEVATION: 84.479

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2. QUANTITIES, DIMENSIONS AND ELEVATIONS TO BE VERIFIED BY THE CONTRACTOR PRIOR TO ORDERING MATERIALS OR COMMENCING CONSTRUCTION.
3. ALL SANITARY SEWER AND APPURTENANCES COMPLY WITH THE REGION OF DURHAM STANDARDS. ALL PRIVATE SEWERS ARE DESIGNED IN ACCORDANCE WITH THE M.O.E. PIBS 6879, "DESIGN GUIDELINES FOR SEWAGE WORKS."
   - SANITARY SEWER PIPES TO BE 150mm CL DR35 PVC PIPE, CL P BEDDING
   - SANITARY SERVICE PIPES TO BE 100mm CL DR28 PVC PIPE, CL P BEDDING, AT MIN 2.0% GRADE.
   - SANITARY MANHOLES AS PER OPSD 701.010 C/W GRATE AS PER OPSD 401.010
   - ALL TRENCHES SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH REGION OF DURHAM STANDARDS.
4. ALL WATER MAINS AND APPURTENANCES COMPLY WITH THE REGION OF DURHAM STANDARDS. ALL PRIVATE WATER SUPPLY PIPES ARE DESIGNED IN ACCORDANCE TO THE M.O.E. PIBS 6881e, "DESIGN GUIDELINES FOR DRINKING-WATER SYSTEMS."
   - ALL WATER MAINS SHALL BE CONSTRUCTED A MINIMUM OF 1.80m BELOW FINISHED GRADE
   - ALL TRENCHES SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH REGION OF DURHAM STANDARDS
   - 100mm DOMESTIC WATERLINE TO BE CL DR18 PVC, CL P BEDDING
   - 150mm FIRELINE TO BE DR 18 PVC, CL P BEDDING
   - 37mm COPPER TYPE 'K' WATER SERVICE PIPES, CL P BEDDING PER S-230.021.
5. ALL STORM SEWERS AND APPURTENANCES SHALL COMPLY WITH THE MUNICIPALITY OF CLARINGTON STANDARDS AND THE ONTARIO PLUMBING CODE.
   - STORM SEWER PIPE LARGER THAN 450mm SHALL BE CL 65D CONC PIPE, CL B BEDDING
   - STORM SEWER PIPE 450mm AND SMALLER SHALL BE DR35 PVC PIPE, CL P BEDDING
   - STORM SEWER MANHOLES AND CATCH BASIN MANHOLES SHALL BE AS PER OPSD 701.010
   - CATCH BASINS SHALL BE AS PER OPSD 705.010.
   - MANHOLE GRATES SHALL BE AS PER OPSD 401.010 P BEDDING
   - CATCH BASIN GRATES SHALL BE AS PER OPSD 400.020
   - ALL TRENCHES SHALL BE BACKFILLED AND COMPACTED IN ACCORDANCE WITH OPSD STANDARDS
6. GENERALLY, A MINIMUM OF 0.25m SHALL BE PROVIDED BETWEEN THE OUTSIDE OF PIPE BARRELS AT THE POINT OF CROSSING FOR STORM AND SANITARY SEWERS. A MINIMUM OF 0.50m SHALL BE PROVIDED BETWEEN THE OUTSIDE OF PIPE BARRELS AT THE POINT OF CROSSING FOR ALL SEWERS CROSSING WATER MAINS.
7. MH ST-1 SHALL BE AN OIL/GRIT SEPARATOR, STORMCEPTOR MODEL EFO5.
8. CONCRETE HEADWALL AS PER OPSD 804.030.
9. RIP-RAP OUTLET TO DITCHING AS PER OPSD 810.010

LEGEND

- DRAINAGE BOUNDARY
- 0.25 / 0.90 — DRAINAGE AREA (ha) / RUN-OFF COEFFICIENT
- (M) — WATER METER LOCATION
- (B) — BACKFLOW PREVENTOR LOCATION
- (E) — ELECTRICAL ROOM
- (PRV) — PRESSURE REDUCING VALVE LOCATION

NO.	SUBMISSION	DATE
1.	REVISED AS PER 1ST SUBMISSION COMMENT	2025/02/13

725 LAKE ROAD, BOWMANVILLE
MUNICIPALITY OF CLARINGTON

SITE SERVICING AND STORM DRAINAGE PLAN

D.G. BIDDLE & ASSOCIATES
CONSULTING ENGINEERS & PLANNERS
98 King Street East
Oshawa, Ontario, L1H 1B6
Phone: 905-576-8500
info@dgbiddle.com
dgbiddle.com

LICENSED PROFESSIONAL ENGINEER
C. J. FLAMMINIO
100544401
FEB. 13/2025
PROVINCE OF ONTARIO

SCALE:	1:300
DESIGNED BY:	M.R.W.
CHECKED BY:	K.G.K.
PROJECT NO.:	123081
DRAWING NO.:	SS-1

Location	GP101-25				Location	GP102-25			
GPS Coord	17N 688845 m E, 4863168 m N				GPS Coord	17N, 688879.5 m E, 4863173.5 m N			
Soil	Light brown, silty sandy clay, some gravel				Soil	Brown, silt and clay, some sand			
Depth	0.75 m		0.75 m		Depth	0.75 m		0.75 m	
Inner/Dual	Inner		Inner		Inner/Dual	Inner		Inner	
	Head	10 cm	Head	20 cm		Head	5 cm	Head	10 cm
Time (min)	Level	Δh/Δt	Level	Δh/Δt	**Time (min)**	Level	Δh/Δt	Level	Δh/Δt
0.0	1.5		9.5		0.0	2.5		5.2	
1.0	2.5	1	18	8.5	1.0	40.2	37.7	45.8	40.6
2.0	3.3	0.8	18.1	0.1	2.0	40.2	0	45.8	0
3.0	4.2	0.9	18.2	0.1	3.0	40.3	0.1	45.9	0.1
4.0	5	0.8	18.4	0.2	4.0	40.3	0	46	0.1
5.0	5.6	0.6	18.7	0.3	5.0	40.3	0	46	0
6.0	6.4	0.8	18.9	0.2	6.0	40.4	0.1	46.1	0.1
7.0	7.1	0.7	22.7	3.8	7.0	40.5	0.1	46.3	0.2
8.0	7.7	0.6	27.3	4.6	8.0	40.6	0.1	46.7	0.4
9.0	8.3	0.6	31.5	4.2	9.0	40.7	0.1	46.8	0.1
10.0	8.9	0.6	36	4.5	10.0	40.7	0	46.9	0.1
11.0	9.7	0.8	41.2	5.2	11.0	40.7	0	47.1	0.2
12.0	10.4	0.7	44.9	3.7	12.0	40.6	-0.1	47.4	0.3
13.0	10.9	0.5	49.6	4.7	13.0	40.6	0	47.6	0.2
14.0	11.2	0.3	54.2	4.6	14.0	40.6	0	48	0.4
15.0	11.5	0.3	58.8	4.6	15.0	40.5	-0.1	48.2	0.2
16.0	11.8	0.3	63.5	4.7	16.0	40.5	0	48.5	0.3
17.0	12.2	0.4	67.6	4.1	17.0	40.5	0	48.8	0.3
18.0	12.5	0.3	71.8	4.2	18.0	40.5	0	48.9	0.1
19.0	12.9	0.4	76.2	4.4	19.0	40.6	0.1	49.2	0.3
20.0	13.3	0.4			20.0	40.7	0.1	49.5	0.3
21.0	13.5	0.2			21.0	40.8	0.1	49.7	0.2
22.0	13.9	0.4			22.0	40.9	0.1	50	0.3
23.0	14.2	0.3			23.0	41	0.1	50.2	0.2
24.0	14.6	0.4			24.0	41.1	0.1	50.4	0.2
25.0	14.8	0.2			25.0	41.2	0.1	50.6	0.2
26.0	15.2	0.4			26.0	41.2	0	51.2	0.6
27.0	15.5	0.3			27.0	41.3	0.1	51.3	0.1
28.0	15.7	0.2			28.0	41.3	0	51.6	0.3
29.0	15.9	0.2			29.0	41.4	0.1	51.8	0.2
30.0	16.3	0.4			30.0	41.4	0	52	0.2
Average Steady State	0.48		4.41			0.04		0.20	
Single Head K (m/sec)	1.87E-07		8.69E-07			2.62E-08		7.80E-08	
Average Single Head K	5.28E-07					5.21E-08			
Infiltration Rate (mm/hr)	**30**		**45**			**18**		**24**	
Average Infiltration Rate (mm/hr)	**39**					**21**			
Average Percolation Time (min/cm)	**15**					**29**			

Guelph Permeameter Calculations

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

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): 0.4800

Res Type	2.16
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	0.480
Q	0.017
pi	3.142

α^*= 0.12 cm^{-1}

C = 1.287543

Q = 0.01728

K_{fs} =	1.87E-05 cm/sec
	1.12E-03 cm/min
	1.87E-07 m/sec
	4.42E-04 inch/min
	7.37E-06 inch/sec

Φ_m = 1.56E-04 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

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): 4.4100

Res Type	2.16
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	4.410
Q	0.15876
pi	3.1415

α^*= 0.12 cm^{-1}

C = 1.980192

Q = 0.15876

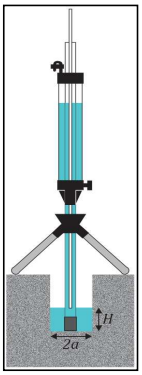
K_{fs} =	8.69E-05 cm/sec
	5.22E-03 cm/min
	8.69E-07 m/ses
	2.05E-03 inch/min
	3.42E-05 inch/sec

Φ_m = 7.24E-04 cm^2/min

Average

K_{fs} =	5.28E-05 cm/sec
	3.17E-03 cm/min
	5.28E-07 m/s
	1.25E-03 inch/min
	2.08E-05 inch/sec

Φ_m = 4.40E-04 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	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reserv (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capilla 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 t 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	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter Calculations

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

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): 0.0400

Res Type	2.16
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	0.040
Q	0.001
pi	3.142

α^*= 0.12 cm^{-1}

C = 0.803154

Q = 0.00144

K_{fs} = 2.62E-06 cm/sec
1.57E-04 cm/min
2.62E-08 m/sec
6.19E-05 inch/min
1.03E-06 inch/sec

Φ_m = 2.18E-05 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): 2.16

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.
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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): 0.2000

Res Type	2.16
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	0.200
Q	0.0072
pi	3.1415

α^*= 0.12 cm^{-1}

C = 1.287543

Q = 0.0072

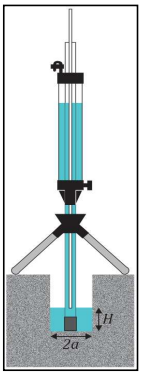
K_{fs} = 7.80E-06 cm/sec
4.68E-04 cm/min
7.80E-08 m/ses
1.84E-04 inch/min
3.07E-06 inch/sec

Φ_m = 6.50E-05 cm^2/min

Average

K_{fs} = 5.21E-06 cm/sec
3.13E-04 cm/min
5.21E-08 m/s
1.23E-04 inch/min
2.05E-06 inch/sec

Φ_m = 4.34E-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	$\alpha^*(cm^{-1})$	Shape Factor
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Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reserv (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capilla 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 t 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	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $\Phi_m = G_3Q_1 - G_4Q_2$