FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

IN SUPPORT OF REZONING APPLICATION

45 Bishop Street

Residential Development

Township of Selwyn, Ontario

counterpoint ENGINEERING

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Vaughan, Ontario L4K 5Y2
Tel: (905) 326-1404

File Number: 22088

Prepared For:

Pro Floor Plans

2	Issued for 2nd Submission	Feb 16, 2024
1	Issued For 1st Submission	Feb 26, 2021
No.	**Revision**	**Date**

EXECUTIVE SUMMARY

This Functional Servicing Report has been prepared on behalf of Pro Floor Plans the registered owner of the subject land. The application proposes a residential development located at 45 Bishop Street in the Township of Selwyn, Ontario in Peterborough County.

The servicing strategy for the proposed development is summarized as follows:

Water Servicing:

There is an existing 150mm watermain on the south side of Bishop Street and an existing hydrant east of the proposed road connection. The existing watermain alignment in Bishop Street is to be confirmed during detailed design.

The proposed development will be serviced through a 50mm connection to the existing 150mm watermain on the south side of Bishop Street. The development demand requirement is governed by the maximum day demand plus fire flow of 12,140 L/min while maintaining a minimum pressure of 140 kPa. As noted above, the Township Fire Department has confirmed that adequate fire protection can be provided from Concession Street to the west.

Sanitary Servicing:

There is currently an existing 200mm sanitary sewer on Bishop Street, draining west. The proposed development will be serviced with a proposed manhole and 200mm sanitary sewer extension from Bishop Street into the proposed cul-de-sac. Individual sanitary service connections will be provided at each of the residential units.

In the proposed dry weather conditions, the addition of the proposed development will result in a total flow of **1.34 L/s.** The proposed sanitary sewer servicing the site shall be 200mm running at a minimum slope of 0.50%. The generated flow from the proposed development is only 6% of the full flow capacity and as a result, the system will operate in a non-surcharged condition. Based on discussions with the Township's peer review engineer, we understand there are no known capacity constraints in the area and that an overall survey and evaluation of the sanitary sewer completed circa 2021 was to confirm capacity for the development once complete. It is assumed that the sanitary network survey has been completed and capacity can be confirmed along with review of this report.

Stormwater Servicing:

The existing site is 1.01 ha and primarily drains south with a small area draining to the north to Bishop Street. There are no existing storm sewers on Bishop Street along the site frontage. Stormwater is conveyed overland via ditches on the north and south sides of Bishop Street and through existing culverts under driveways, flowing west.

The site shall be serviced by a proposed storm sewer system that will collect all paved drainage and a portion of the roof drainage from the site. The majority of the post development drainage collected from the cul-de-sac, and front half of lot drainage will drain toward a proposed storm sewer within Bishop Street Flows from the piped system will be controlled using an orifice plate in a control manhole which will attenuate the discharge to a proposed external Bishop Street storm sewer system and later into the existing ditch and culvert system on the south side of Bishop Street, west of the site area. An Oil-Grit Separator unit is proposed upstream of the Bishop Street storm sewer. Runoff from the rear yard and roof drainage will be directed to a level spreader and vegetate filter strip feature at the south boundary

The majority of rear unit roof drainage and runoff from the backyards is directed to swales on the east and west property boundaries where flow is conveyed overland to the proposed LID at the south property boundary.

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1.0 INTRODUCTION

1.1 Background

This Functional Servicing and Stormwater Management Report has been prepared on behalf of Pro Floor Plans in support of the rezoning application for the proposed 1.01 ha Residential Development.

This application proposes to construct a new residential development on the existing vacant land on 45 Bishop Street. The purpose of this report is to demonstrate that the existing infrastructure within the vicinity on Bishop Street, as well as the natural lands south of the site can accommodate the proposed development.

The subject site lies within the Township of Selwyn, Ontario in Lakefield. It is located on the south side of Bishop Street and is bounded by residential dwellings along Bishop Street to the north and existing vacant/forested areas to the east, south and west. **Figure 1 – Site Location** illustrates the subject site within the context of its surroundings. The proposed Residential Development consists of 8 townhouse units, 8 semi-detached units, and a proposed municipal road access from Bishop Street that leads to a cul-de-sac within the development. The proposed development layout is shown on **Figure 2 – General Plan.**

The existing site is currently a vacant site with open land, shrubs and vegetation.

1.2 Study Parameters

This servicing assessment is based on:

- Topographic Survey, prepared by IBW Surveyors
- Conceptual Architectural Plans, prepared by Zelinka Priamo Ltd.
- Small Scale Hydrogeological Assessment prepared by A&A Environmental Consultants Inc, August 14, 2023
- Engineering Design Standards, Infrastructure Management Division, April 2019, City of Peterborough

- Fire Underwriters Survey, 1999,
- Correspondence with the Region/Town

2.0 WATER SUPPLY

2.1 Existing Water Supply

There is an existing 150mm watermain on the south side of Bishop Street and an existing hydrant east of the proposed road connection. The existing watermain alignment in Bishop Street is to be confirmed during detailed design. The proposed site is not currently serviced with a connection to the existing system.

2.2 Proposed Water Supply

The proposed development will be serviced through a 50mm connection to the existing 150mm watermain on the south side of Bishop Street. Each of the residential unit will be serviced with a 25mm water service. A hydrant is proposed for flushing and testing purposes only. The Township Fire Department has confirmed that adequate fire protection can be provided from Concession Street to the west.

Refer to **Figure 3 – Water Servicing Plan** for the existing and proposed watermain layout.

The City of Peterborough's design criteria does not dictate specific water demand criteria, therefore, the MECP standards were used to dictate the water demand. The MECP standards states that governing flows shall be the greater of a) maximum day demand plus fire flow, or b) maximum hour demand. Based on MECP guidelines, it was assumed that the average day demand is equal to the average daily flow for residential development for sanitary being 450 L/cap/day. Therefore, an average day demand of 450 L/cap/day was used to calculate the residential maximum day and maximum hour water demand (domestic demand). The calculated daily demands for the proposed development are shown in ***Table 1*** below.

In addition to the domestic demand generated from the development, the fire flow demand has been calculated in accordance with The Fire Underwriter's Survey (FUS) guidelines. Both the townhouse and semi-detached dwellings are assumed to be wood frame construction, have combustible contents and have no sprinkler system installed. The resulting critical fire flow was **12,000 L/min**. Therefore, the resulting maximum day plus fire flow demand for the proposed residential site is **12,140 L/min** (12,000 + 140).

Table 1: Proposed Water Demand Summary

	Population	Average Daily Usage (L/min)	Maximum Hour (L/min)	Maximum Day (L/min)	Fire Flow Required (L/min)	Water Demand (L/min)
Residential	47	15	211	140	12,000	12,140
Totals	**47**	**15**	**211**	**140**	**12,000**	**12,140**

. The MECP design criteria was used to dictate the following system pressure requirements:

- Maximum pressure during the minimum hourly demand = 700 kPa
- Minimum pressure during maximum hour demand = 275 kPa
- Minimum Fire Flow pressure during simultaneous maximum day demand plus fire flow = 140 kPa.

Refer to **Appendix B** for the supporting calculations of the proposed water supply system.

The development demand requirement is governed by the maximum day demand plus fire flow of 12,140 L/min while maintaining a minimum pressure of 140 kPa. As noted above, the Township Fire Department has confirmed that adequate fire protection can be provided from Concession Street to the west.

3.0 SANITARY SERVICING

3.1 Existing Sanitary Servicing

There is currently an existing 200mm sanitary sewer on Bishop Street, draining west. There are no existing sanitary connections/stubs along the frontage of the site.

3.2 Proposed Sanitary Servicing

The proposed development will be serviced with a proposed manhole and 200mm sanitary sewer extension from Bishop Street into the proposed cul-de-sac. A new sanitary manhole will need to be installed along the existing sanitary sewer on Bishop Street. Individual sanitary service connections will be provided at each of the residential units.

The proposed sanitary demand is calculated as per the City of Peterborough Engineering Design Standards (2019) which state the following parameters:

- Domestic Flow: Q = 450 L/p/d
- Domestic Peaking Factor: As per Harmon's Formula
- Infiltration: 0.28 L/s/ha

In the proposed dry weather conditions, the addition of the proposed development will result in a total flow of **1.34 L/s.** The proposed sanitary sewer servicing the site shall be 200mm running at a minimum slope of 0.50%. Therefore, the capacity in the proposed sanitary sewer is 23.57 L/s. The generated flow from the proposed development is only 6% of the full flow capacity and as a result, the system will operate in a non-surcharged condition. Based on discussions with the Township's peer review engineer, we understand there are no known capacity constraints in the area and that an overall survey and evaluation of the sanitary sewer completed circa 2021 was to confirm capacity for the development once complete. It is assumed that the sanitary network survey has been completed and capacity can be confirmed along with review of this report.

Refer to **Figure 4 – Sanitary Servicing Plan** for the existing and proposed sanitary network.

Refer to **Appendix C** for sanitary design flow calculations.

4.0 STORMWATER SERVICING

4.1 Existing Stormwater Drainage

The existing site is 1.01 ha and primarily drains south with a small area draining to the north to Bishop Street. It is currently comprised of open land and vegetation and is generally comprised of two drainage areas. There are no existing storm sewers on Bishop Street along the site frontage. Stormwater is conveyed overland via ditches on the north and south sides of Bishop Street and through existing culverts under driveways, flowing west. Refer to **Figure 6 – Pre-Development Drainage Plan**. The existing drainage areas are summarized in ***Table 2*** below.

Based on City of Peterborough's standards, the pre-development site characteristics are as follows:

Table 2 – Pre-Development Drainage Areas

Area ID	Area (ha)	Runoff Coefficient	Outlet
101	0.10	0.25	Bishop Street Ditch
102	0.91	0.25	Overland to South

4.2 Allowable Release Rate

As per the City of Peterborough's design criteria, the site shall control peak runoff flows from the 2-year to the 100-year storm event under post-development conditions to the corresponding pre-development release rate or less.

The allowable discharge from the subject site is calculated as follows: $\mathbf{Q_A = C \times A \times I}$ **(L/s)**

Table 3: Allowable Release Rates

Area ID	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Area 101 Allowable Release Rate (L/s)	5	6	7	9	11	13
Area 102 Allowable Release Rate (L/s)	43	57	66	85	103	117

Refer to **Appendix D** for allowable release rate calculations.

4.3 Proposed Stormwater Servicing

The site shall be serviced by a proposed storm sewer system that will collect all paved drainage and a portion of the roof drainage from the site. The majority of the post development drainage collected from the cul-de-sac, and front half of lot drainage will drain toward a proposed storm sewer within Bishop Street. Flows from the piped system will be controlled using an orifice plate in a control manhole which will attenuate the discharge to a proposed external Bishop Street storm sewer system and later into the existing ditch and culvert system on the south side of Bishop Street, west of the site area. An Oil-Grit Separator unit is proposed upstream of the Bishop Street storm sewer. The external Bishop Street storm sewer shall have a depth sufficient for vertical clearance with the existing proposed sanitary system and shall run along Bishop Street with a minimum slope until it can outlet to the existing ditch on the south side of Bishop Street, beyond the last dwelling unit and driveway prior to Concession Street.

Runoff from the rear yard and roof drainage will be directed to a level spreader and vegetate filter strip feature at the south boundary. The post-development flows to the south in post-development conditions can meet pre-development flow rates to the south without the need for quantity storage.

The majority of rear unit roof drainage and runoff from the backyards is directed to swales on the east and west property boundaries where flow is conveyed overland to the proposed LID at the south property boundary.

Refer to **Figure 5 – Storm Servicing Plan** for the existing and proposed storm sewer layout.

4.4 Proposed Stormwater Management

4.4.1 Quantity Control

The 1.01 ha of developable site will be divided into two post development drainage boundaries.

Refer to **Figure 7 – Post-Development Drainage Plan**.

Area 201 (0.57 ha) represents the paved areas and a portion of the roof area drainage. Drainage from this area will be directed to the catch basins along the new road allowance and into the proposed storm sewer network. A run-off coefficient of 0.63 was determined for Area 201.

Area 202 (0.48 ha) represents most of the landscaped areas (backyards) and roof area drainage. Most of the drainage from Area 202 will be directed to the proposed rear lot drainage swales on the west and east property boundaries and into a LID at the south property boundary. A run-off coefficient of 0.38 was determined for Area 202.

Drainage from the cul-de-sac, driveways, front yards and the front half of roof areas from each unit will be directed via catch basins to the underground storage pipe. Storage requirements have been evaluated for the 2-year to the 100-year storms to attenuate the post-development runoff rates down to the corresponding pre-development release rates for Area 201.

The box culvert can be fitted with on outlet control to allow a flow rate equal to the 2-Year pre-development release rate (5 L/s) and to allow a flow rate total equal or below the 100-Year pre-development release rate (13L/s). Details of the outlet control structure can be explored during detailed design to ensure allowable release rates are achieved for all storm events.

Post-development drainage from the rear roof and rear yard areas have been evaluated for the overland outlet to the south. Post-development flows are less than pre-development for all storm events and therefore there is no requirement for quantity control and storage for overland flow to the south.

Table 4 below summarizes the post-development release rate and corresponding storage requirement for the 2-Year to 100-Year storm event.

Table 4– Peak Flow and Storage Summary

	North Outlet: to Bishop Street			South Outlet: Overland Level Spreader		
Storm Event	Pre-Development Release Rate (L/s)	Post-Development Release Rate (L/s)	Storage Required (m^3)	Pre-Development Release Rate (L/s)	Post-Development Release Rate (L/s)	Storage Required (m^3)
2	5	5	69	43	38	0
5	6	6	105	57	50	0
10	7	7	115	66	58	0
25	9	9	141	85	72	0
50	11	11	161	103	83	0
100	13	13	174	117	82	0

Major flows in excess of the 100-year event or in emergency conditions would overtop at the west side of the new intersection with Bishop Street and be conveyed overland along Bishop Street.

The total flow from the existing drainage area to the south ditch of Bishop Street in addition to the flow from the site has been calculated, yielding a flow rate of approximately 216 L/s in the 5-Year event and 376 L/s in the 100-Year event. The capacity of the ditch has also been estimated based on assumed minimum dimensions. The slope of the Bishop Street ditch generally matches the slope of the road and has slopes that range from 1% to 6% for the majority of the length downstream of the proposed storm outlet. Approaching Concession Street, it appears the ditch levels out. A ditch with dimensions of 0.41m flow depth, 0.2m bottom width and 3:1 side slopes has capacity to take the 100 year uncontrolled flow from the existing drainage area and the proposed development. See attached calculations in Appendix D for details. Further survey of the downstream ditch system is recommended at the Draft Plan Approval or detailed design stage as discussed below.

Future Detailed Design Considerations

The storage volume assumed in this report and design figures assumes full attenuation to pre-development rates. During detailed design, it is recommended that the conveyance capacity of the downstream ditch and pipe and/or culvert network be investigated. If excess capacity is available or can be achieved by ditch improvements, culvert improvement is a combination of both, the quantity control design can be optimized by utilizing any available conveyance capacity and reducing the storage volume required.

As another optimization option, the detailed design could consider placement of the control manhole further downstream along Bishop Street to allow a greater length of storage pipe and thereby reduce the size of the proposed storage pipe.

4.4.2 Quality Control

An enhanced level of quality control is required for the site, which will be provided by an oil-grit separator unit for drainage to Bishop Street. See Appendix D for recommended OGS unit and sizing calculations.

The cul-de-sac on the subject site is also expected to be a low traffic area, therefore, there is minimal concerns for hazardous pollutants and sediment caused by vehicular traffic on the site.

Runoff to the south outlet consists of roof and rear yard areas only and is considered clean runoff. However, additional polishing will be provided by the proposed level spreader and vegetated filter strip along the south property boundary. We note that the vegetated filter strip is provided by the City owned block, south of the current site.

4.4.3 Water Balance

As per the criteria provided by the peer review engineer, water balance would be required if soil conditions permit, and no water balance target was provided. A best-efforts approach has been taken in order to meet pre-development conditions given the site constraints. A water balance assessment was completed by A&A Environmental Consultants Inc. (A&A) in their report 'Small Scale Hydrogeological Assessment', August 2023, see **Appendix E** for report. Parameters such as infiltration factors, precipitation, evaporation, and evapotranspiration were taken from the hydrogeological report to establish water budget calculations. In correspondence with A&A, it was indicated that bedrock was shallow around the perimeter of the site such that monitoring well locations were only possible within the central area of the site in the fill soils. Based on this information, it is assumed infiltration LIDs will not be suitable along the south boundary of the site and the LID proposed has been revied to a level spreader and vegetated filter strip to provide a quantity benefit rather than to propose retention and infiltration in this area.

As per water balance calculations, under existing conditions the site produces 1,297 m^3 of infiltration on an annual basis. Under proposed conditions the site produces 754 m^3 of infiltration on an annual basis. The post-development conditions will create an infiltration deficit of **543 m^3/year**. See water budget calculations provided in **Appendix D**.

Mitigation measures are to be provided through infiltration in the rear yards. According to LSRCA guidelines, infiltration measures must have a minimum flow path of over 5 meters in order to be credited for infiltration. Rear yard swales have been established 5 meters away from the backyard building face of all the units on the site. The units have been established to be split drained so half the roofs will be directed towards the rear yard swales. An infiltration factor is applied to the roof volume draining to swales to mitigate the infiltration deficit. The infiltration measures contribute to **282 m^3/year** reducing the deficit to **261 m^3/year**.

At a later detailed design stage, additional LID features could be explored in areas with sufficient depth to the water table. Water balance will be provided by the proposed LID features, which will promote infiltration, retention and evapotranspiration of the incoming runoff to further reduce the infiltration deficit.

5.0 SITE GRADING

The site will be graded in accordance with the City of Peterborough design standards, requirements under the Accessibility for Ontarians with Disabilities Act (AODA) and building design. The grading design will respect the existing overland drainage patterns in order to minimize disturbance to the existing site and surrounding land. Refer to **Figure 8** – Conceptual Grading Plan.

Based on bedrock encountered by A&A during the hydrogeological investigation, further geotechnical investigation is recommended at the draft plan stage to evaluate the bedrock surface relative to servicing trenches and basement elevations. Bedrock data may have an influence on the proposed grading design.

6.0 CONCLUSIONS

Based on the assessment provided above, the existing adjacent infrastructure can accommodate the proposed change in land use as follows:

WATER SERVICING:

There is an existing 150mm watermain on the south side of Bishop Street and an existing hydrant east of the proposed road connection. The existing watermain alignment in Bishop Street is to be confirmed during detailed design.

The proposed development will be serviced through a 50mm connection to the existing 150mm watermain on the south side of Bishop Street. The development demand requirement is governed by the maximum day demand plus fire flow of 12,140 L/min while maintaining a minimum pressure of 140 kPa. As noted above, the Township Fire Department has confirmed that adequate fire protection can be provided from Concession Street to the west.

SANITARY SERVICING:

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In the proposed dry weather conditions, the addition of the proposed development will result in a total flow of **1.34 L/s.** The proposed sanitary sewer servicing the site shall be 200mm running at a minimum slope of 0.50%. The generated flow from the proposed development is only 6% of the full flow capacity and as a result, the system will operate in a non-surcharged condition. Based on discussions with the Township's peer review engineer, we understand there are no known capacity constraints in the area and that an overall survey and evaluation of the sanitary sewer completed circa 2021 was to confirm capacity for the development once complete. It is assumed that the sanitary network survey has been completed and capacity can be confirmed along with review of this report.

STORMWATER SERVICING:

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The site shall be serviced by a proposed storm sewer system that will collect all paved drainage and a portion of the roof drainage from the site. The majority of the post development drainage collected from the cul-de-sac, and front half of lot drainage will drain toward a proposed storm sewer within Bishop Street Flows from the piped system will be controlled using an orifice plate in a control manhole which will attenuate the discharge to a proposed external Bishop Street storm sewer system and later into the existing ditch and culvert system on the south side of Bishop Street, west of the site area. An Oil-Grit Separator unit is proposed upstream of the Bishop Street storm sewer. Runoff from the rear yard and roof drainage will be directed to a level spreader and vegetate filter strip feature at the south boundary

The majority of rear unit roof drainage and runoff from the backyards is directed to swales on the east and west property boundaries where flow is conveyed overland to the proposed LID at the south property boundary.

We trust the information provided in the report meets with your requirements. Should there be any questions or comments, please feel free to contact the undersigned.

Sincerely,

Counterpoint Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
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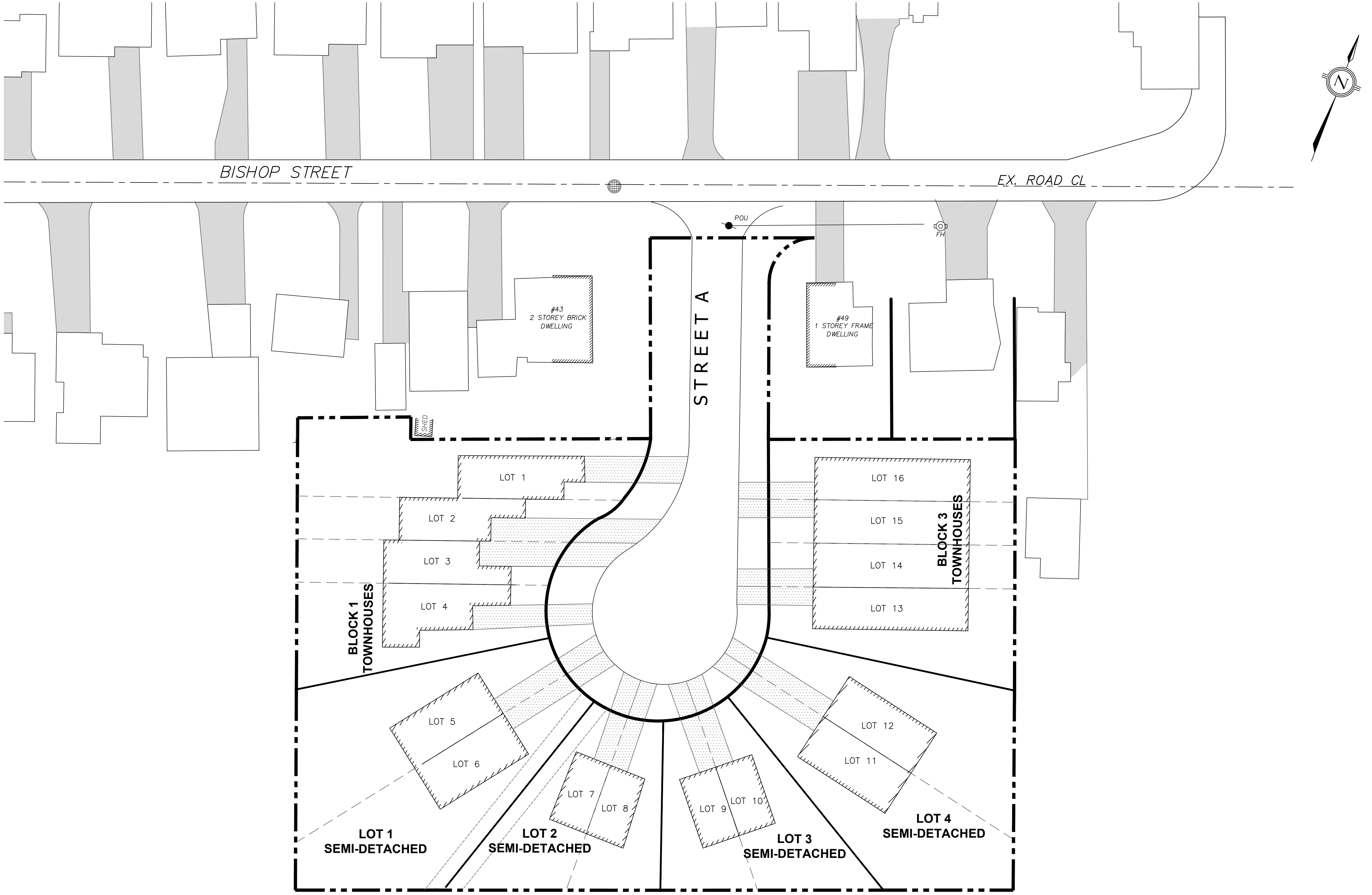
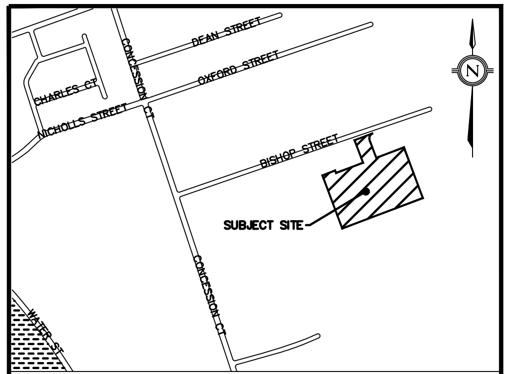
Appendix A

Figures

Project No.: 22088

February 2024





KEY PLAN

LEGEND

▬ · · ▬ PROPERTY LINE

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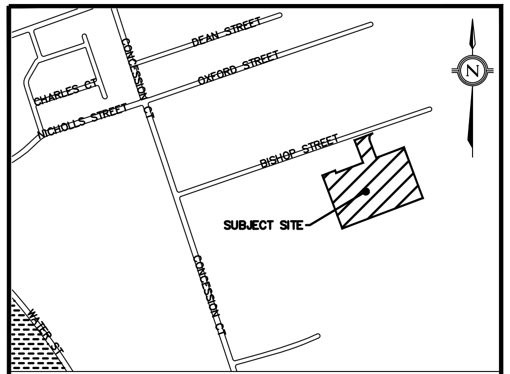
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

GENERAL PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 2
SCALE: 1:750	



KEY PLAN

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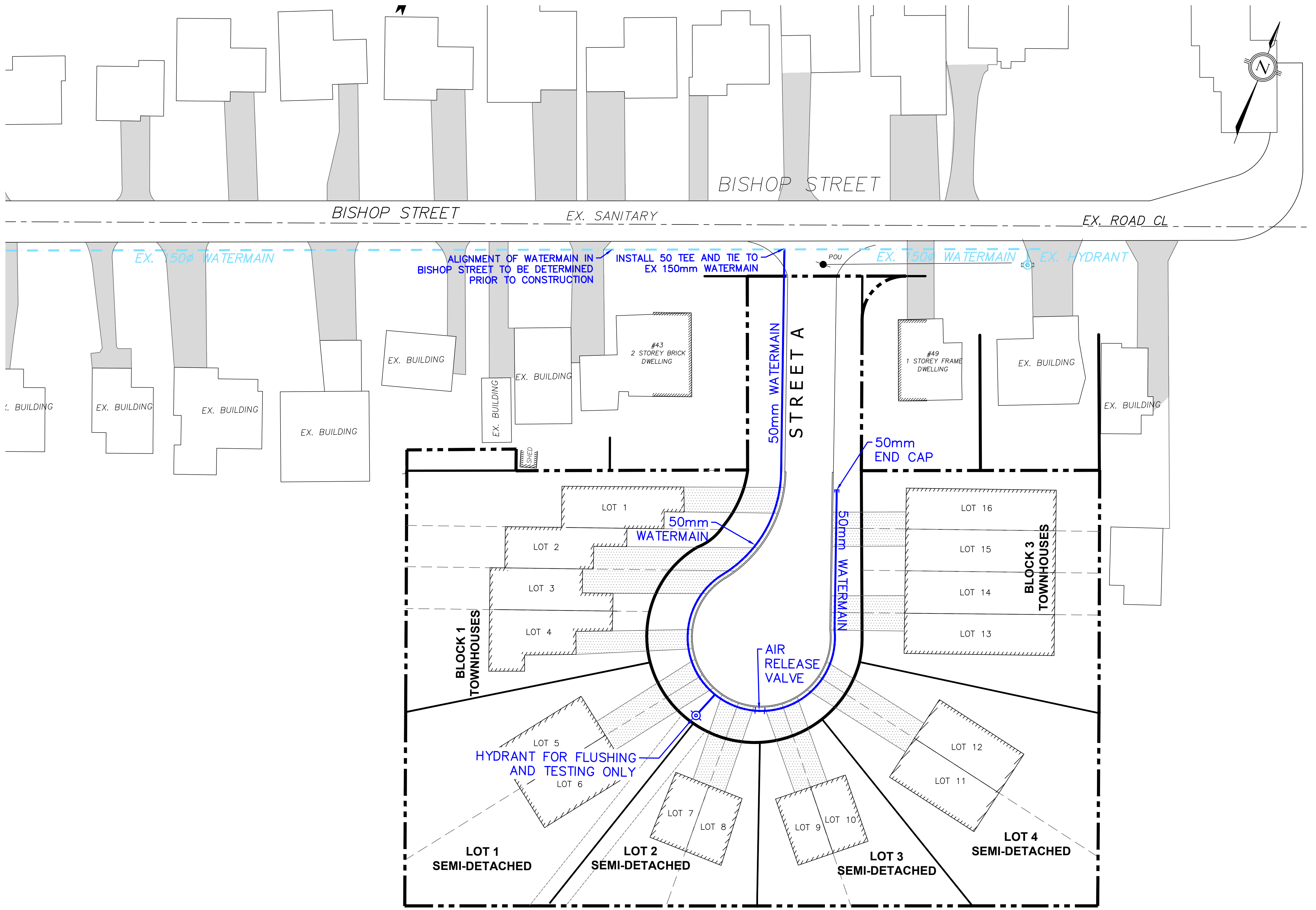
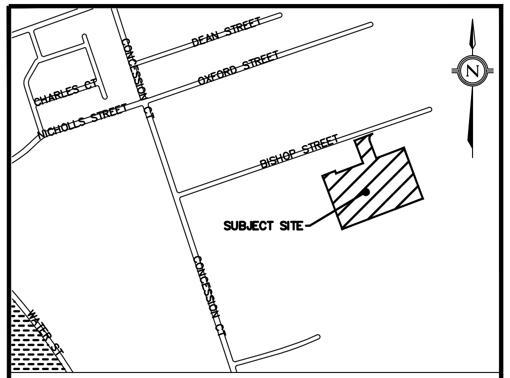
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

SITE LOCATION PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 1
SCALE: N.T.S	





KEY PLAN

LEGEND

- ▬ · · ▬ PROPERTY LINE
- ▬ · ▬ EXISTING WATERMAIN
- ⊙ EXISTING HYDRANT
- ▬ PROPOSED WATERMAIN
- ⊙ PROPOSED HYDRANT

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45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

WATER SERVICING PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 3
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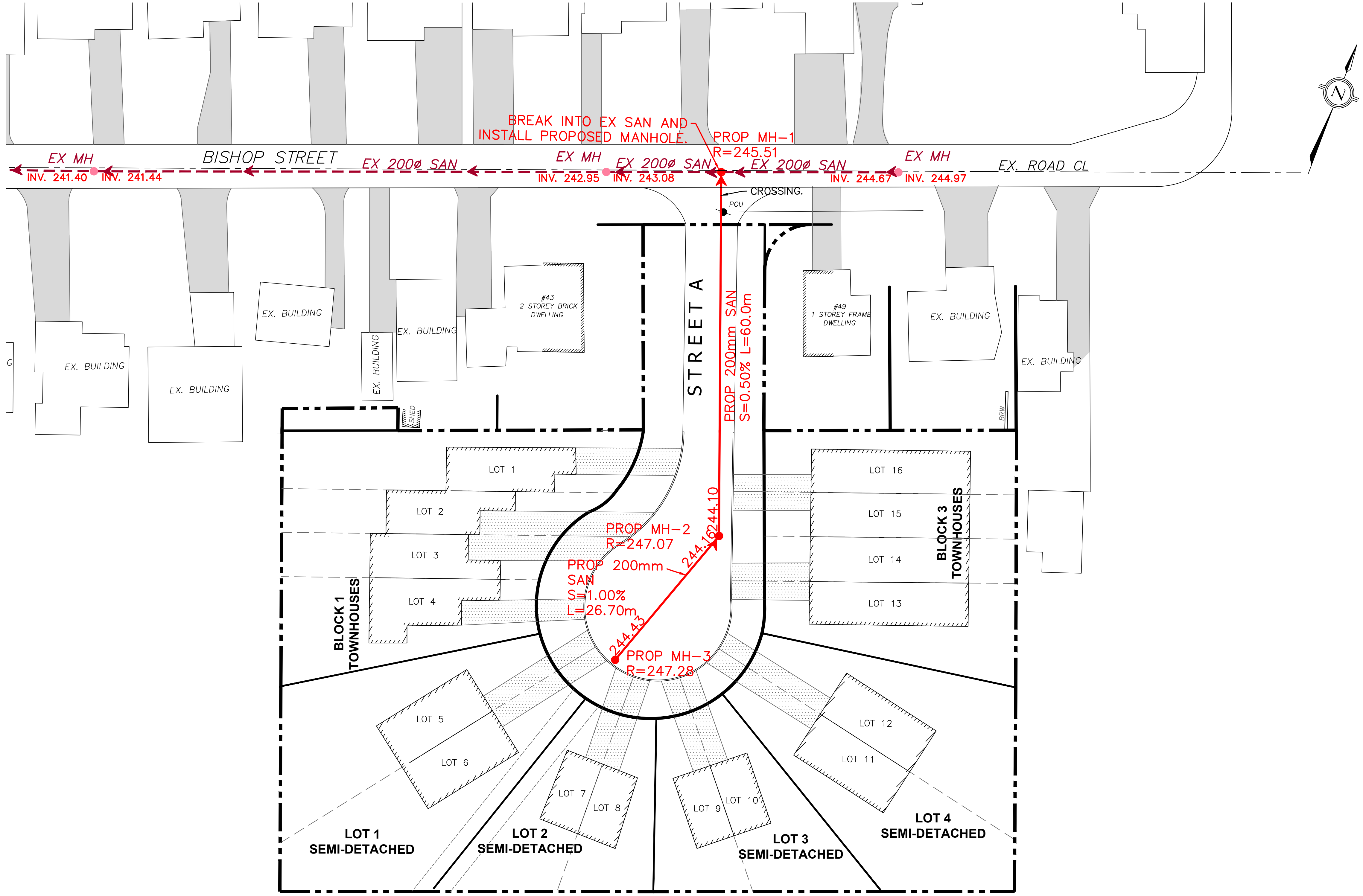

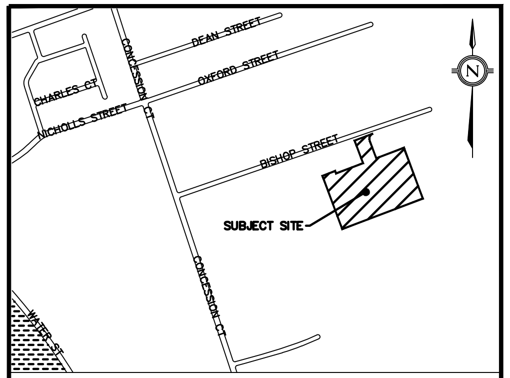

KEY PLAN

LEGEND

▬ · · ▬	PROPERTY LINE
– – –	EXISTING SANITARY SEWER
●	EXISTING SANITARY MANHOLE
▬	PROPOSED SANITARY SEWER
●	PROPOSED SANITARY MANHOLE

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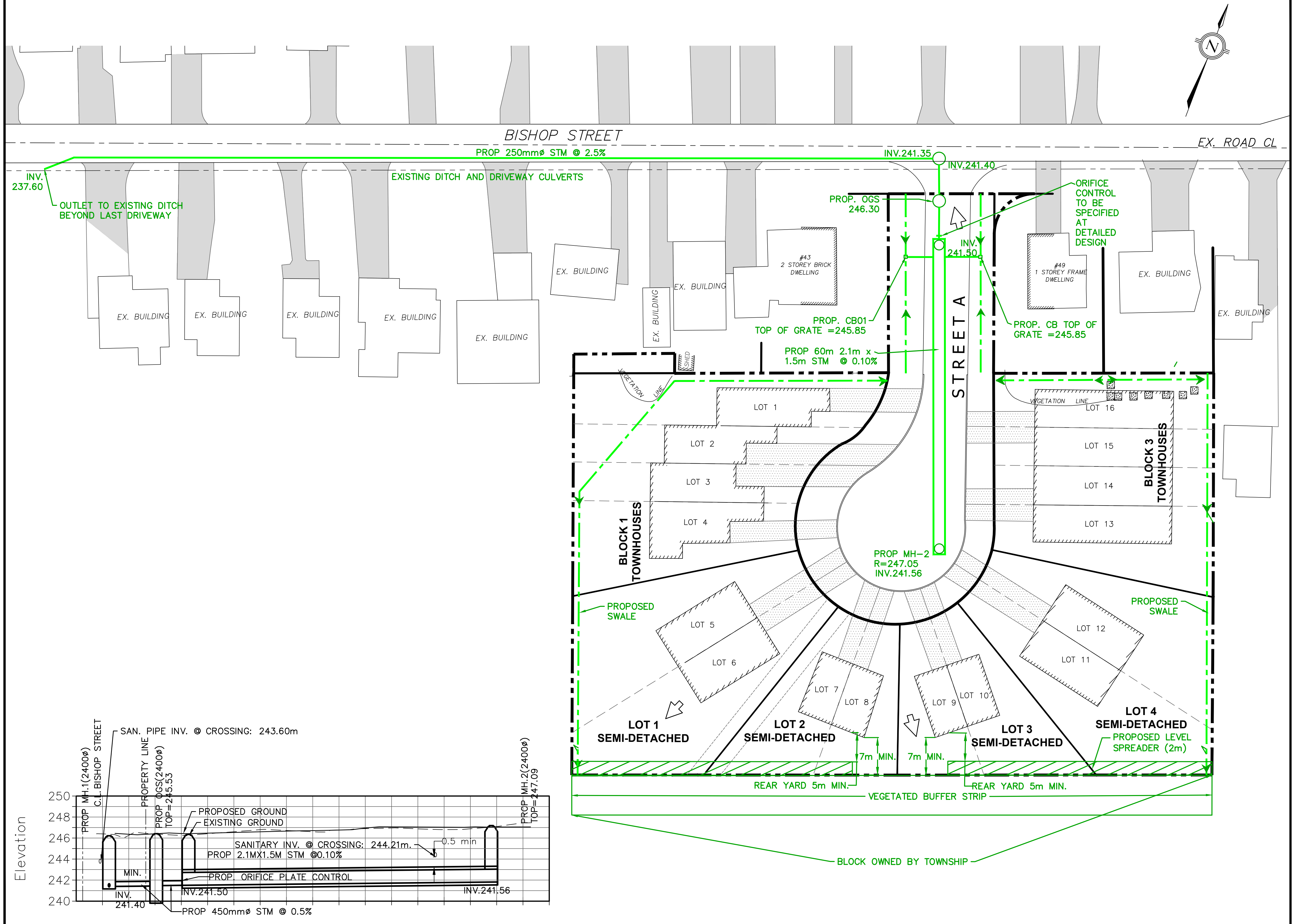
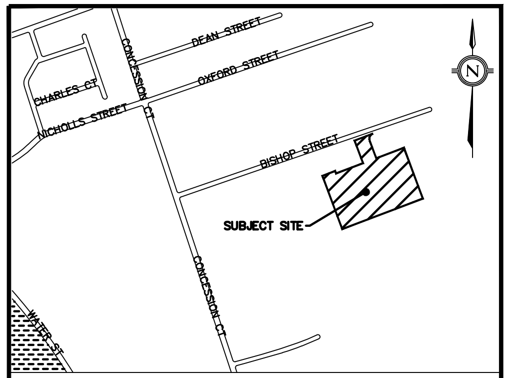
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

SANITARY SERVICING PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 4
SCALE: 1:750	





KEY PLAN

LEGEND

▬ · ▬	PROPERTY LINE
◎	PROPOSED STORM CATCHBASIN MANHOLE
□	PROPOSED STORM CATCHBASIN
▨	PROPOSED LEVEL SPREADER
- - →	PROPOSED SWALE
——→	PROPOSED STORM SEWER

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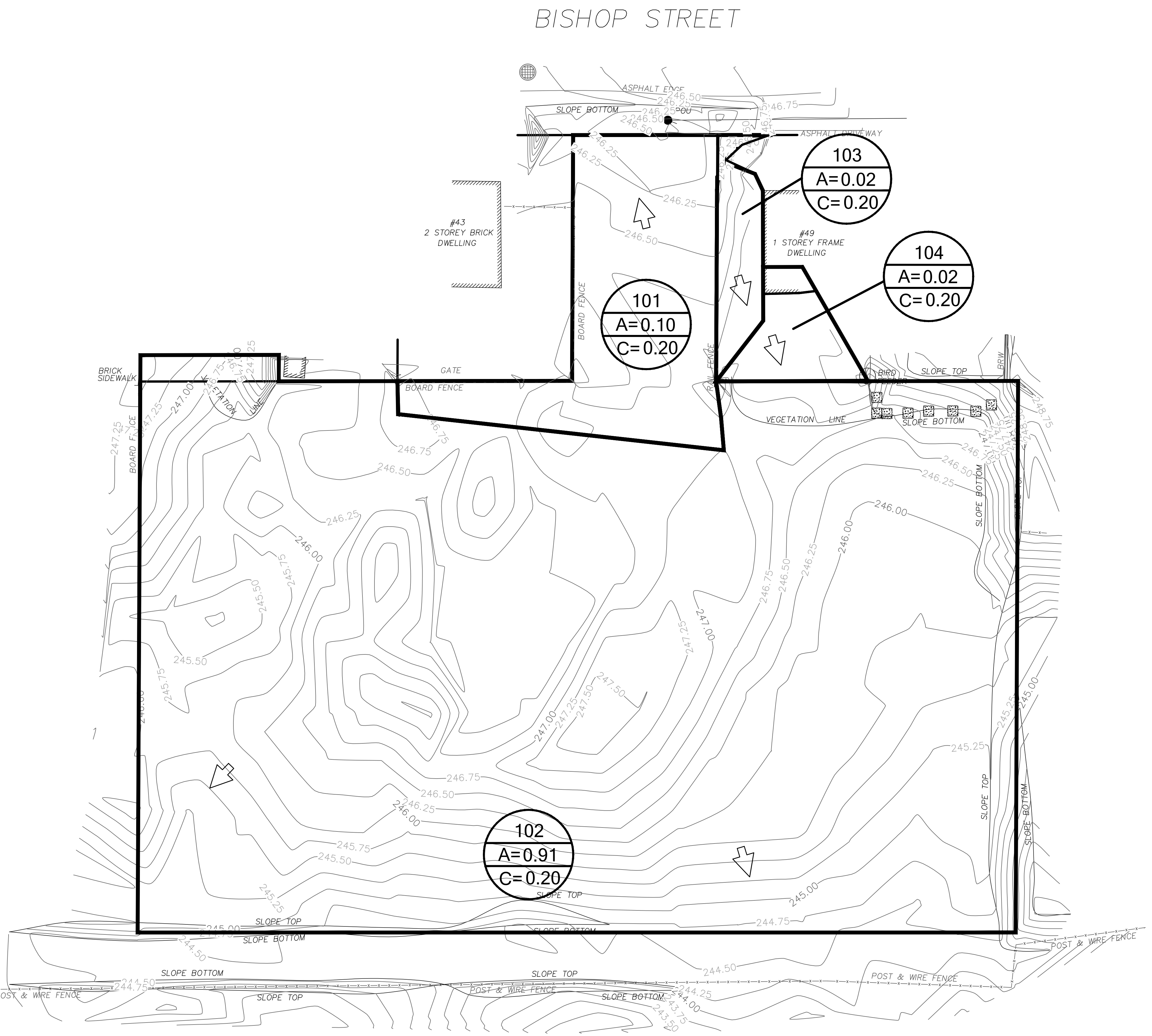
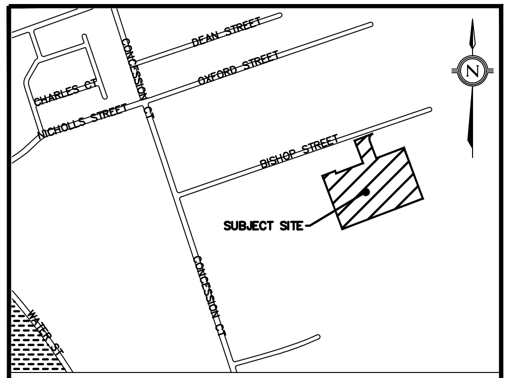
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

STORM SERVICING PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 5
SCALE: 1:750	





KEY PLAN

LEGEND

101 — AREA ID
A=0.26 — DRAINAGE AREA (HA)
C=0.25 — RUNOFF COEFFICIENT (5- YEAR)

— DRAINAGE BOUNDARY

⇦ OVERLAND FLOW PATH

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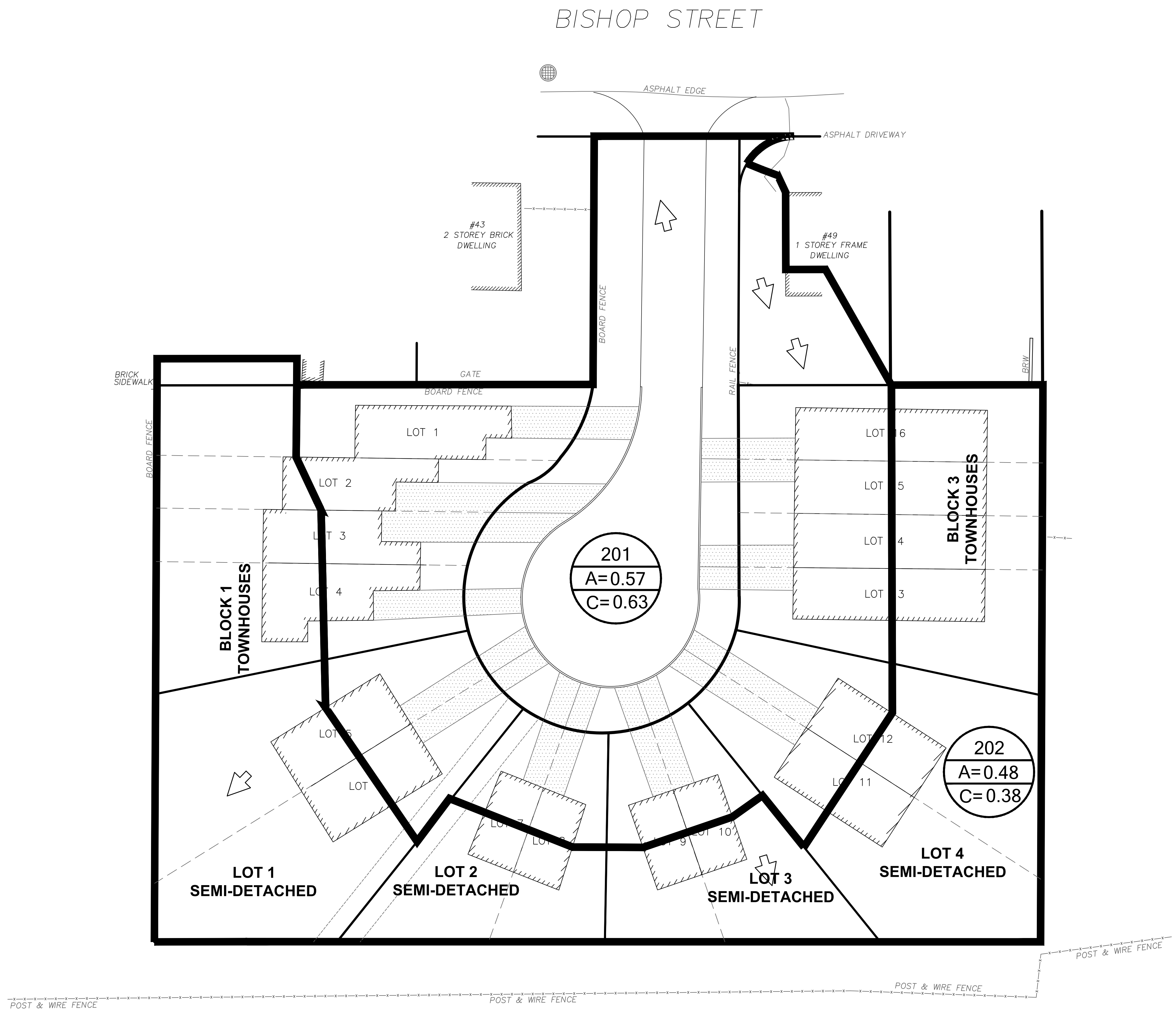
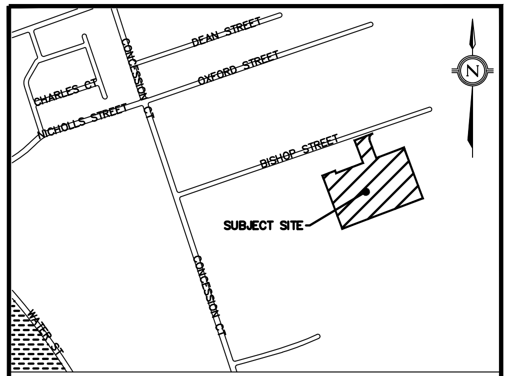
COUNTERPOINT ENGINEERING INC.
8395 Jane St., Suite 100, Vaughan, ON L4K 5Y2 Phone 905.326.1404 Fax 905.326.1405

45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

PRE-DEVELOPMENT DRAINAGE PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 6
SCALE: 1:600	





KEY PLAN

LEGEND

101 — AREA ID
A=0.26 — DRAINAGE AREA (HA)
C=0.25 — RUNOFF COEFFICIENT (5- YEAR)

━━ DRAINAGE BOUNDARY

⇦ OVERLAND FLOW PATH

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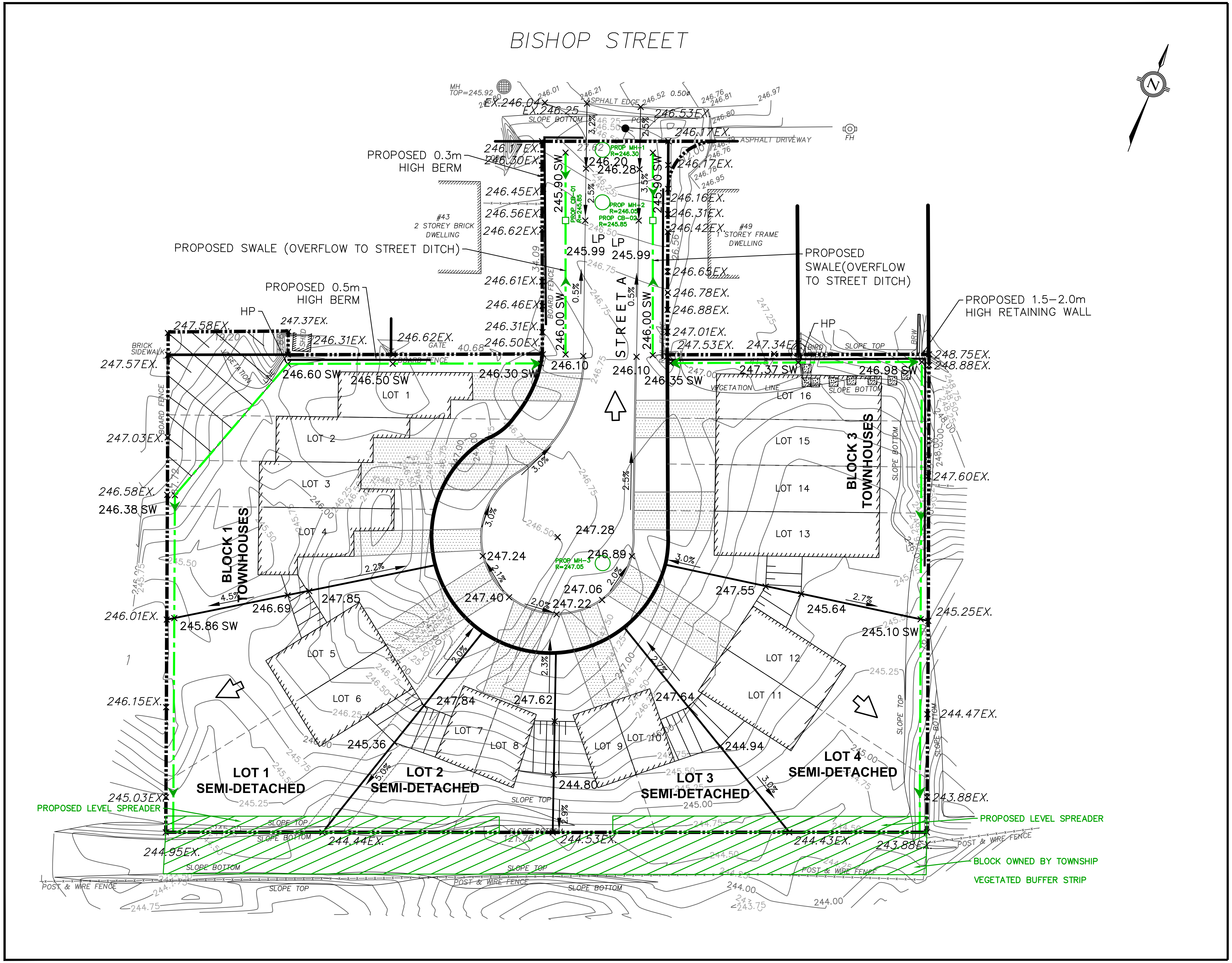
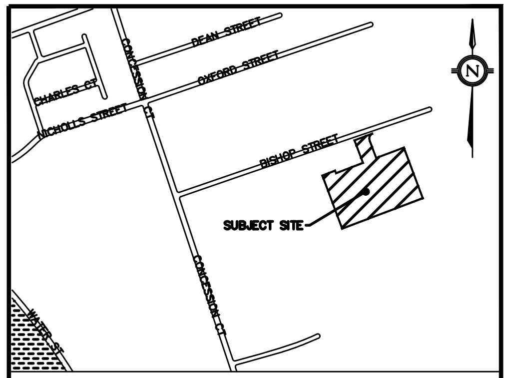
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

POST-DEVELOPMENT DRAINAGE PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 7
SCALE: 1:600	





KEY PLAN

LEGEND

▬ · · ▬	PROPERTY LINE
×246.58EX.	EXISTING ELEVATION
—246.58—	EXISTING CONTOUR
×246.58	PROPOSED ELEVATION
⇦	EMERGENCY OVERLAND FLOW
◎	PROPOSED STORM CATCHBASIN MANHOLE
▫	PROPOSED STORM CATCHBASIN
▨	PROPOSED SURFACE STORAGE/LID FEATURE
—→	PROPOSED SWALE
	PROPOSED STORM SEWER
2.0%	PROPOSED SLOPE

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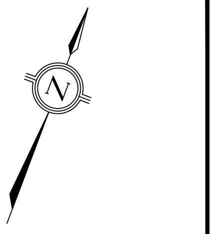
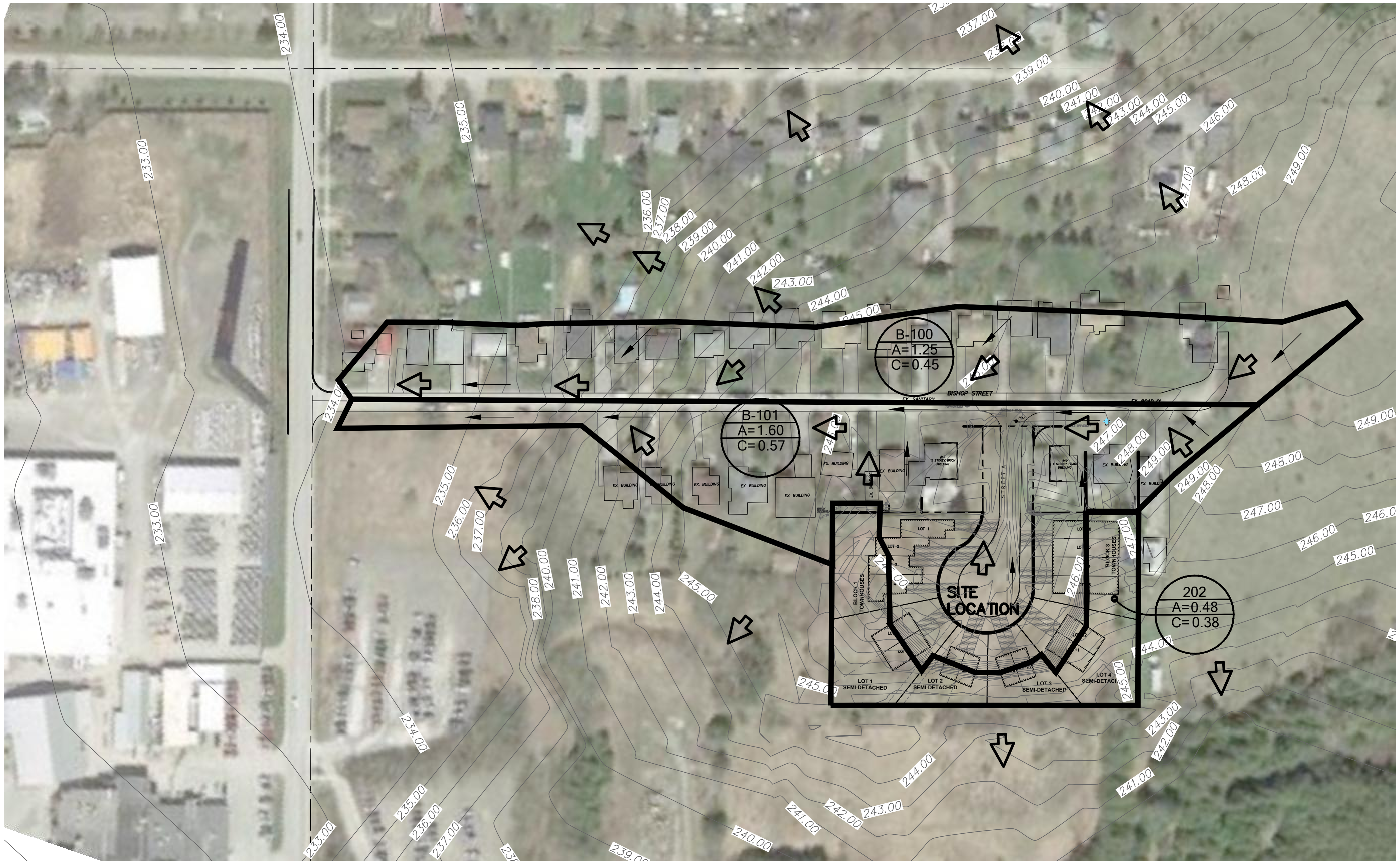
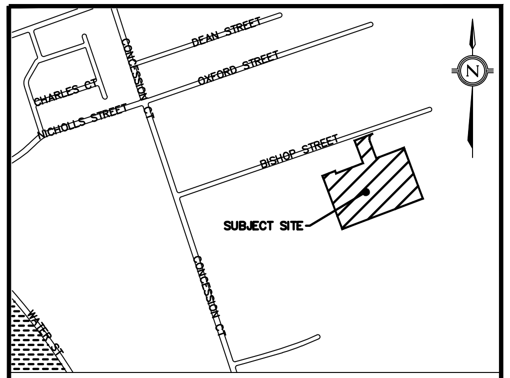
45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

CONCEPTUAL GRADING PLAN

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 8
SCALE: 1:600	







KEY PLAN

LEGEND

— · —	PROPERTY LINE
202 A=0.48 C=0.25	AREA ID DRAINAGE AREA RUNOFF COFFICIENT
▬	PROPOSED DRAINAGE AREA

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45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

POST-DEV STORM DRAINAGE AREA
CONTRIBUTION TO BISHOP STREET DITCH

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. 9
SCALE: 1:2000	

Design Guidance for Level Spreader

Criteria	Required	Provided	Requirement Satisfied (Y/N)
Drainage Area	<2 ha	0.48 ha	Y
Slope and Width	<10% (Ideal 1%-5%)	2.7%-5%	Y
Flow Depth	50-100mm (4 Hour Chicago 10mm Storm)	1.35mm*	Y
Storage	29m3 (10mm from 0.1 ha Roof Area + 5mm from 0.38 ha Rear Yard Area)	31m3**	Y
Vegetation	Fescues, Redtop or Native	To be provided at detailed design	Y

**Flow depth assuming 103m length of level spreader available per calculation below*

L=Q/(α*H^1.5)

Q	0.01 m3/s
H	0.001354 m
α	1.7
L	103 m

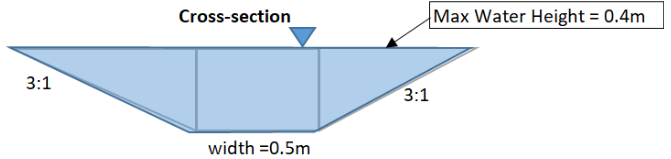
$$Q = \alpha L H^{1.5}$$

Equation 4.4: Weir Flow

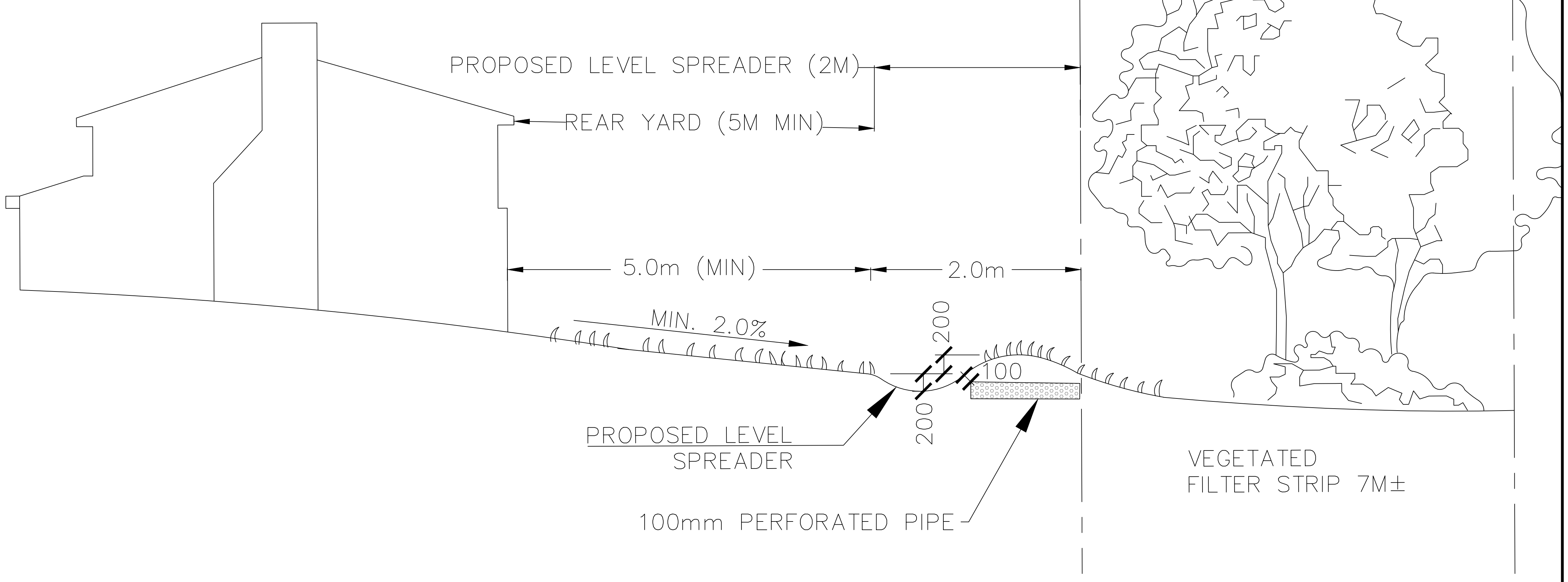
where Q = discharge
α = coefficient
L = length of crest of weir
H = head

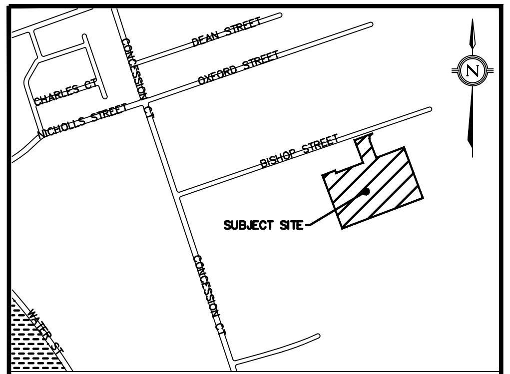
***Storage provided based on calculation provided below*

Cross-section



Total Length of Level Spreader	**103**	**m**
Total Volume Provided	**30.90**	**m3**





KEY PLAN

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45 BISHOP STREET
RESIDENTIAL DEVELOPMENT
LAKEFIELD, ONTARIO

LEVEL SPREADER AND
VEGETATED FILTER STRIP DETAIL

DESIGNED BY: JP	DATE: FEB 2024
CHECKED BY: KR	PROJECT No. 22088
DRAWING BY: JP	
CHECKED BY: KR	FIGURE No. DET–01
SCALE: N.T.S	

Appendix B

Water Demand Calculations

Project No.: 22088

February 2024

Counterpoint Engineering Inc.

Water Demand Design Calculations

Project: **45 Bishop Street**
Project No: **22088**
Location: **Lakefield, Ontario**
Site Area: 1.01 ha

Equivalent Population per Land Use (as per City of Peterborough)

Single Family	3.5	ppu
Semi-Detached, 3+ BD Townhouse	3.5	ppu
2 BD Townhouse	2.4	ppu
2-3 BD Apartment	2.0	ppu
1 BD Apartment	1.6	ppu

	Townhouse	**Semi-detached**	**Commercial (m^2)**	**Residential Population**
Proposed Development	8	8	**-**	47
TOTAL UNITS / AREA (m^2)	8	8	**-**	**47**

	Residential Population	**TOTAL POPULATION**
Residential	47	47
Commercial	-	0
Total Equivalent Population		**47**

City of Peterborough Watermain Guidelines

Per Capita Demand

Average Daily Demand	450	(L/capita/day)

Commercial Demand	1.15	L/s/ha

Peaking Factors

Land Use	Minimum Hour	Maximum Day	Maximum Hour	
Residential	0.10	9.50	14.30	(MECP factors for equivalent population of 30)

Proposed Site

Water Demand based on Equivalent Population

	Population	**Average Daily Usage (L/min)**	**Maximum Hour (L/min)**	**Maximum Day (L/min)**	**Fire Flow Required (L/min)**	**Water Demand (L/min)**
Residential	47	15	211	140	12,000	12,140
Commercial	0	0	0	0	0	0
Totals	**47**	**15**	**211**	**140**	**12,000**	**12,140**

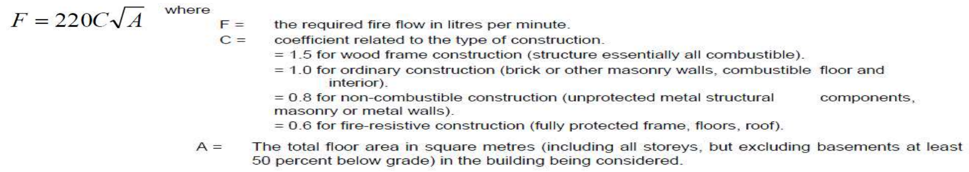
Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT TOWNHOUSE BLOCK 1

Fire Underwriters Survey

Project : **45 Bishop Street**
Project No: **22088**

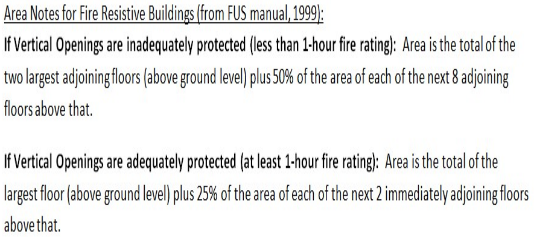
Guide for Determination of Required Flow Copyright I.S.O



$F = 220C\sqrt{A}$ where

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6



Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

1) **Fire Flow**

Type of Construction: WF
C= 1.5
A*= 594 m^2
F= 8,000 **L/min** (rounded to nearest 1,000 L/min)

Assuming fire walls are installed as per building code.

2) **Occupancy Reduction/Surcharge**

Contents Factor: C
Reduction/Surcharge of 0% = 0 L/min
F= **8000L/min +** **0** **L/min** = 8,000 **L/min**

3) **System Type Reduction**

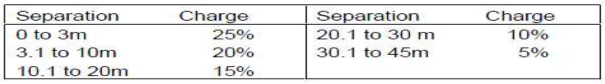
NFPA 13 Sprinkler:	NO	0%
Standard Water Supply:	NO	0%
Fully Supervised:	NO	0%
Total		0%

Reduction of 0% L/min = 0 L/min
F= **8000L/min -** **0** **L/min** = 8,000 **L/min**

4) **Separation Charge**

Building Face	Dist(m)	Charge	
North	25	10%	(fire wall between adjacent units-10% charge)
East	52	0%	
South	8	20%	
West	20	15%	
Total		45%	**of** **8000** **L/min** = 3,600 **L/min**

(max exposure charge can be 75%)



Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F= **8000L/min +** **3600L/min** = 11,600 **L/min** (2,000L/min<F<45,000L/min)

F=	12,000	**L/min**
F=	200	**L/s**
F=	3,170	**gpm**

(round to the nearest 1,000L/min)

Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT TOWNHOUSE BLOCK 1

Fire Underwriters Survey

Project : **45 Bishop Street**
Project No: **22088**

Guide for Determination of Required Flow Copyright I.S.O

$$F = 220C\sqrt{A}$$

where
F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

1) **Fire Flow**

Type of Construction:	WF		
C=	1.5		
A*=	376	m^2	
F=	6,000	**L/min**	(rounded to nearest 1,000 L/min)

Assuming fire walls are installed as per building code.

2) **Occupancy Reduction/Surcharge**

Contents Factor:		C			
Reduction/Surcharge of		0%	=	0	L/min
F=	**6000L/min +**	**0 L/min**	=	6,000	**L/min**

3) **System Type Reduction**

NFPA 13 Sprinkler:		NO	0%		
Standard Water Supply:		NO	0%		
Fully Supervised:		NO	0%		
Total			0%		
Reduction of		0%	L/min =	0	L/min
F=	**6000L/min -**	**0**	**L/min** =	6,000	**L/min**

4) **Separation Charge**

Building Face	Dist(m)	Charge	
North	25	10%	(fire wall between adjacent units-10% charge)
East	27	10%	
South	8	20%	
West	51	0%	(>45m)
Total		40%	**of** **6000** **L/min** **=** 2,400 **L/min**

(max exposure charge can be 75%)

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F=	**6000L/min +**	**2400L/min**	**=**	8,400 **L/min**	(2,000L/min<F<45,000L/min)

F=	8,000	**L/min**	(round to the nearest 1,000L/min)
F=	133	**L/s**	
F=	2,113	**gpm**	

Counterpoint Engineering Inc.

REQUIRED FIRE FLOW WORKSHEET - PROPOSED DEVELOPMENT TOWNHOUSE BLOCK 1

Fire Underwriters Survey

Project : **45 Bishop Street**
Project No: **22088**

Guide for Determination of Required Flow Copyright I.S.O

$$F = 220C\sqrt{A}$$

where

F = the required fire flow in litres per minute.
C = coefficient related to the type of construction.
= 1.5 for wood frame construction (structure essentially all combustible).
= 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).
= 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).
= 0.6 for fire-resistive construction (fully protected frame, floors, roof).
A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building being considered.

Type of Construction		Class Factor
WF	Wood Frame	1.5
OC	Ordinary Construction	1.0
NC	Non-Combustible	0.8
FC	Fire-Resistive	0.6

Area Notes for Fire Resistive Buildings (from FUS manual, 1999):

If Vertical Openings are inadequately protected (less than 1-hour fire rating): Area is the total of the two largest adjoining floors (above ground level) plus 50% of the area of each of the next 8 adjoining floors above that.

If Vertical Openings are adequately protected (at least 1-hour fire rating): Area is the total of the largest floor (above ground level) plus 25% of the area of each of the next 2 immediately adjoining floors above that.

Contents		% Reduction
NC	Non-Combustible	25
LC	Limited Combustible	15
C	Combustible	0
FB	Free Burning	15
RB	Rapid Burning	25

1) Fire Flow

Type of Construction: WF
C= 1.5
A*= 573 m^2
F= 8,000 **L/min** (rounded to nearest 1,000 L/min)

Assuming fire walls are installed as per building code.

2) Occupancy Reduction/Surcharge

Contents Factor: C
Reduction/Surcharge of 0% = 0 L/min
F= **8000L/min +** **0 L/min** = **8,000** **L/min**

3) System Type Reduction

NFPA 13 Sprinkler:	NO	0%
Standard Water Supply:	NO	0%
Fully Supervised:	NO	0%
Total		0%

Reduction of 0% L/min = 0 L/min
F= **8000L/min -** **0 L/min** = **8,000** **L/min**

4) Separation Charge

Building Face	Dist(m)	Charge	
North	9	20%	
East	7	20%	
South	46	0%	(>45m)
West	46	0%	(>45m)
Total		40%	**of** **8000 L/min = 3,200 L/min**

(max exposure charge can be 75%)

Separation	Charge	Separation	Charge
0 to 3m	25%	20.1 to 30 m	10%
3.1 to 10m	20%	30.1 to 45m	5%
10.1 to 20m	15%		

F= **8000L/min +** **3200L/min** = **11,200** **L/min** (2,000L/min<F<45,000L/min)

F=	**11,000**	**L/min**
F=	**183**	**L/s**
F=	**2,906**	**gpm**

(round to the nearest 1,000L/min)

counterpoint engineering

NFPA Theoretical Flow Calculations

Project Name: **45 Bishop Street**
Project Number: **22088**

Based on National Fire Protection Association Guidelines, the available flow at the minimum residual pressure of 20psi can be calculated based on the observed flow at the observed pressure readings, as follows:

$\mathbf{Q_F = 29.83 \times c \times d^2 \times p^{0.5}}$, where

Q_F = observed flow (US GPM)
c = hydrant nozzle coefficient (0.90 - 0.95)
d = nozzle diameter (in)
p = observed pitot pressure

$\mathbf{Q_R = Q_F \times h_F^{0.54} / h_R^{0.54}}$, where

Q_R = available flow
Q_F = observed flow (US GPM)
h_F = drop from measured static to desired baseline pressure
h_R = drop from measured static to measured residual pressure

Based on flow test results obtained by ViPond Inc., July 12, 2012

c =	0.9		
d =	2.5	in	
number of ports =	1		
p =	55		
Q_F =	**1244**	**US GPM**	
Measured Static Pressure =	74	psi	
Measured Residual Pressure =	66	psi	
Desired Residual Pressure =	20	psi	, minimum per City of Toronto design criteria
Q_R =	**3490**	**US GPM**	per fire conneciton
	13,210	**L/min**	

Appendix C

Sanitary Design Flow Calculations

Project No.: 22088

February 2024

Counterpoint Engineering Inc.

Project: 45 Bishop Street
Project No: 22088
Location: Lakefield, Ontario
Site Area: 1.01 ha

Proposed Sanitary Flow Calculations

As per Engineering Design Standards, City of Peterborough, 2019

Design flow = (Population in Thousands x Average Daily Flow x Peaking Factor)/86.4 + (Infiltration Rate x Area)

Persons Per Unit and per Land Use

Single Family	3.5	ppu
Semi-Detached, 3+ BD Townhouse	3.5	ppu
2 BD Townhouse	2.4	ppu
2-3 BD Apartment	2.0	ppu
1 BD Apartment	1.6	ppu
Commercial / Retail	1.15	l/s/ha

	Residential Units			**Retail**
	Townhouse	**Semi-detached**	**Total Units**	**Area (m^2)**
TOTAL UNITS / AREA (m^2)	**8**	**8**	**16**	**-**

	Population	**TOTAL POPULATION**
Residential	47	47
Commercial	-	n/a
Total Equivalent Population		**47**

Peak Flow Design Parameters

Residential Average flow	450	litres/person/day
Commercial Average flow	1.15	l/s/ha
Infiltration	0.28	litres/second/ha

Harmon Peaking Factor

PF = 1 + (14/(4+(P/1000)$^{1/2}$))

Residential Population	**Harmon Peak Factor**
47	**4.32**

Residential Flow	1.06	**l/s**
Commercial Flow	-	**l/s**
Infiltration	0.28	**l/s**
Groundwater Flows	0.00	**l/s**

Flow	**1.34**	**l/s**

Appendix D

Stormwater Management Design Calculations

Project No.: 22088

February 2024

Veranda Properties

22088

Bishop Street Ditch Flow and Sample Capacity Calculations

Project No.: 22088

February 2024

SWM DESIGN CALCULATIONS
DRAINAGE AREAS AND RUNOFF COEFFICIENT CALCULATIONS FOR B-101

Project Name: 45 Bishop Street **Prepared by:** ZC
Municipality: Township of Selwyn, ON
Project No.: 22088 **Last Revised:** 20-Feb-24
Date: 20-Feb-24

Adjustment Ratio:	1	1.1	1.2	1.25
Runoff Coefficients:	**2 to 10-year**	**25-year**	**50-year**	**100-year**
Landscaped/Grass:	0.20	0.22	0.24	0.25
Gravel:	0.50	0.55	0.60	0.63
Pavement:	0.95	1.00	1.00	1.00
Roof:	0.95	1.00	1.00	1.00

Runoff Coefficients based on City of Peterborough Design Standards

POST DEVELOPMENT CONDITIONS FOR B-101

	Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
Area B-101 Properties	2279	0	4389	4140	15999	1.60

Area 201 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.53	0.56	0.57	0.57

SWM DESIGN CALCULATIONS
Pre-Development 5-Year Flow Rate Calculations for Area B-101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: ZC
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**1098**
Event	**5-year**	b	**10.1**
		c	**0.83**

Site Data

Area (ha)	**1.60**
Runoff Coefficient	**0.53**
AC	0.86
Tc (min)	**10**
Rainfall Intensity (mm/hr)	91
Rational Flow Rate (l/s)	**216**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

SWM DESIGN CALCULATIONS
Post-Development 100-Year Flow Rate Calculations for Area B-101

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: ZC
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**2507**
Event	**100-year**	b	**14.8**
		c	**0.88**

Site Data

Area (ha)	**1.60**
Runoff Coefficient	**0.57**
AC	0.91
Tc (min)	**10**
Rainfall Intensity (mm/hr)	149
Rational Flow Rate (l/s)	**376**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coef
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Veranda Properties

22088

Subject Site Quantity Control Calculations

Project No.: 22088

February 2024

SWM DESIGN CALCULATIONS
DRAINAGE AREAS AND RUNOFF COEFFICIENT CALCULATIONS

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: ZC
Last Revised: 20-Feb-24

Adjustment Ratio:	1	1.1	1.2	1.25
Runoff Coefficients:	**2 to 10-year**	**25-year**	**50-year**	**100-year**
Landscaped/Grass:	0.25	0.28	0.30	0.31
Gravel:	0.50	0.55	0.60	0.63
Pavement:	0.95	1.00	1.00	1.00
Roof:	0.95	1.00	1.00	1.00

Runoff Coefficients based on City of Peterborough Design Standards

PRE DEVELOPMENT CONDITIONS

Area 101 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
1011	0	0	0	1011	0.10

Area 101 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.25	0.28	0.30	0.31

Area 102 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
9070	0	0	0	9070	0.91

Area 102 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.25	0.28	0.30	0.31

POST DEVELOPMENT CONDITIONS

Area 201 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
2600		1930	1141	5671	0.57

Area 201 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.63	0.67	0.68	0.68

Area 202 Properties:

Grass (m^2)	Gravel (m^2)	Pavement (m^2)	Roof (m^2)	Total Area (m^2)	Total Area (ha)
3635			1117	4752	0.48

Area 202 Runoff Coefficients for Corresponding Storms:

Storm Event:	2 to 10-Year	25-Year	50-Year	100-Year
	0.41	0.45	0.46	0.47

counterpoint engineering

Rational Method

Pre-Development Release Rates (Area 101)

Project No:	22088
Project Name:	45 Bishop Street
Date:	2024-02-20 13:37

Event:		2	years
ABC's:	a	662	
	b	7.5	
	c	0.79	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.25	
Site Area	A	0.10	ha
Intensity [i=a/(t+b)^{c}]	i	69.00	mm/hr
Flow [Q=CiA/360]	Q	0.00	m^{3}/s
		5	l/s

Event:		5	years
ABC's:	a	1098	
	b	10.1	
	c	0.83	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.25	
Site Area	A	0.10	ha
Intensity [i=a/(t+b)^{c}]	i	90.98	mm/hr
Flow [Q=CiA/360]	Q	0.01	m^{3}/s
		6	l/s

Event:		10	years
ABC's:	a	1560	
	b	13	
	c	0.860	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.25	
Site Area	A	0.10	ha
Intensity [i=a/(t+b)^{c}]	i	105.21	mm/hr
Flow [Q=CiA/360]	Q	0.01	m^{3}/s
		7	l/s

Event:		25	years
ABC's:	a	2010	
	b	14	
	c	0.88	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.28	
Site Area	A	0.10	ha
Intensity [i=a/(t+b)^{c}]	i	122.63	mm/hr
Flow [Q=CiA/360]	Q	0.01	m^{3}/s
		9	l/s

Event:		50	years
ABC's:	a	2200	
	b	14.6	
	c	0.87	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.30	
Site Area	A	0.10	ha
Intensity [i=a/(t+b)^{c}]	i	135.62	mm/hr
Flow [Q=CiA/360]	Q	0.01	m^{3}/s
		11	l/s

Event:		100	years
ABC's:	a	2507	
	b	14.8	
	c	0.88	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.31	
Site Area	A	0.10	ha
Intensity [i=a/(t+b)^{c}]	i	148.61	mm/hr
Flow [Q=CiA/360]	Q	0.01	m^{3}/s
		13	l/s

Rational Method

Pre-Development Release Rates (Area 102)

Project No:	22088
Project Name:	45 Bishop Street
Date:	2024-02-20 13:37

Event:		2	years
ABC's:	a	**662**	
	b	**7.5**	
	c	**0.79**	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.25	
Site Area	A	0.91	ha
Intensity [$i=a/(t+b)^c$]	i	69.00	mm/hr
Flow [Q=CiA/360]	Q	0.04	m^3/s
		43	l/s

Event:		5	years
ABC's:	a	**1098**	
	b	**10.1**	
	c	**0.83**	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.25	
Site Area	A	0.91	ha
Intensity [$i=a/(t+b)^c$]	i	90.98	mm/hr
Flow [Q=CiA/360]	Q	0.06	m^3/s
		57	l/s

Event:		10	years
ABC's:	a	**1560**	
	b	**13**	
	c	**0.860**	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.25	
Site Area	A	0.91	ha
Intensity [$i=a/(t+b)^c$]	i	105.21	mm/hr
Flow [Q=CiA/360]	Q	0.07	m^3/s
		66	l/s

Event:		25	years
ABC's:	a	**2010**	
	b	**14**	
	c	**0.88**	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.28	
Site Area	A	0.91	ha
Intensity [$i=a/(t+b)^c$]	i	122.63	mm/hr
Flow [Q=CiA/360]	Q	0.08	m^3/s
		85	l/s

Event:		50	years
ABC's:	a	**2200**	
	b	**14.6**	
	c	**0.87**	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.30	
Site Area	A	0.91	ha
Intensity [$i=a/(t+b)^c$]	i	135.62	mm/hr
Flow [Q=CiA/360]	Q	0.10	m^3/s
		103	l/s

Event:		100	years
ABC's:	a	**2507**	
	b	**14.8**	
	c	**0.88**	
Time of Concentration:	t	10	min
Runoff Coefficient:	C	0.31	
Site Area	A	0.91	ha
Intensity [$i=a/(t+b)^c$]	i	148.61	mm/hr
Flow [Q=CiA/360]	Q	0.12	m^3/s
		117	l/s

SWM DESIGN CALCULATIONS
Storage Calculations for 100-Year Storm Event for Area 201 - South

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: ZC
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**2507**
Event	**100-year**	b	**14.8**
		c	**0.88**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff
A = the drainage area (ha)
i = rainfall intensity (mm/h

Site Data

Area (ha)	**0.57**
Runoff Coefficient	**0.68**
AC	0.39
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**13**
Storage Required (m^3)	**174**

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	149	0.160	96	8	88	
15	126	0.136	123	12	111	
20	110	0.119	143	16	127	
25	98	0.106	159	20	139	
30	88	0.095	172	23	148	
35	80	0.087	182	27	155	
40	74	0.080	192	31	160	
45	68	0.074	200	35	164	
50	64	0.069	207	39	168	
55	60	0.065	213	43	170	
60	56	0.061	219	47	172	
65	53	0.057	224	51	173	
70	50	0.054	228	55	174	
75	48	0.052	233	59	174	
80	46	0.049	237	63	174	********
85	44	0.047	240	67	174	
90	42	0.045	244	70	173	
95	40	0.043	247	74	173	
100	39	0.042	250	78	172	
105	37	0.040	253	82	171	
110	36	0.039	255	86	169	
115	35	0.037	258	90	168	
120	33	0.036	260	94	166	

SWM DESIGN CALCULATIONS
Storage Calculations for 100-Year Storm Event - Area 202

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: ZC
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**2507**
Event	**100-year**	b	**14.8**
		c	**0.88**

Site Data

Area (ha)	**0.48**
Runoff Coefficient	**0.41**
AC	0.20
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**82**
Storage Required (m^3)	**0**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/
C = the site specific run
A = the drainage area (h
i = rainfall intensity (m

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)
10	149	0.082	49	49	0
15	126	0.07	63	74	0
20	110	0.06	73	98	0
25	98	0.05	81	123	0
30	88	0.05	88	148	0
35	80	0.04	93	172	0
40	74	0.04	98	197	0
45	68	0.04	102	221	0
50	64	0.04	106	246	0
55	60	0.03	109	271	0
60	56	0.03	112	295	0
65	53	0.03	115	320	0
70	50	0.03	117	344	0
75	48	0.03	119	369	0
80	46	0.03	121	394	0
85	44	0.02	123	418	0
90	42	0.02	125	443	0
95	40	0.02	127	467	0
100	39	0.02	128	492	0
105	37	0.02	130	517	0
110	36	0.02	131	541	0
115	35	0.02	132	566	0
120	33	0.02	133	590	0

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SWM DESIGN CALCULATIONS
Storage Calculations for Controlled Drainage Area - 50-Year Storm North

Project Name: 45 Bishop Street
Prepared by: P.T
Municipality: Township of Selwyn, ON
Project No.: 22088
Last Revised: 20-Feb-24
Date: 20-Feb-24

Rainfall Data

Location:	City of Peterborough, ON	a	2200
Event	50-year	b	14.6
		c	0.87

Site Data

Area (ha)	0.57
Runoff Coefficient	0.68
AC	0.39
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	11
Storage Required (m^3)	**161**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	136	0.15	87	7	80	
15	115	0.12	111	10	101	
20	101	0.11	129	14	116	
25	90	0.10	144	17	127	
30	81	0.09	156	21	135	
35	74	0.08	166	24	142	
40	68	0.07	174	27	147	
45	63	0.07	182	31	151	
50	59	0.06	188	34	154	
55	55	0.06	194	38	156	
60	52	0.06	199	41	158	
65	49	0.05	204	45	159	
70	46	0.05	208	48	160	
75	44	0.05	212	51	161	
80	42	0.04	216	55	161	
85	40	0.04	219	58	161	********
90	38	0.04	223	62	161	
95	37	0.04	226	65	160	
100	36	0.04	228	69	160	
105	34	0.04	231	72	159	
110	33	0.04	234	75	158	
115	32	0.03	236	79	157	
120	31	0.03	238	82	156	

SWM DESIGN CALCULATIONS
Storage Calculations for Drainage Area 202 - 50-Year Storm

Project Name: 45 Bishop Street
Prepared by: P.T
Municipality: Township of Selwyn, ON
Project No.: 22088
Last Revised: 20-Feb-24
Date: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**2200**
Event	**50-year**	b	**14.6**
		c	**0.87**

Site Data

Area (ha)	**0.48**
Runoff Coefficient	**0.46**
AC	0.22
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**83**
Storage Required (m^3)	**0**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	136	0.08	50	50	0	********
15	115	0.07	64	75	0	
20	101	0.06	74	100	0	
25	90	0.06	83	125	0	
30	81	0.05	89	149	0	
35	74	0.05	95	174	0	
40	68	0.04	100	199	0	
45	63	0.04	104	224	0	
50	59	0.04	108	249	0	
55	55	0.03	111	274	0	
60	52	0.03	114	299	0	
65	49	0.03	117	324	0	
70	46	0.03	119	349	0	
75	44	0.03	122	374	0	
80	42	0.03	124	398	0	
85	40	0.02	126	423	0	
90	38	0.02	128	448	0	
95	37	0.02	129	473	0	
100	36	0.02	131	498	0	
105	34	0.02	132	523	0	
110	33	0.02	134	548	0	
115	32	0.02	135	573	0	
120	31	0.02	137	598	0	

SWM DESIGN CALCULATIONS
Storage Calculations for Controlled Drainage Area 201 - 25-Year Storm

Project Name: 45 Bishop Street
Prepared by: P.T
Municipality: Township of Selwyn, ON
Project No.: 22088
Last Revised: 20-Feb-24
Date: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**2010**
Event	**25-year**	b	**14**
		c	**0.88**

Site Data

Area (ha)	**0.57**
Runoff Coefficient	**0.67**
AC	0.38
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**9**
Storage Required (m^3)	**141**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	123	0.13	77	6	72	
15	104	0.11	98	9	90	
20	90	0.09	114	11	103	
25	80	0.08	126	14	112	
30	72	0.08	136	17	119	
35	65	0.07	145	20	125	
40	60	0.06	152	23	129	
45	56	0.06	158	26	132	
50	52	0.05	163	28	135	
55	48	0.05	168	31	137	
60	46	0.05	173	34	138	
65	43	0.05	176	37	139	
70	41	0.04	180	40	140	
75	39	0.04	183	43	141	
80	37	0.04	186	45	141	********
85	35	0.04	189	48	141	
90	34	0.04	192	51	141	
95	32	0.03	194	54	140	
100	31	0.03	197	57	140	
105	30	0.03	199	60	139	
110	29	0.03	201	63	138	
115	28	0.03	203	65	137	
120	27	0.03	205	68	136	

SWM DESIGN CALCULATIONS
Storage Calculations for Drainage Area 202 - 25-Year Storm

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: P.T
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**2010**
Event	**25-year**	b	**14**
		c	**0.88**

Site Data

Area (ha)	**0.48**
Runoff Coefficient	**0.45**
AC	0.21
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**72**
Storage Required (m^3)	**0**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	**Rainfall Intensity**	**Storm Runoff**	**Runoff Volume**	**Released Volume**	**Storage Volume**	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	123	0.07	43	43	0	********
15	104	0.06	55	65	0	
20	90	0.05	64	86	0	
25	80	0.05	71	108	0	
30	72	0.04	76	130	0	
35	65	0.04	81	151	0	
40	60	0.04	85	173	0	
45	56	0.03	88	194	0	
50	52	0.03	91	216	0	
55	48	0.03	94	238	0	
60	46	0.03	96	259	0	
65	43	0.03	99	281	0	
70	41	0.02	101	302	0	
75	39	0.02	102	324	0	
80	37	0.02	104	346	0	
85	35	0.02	106	367	0	
90	34	0.02	107	389	0	
95	32	0.02	109	410	0	
100	31	0.02	110	432	0	
105	30	0.02	111	454	0	
110	29	0.02	112	475	0	
115	28	0.02	113	497	0	
120	27	0.02	114	518	0	

SWM DESIGN CALCULATIONS
Storage Calculations for Controlled Drainage Area 201 - 10-Year Storm

Project Name: 45 Bishop Street
Prepared by: P.T
Municipality: Township of Selwyn, ON
Project No.: 22088
Last Revised: 20-Feb-24
Date: 20-Feb-24

Rainfall Data

Location:	City of Peterborough, ON	a	1560
Event	10-year	b	13
		c	0.86

Site Data

Area (ha)	0.57
Runoff Coefficient	0.63
AC	0.36
Tc (min)	10
Time Increment (min)	5
Release Rate (l/s)	7
Storage Required (m^3)	**115**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	105	0.10	63	4	58	
15	89	0.09	79	7	73	
20	77	0.08	92	9	83	
25	68	0.07	102	11	91	
30	61	0.06	110	13	96	
35	56	0.06	116	16	101	
40	51	0.05	122	18	104	
45	47	0.05	127	20	107	
50	44	0.04	132	22	109	
55	41	0.04	136	24	111	
60	39	0.04	139	27	113	
65	37	0.04	142	29	114	
70	35	0.03	145	31	114	
75	33	0.03	148	33	115	
80	32	0.03	151	35	115	
85	30	0.03	153	38	115	********
90	29	0.03	155	40	115	
95	28	0.03	157	42	115	
100	27	0.03	159	44	115	
105	26	0.03	161	47	115	
110	25	0.02	163	49	114	
115	24	0.02	165	51	114	
120	23	0.02	166	53	113	

SWM DESIGN CALCULATIONS
Storage Calculations for Drainage Area 202 - 10-Year Storm

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: P.T
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**1560**
Event	**10-year**	b	**13**
		c	**0.86**

Site Data

Area (ha)	**0.48**
Runoff Coefficient	**0.41**
AC	0.20
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**58**
Storage Required (m^3)	**0**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	105	0.06	35	35	0	********
15	89	0.05	44	52	0	********
20	77	0.04	51	70	0	********
25	68	0.04	56	87	0	********
30	61	0.03	61	104	0	********
35	56	0.03	64	122	0	********
40	51	0.03	67	139	0	********
45	47	0.03	70	157	0	********
50	44	0.02	73	174	0	********
55	41	0.02	75	191	0	********
60	39	0.02	77	209	0	********
65	37	0.02	79	226	0	********
70	35	0.02	80	244	0	********
75	33	0.02	82	261	0	********
80	32	0.02	83	278	0	********
85	30	0.02	84	296	0	********
90	29	0.02	86	313	0	********
95	28	0.02	87	331	0	********
100	27	0.01	88	348	0	********
105	26	0.01	89	365	0	********
110	25	0.01	90	383	0	********
115	24	0.01	91	400	0	********
120	23	0.01	92	418	0	********

SWM DESIGN CALCULATIONS
Storage Calculations for Controlled Area 201 - 5-Year Storm

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: P.T

Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**1098**
Event	**5-year**	b	**10.1**
		c	**0.83**

Site Data

Area (ha)	**0.57**
Runoff Coefficient	**0.68**
AC	0.39
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**6**
Storage Required (m^3)	**105**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	91	0.10	59	4	55	
15	76	0.08	73	6	68	
20	65	0.07	84	8	76	
25	57	0.06	93	10	83	
30	51	0.06	99	11	88	
35	47	0.05	105	13	92	
40	43	0.05	110	15	95	
45	39	0.04	115	17	97	
50	37	0.04	118	19	99	
55	34	0.04	122	21	101	
60	32	0.03	125	23	102	
65	30	0.03	128	25	103	
70	29	0.03	131	27	104	
75	27	0.03	133	29	104	
80	26	0.03	135	31	105	
85	25	0.03	138	33	105	
90	24	0.03	140	34	105	********
95	23	0.02	142	36	105	
100	22	0.02	143	38	105	
105	21	0.02	145	40	105	
110	21	0.02	147	42	105	
115	20	0.02	148	44	104	
120	19	0.02	150	46	104	

counterpoint
ENGINEERING

SWM DESIGN CALCULATIONS
Storage Calculations for Controlled Drainage Area - 5-Year Storm

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: P.T
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**1098**
Event	**5-year**	b	**10.1**
		c	**0.83**

Site Data

Area (ha)	**0.48**
Runoff Coefficient	**0.41**
AC	0.20
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**50**
Storage Required (m^3)	**0**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	91	0.05	30	30	0	********
15	76	0.04	37	45	0	********
20	65	0.04	43	60	0	********
25	57	0.03	47	75	0	********
30	51	0.03	51	90	0	********
35	47	0.03	53	105	0	********
40	43	0.02	56	120	0	********
45	39	0.02	58	135	0	********
50	37	0.02	60	150	0	********
55	34	0.02	62	165	0	********
60	32	0.02	64	180	0	********
65	30	0.02	65	195	0	********
70	29	0.02	66	210	0	********
75	27	0.02	68	225	0	********
80	26	0.01	69	240	0	********
85	25	0.01	70	255	0	********
90	24	0.01	71	270	0	********
95	23	0.01	72	285	0	********
100	22	0.01	73	300	0	********
105	21	0.01	74	315	0	********
110	21	0.01	75	330	0	********
115	20	0.01	75	345	0	********
120	19	0.01	76	360	0	********

SWM DESIGN CALCULATIONS
Storage Calculations for 2-Year Storm Event - 201

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: P.T
Last Revised: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**662**
Event	**2-year**	b	**7.5**
		c	**0.79**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff coefficient
A = the drainage area (ha)
i = rainfall intensity (mm/hr)

Site Data

Area (ha)	**0.57**
Runoff Coefficient	**0.63**
AC	0.36
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**5**
Storage Required (m^3)	**69**

Pre-dev Release Rate north to Bishop Street

Time	**Rainfall Intensity**	**Storm Runoff**	**Runoff Volume**	**Released Volume**	**Storage Volume**	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	69	0.07	41	3	38	
15	57	0.06	50	4	46	
20	48	0.05	57	6	52	
25	42	0.04	63	7	56	
30	38	0.04	67	9	59	
35	34	0.03	71	10	61	
40	31	0.03	75	12	63	
45	29	0.03	78	13	64	
50	27	0.03	80	15	66	
55	25	0.03	83	16	67	
60	24	0.02	85	17	67	
65	22	0.02	87	19	68	
70	21	0.02	89	20	68	
75	20	0.02	90	22	69	
80	19	0.02	92	23	69	
85	19	0.02	94	25	69	
90	18	0.02	95	26	69	********
95	17	0.02	97	28	69	
100	16	0.02	98	29	69	
105	16	0.02	99	31	69	
110	15	0.02	100	32	68	
115	15	0.01	102	33	68	
120	14	0.01	103	35	68	

SWM DESIGN CALCULATIONS
Storage Calculations for 2-Year Storm Event - 202

Project Name: 45 Bishop Street
Prepared by: P.T
Municipality: Township of Selwyn, ON
Project No.: 22088
Last Revised: 20-Feb-24
Date: 20-Feb-24

Rainfall Data

Location:	**City of Peterborough, ON**	a	**662**
Event	**2-year**	b	**7.5**
		c	**0.79**

Site Data

Area (ha)	**0.48**
Runoff Coefficient	**0.41**
AC	0.20
Tc (min)	**10**
Time Increment (min)	**5**
Release Rate (l/s)	**38**
Storage Required (m^3)	**0**

The Rational Equation:

$$Q = \frac{(C)(i)(A)}{360}$$

where,

Q = the design flow (m^3/s)
C = the site specific runoff
A = the drainage area (ha
i = rainfall intensity (mm/l

Time	Rainfall Intensity	Storm Runoff	Runoff Volume	Released Volume	Storage Volume	
(min)	(mm/hr)	(m^3/s)	(m^3)	(m^3)	(m^3)	
10	69	0.038	23	23	0	********
15	57	0.03	28	34	0	********
20	48	0.03	32	46	0	********
25	42	0.02	35	57	0	********
30	38	0.02	37	68	0	********
35	34	0.02	39	80	0	********
40	31	0.02	41	91	0	********
45	29	0.02	43	103	0	********
50	27	0.01	44	114	0	********
55	25	0.01	46	125	0	********
60	24	0.01	47	137	0	********
65	22	0.01	48	148	0	********
70	21	0.01	49	160	0	********
75	20	0.01	50	171	0	********
80	19	0.01	51	182	0	********
85	19	0.01	52	194	0	********
90	18	0.01	53	205	0	********
95	17	0.01	53	217	0	********
100	16	0.01	54	228	0	********
105	16	0.01	55	239	0	********
110	15	0.01	55	251	0	********
115	15	0.01	56	262	0	********
120	14	0.01	57	274	0	********

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SWM DESIGN CALCULATIONS
Storage Provided Calculations

Project Name: 45 Bishop Street
Municipality: Township of Selwyn, ON
Project No.: 22088
Date: 20-Feb-24

Prepared by: R.K./ZC
Last Revised: 20-Feb-24

Pipes Storage

Pipe Diameter (mm)	Area (m^2)	Length (m)	Volume (m^3)
2.1 x 1.5	3.150	60.0	189.0
Total Provided Storage (m^3)	**189.00**		

Summation of Provided Storages (m^3)	**189**
Total Required Storage (m^3)	**174**
Required Underground Storage (m^3)	**-15**

Stormceptor®EF Sizing Report

Imbrium® Systems
ESTIMATED NET ANNUAL SEDIMENT (TSS) LOAD REDUCTION

02/23/2024

Province:	Ontario
City:	Lakefield
Nearest Rainfall Station:	PETERBOROUGH
Climate Station Id:	6166456
Years of Rainfall Data:	15

Site Name:	45 Bishop St.

Drainage Area (ha):	0.57
Runoff Coefficient 'c':	0.63

Particle Size Distribution:	Fine
Target TSS Removal (%):	80.0
Required Water Quality Runoff Volume Capture (%):	90.0

Oil / Fuel Spill Risk Site?	Yes
Upstream Flow Control?	Yes
Upstream Orifice Control Flow Rate to Stormceptor (L/s):	13
Peak Conveyance (maximum) Flow Rate (L/s):	13

Project Name:	45 Bishop St.
Project Number:	22088
Designer Name:	Brandon O'Leary
Designer Company:	Rinker Pipe
Designer Email:	brandon.oleary@RinkerPipe.com
Designer Phone:	905-630-0359
EOR Name:	Prince Trinidad-Rhodius
EOR Company:	Counterpoint Engineering Inc.
EOR Email:	
EOR Phone:	

Net Annual Sediment (TSS) Load Reduction Sizing Summary

Stormceptor Model	TSS Removal Provided (%)
EFO4	87
EFO6	95
EFO8	98
EFO10	99
EFO12	100

Recommended Stormceptor EFO Model: **EFO4**

Estimated Net Annual Sediment (TSS) Load Reduction (%): **87**

Water Quality Runoff Volume Capture (%): **> 90**

THIRD-PARTY TESTING AND VERIFICATION

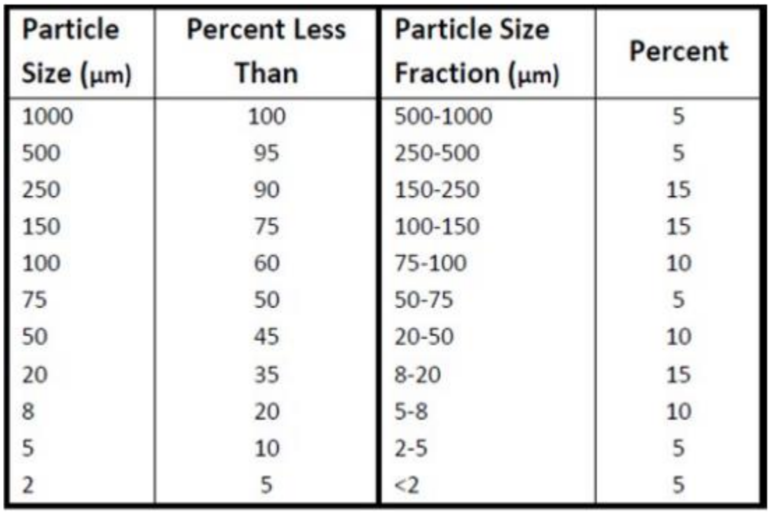
►**Stormceptor® EF and Stormceptor® EFO** are the latest evolutions in the Stormceptor® oil-grit separator (OGS) technology series, and are designed to remove a wide variety of pollutants from stormwater and snowmelt runoff. These technologies have been third-party tested in accordance with the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators** and performance has been third-party verified in accordance with the **ISO 14034 Environmental Technology Verification (ETV)** protocol.

PERFORMANCE

►**Stormceptor® EF and EFO** remove stormwater pollutants through gravity separation and floatation, and feature a patent-pending design that generates positive removal of total suspended solids (TSS) throughout each storm event, including high-intensity storms. Captured pollutants include sediment, free oils, and sediment-bound pollutants such as nutrients, heavy metals, and petroleum hydrocarbons. Stormceptor is sized to remove a high level of TSS from the frequent rainfall events that contribute the vast majority of annual runoff volume and pollutant load. The technology incorporates an internal bypass to convey excessive stormwater flows from high-intensity storms through the device without resuspension and washout (scour) of previously captured pollutants. Proper routine maintenance ensures high pollutant removal performance and protection of downstream waterways.

PARTICLE SIZE DISTRIBUTION (PSD)

►The **Canadian ETV PSD** shown in the table below was used, or in part, for this sizing. This is the identical PSD that is referenced in the Canadian ETV ***Procedure for Laboratory Testing of Oil-Grit Separators*** for both sediment removal testing and scour testing. The Canadian ETV PSD contains a wide range of particle sizes in the sand and silt fractions, and is considered reasonably representative of the particle size fractions found in typical urban stormwater runoff.



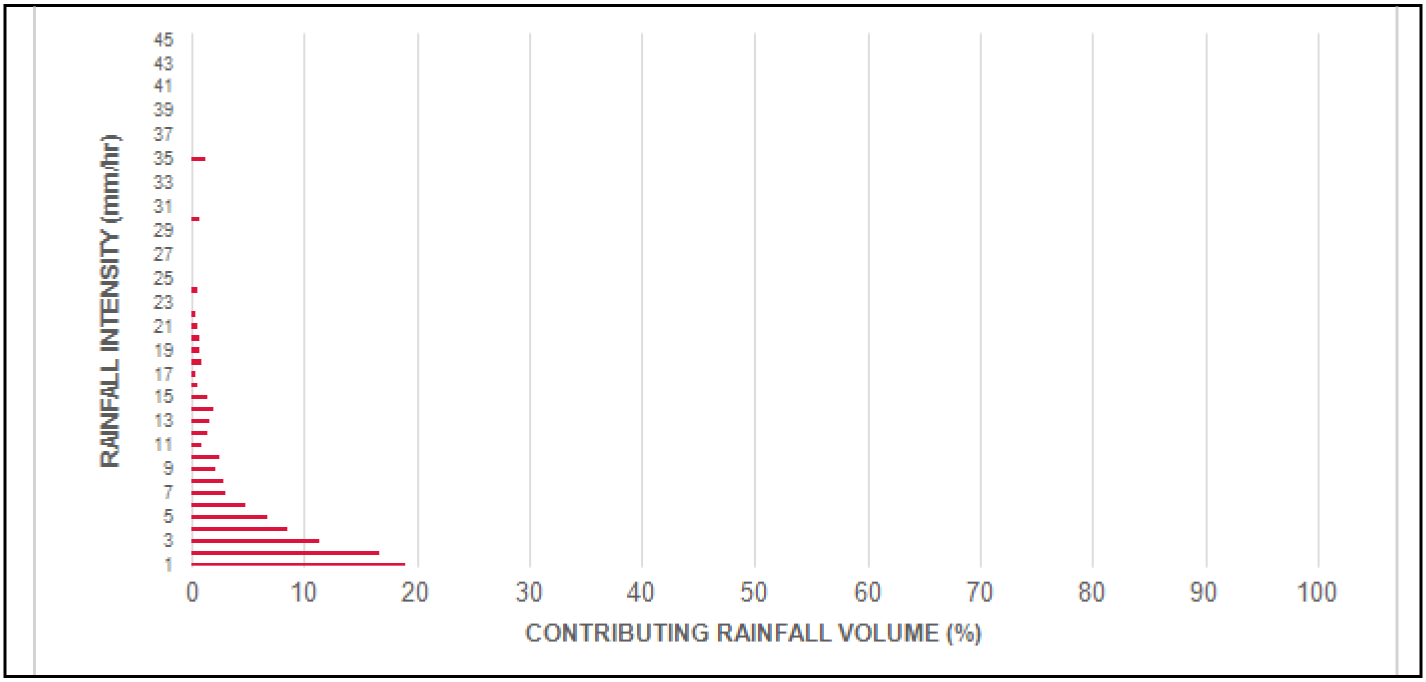
Particle Size (µm)	Percent Less Than	Particle Size Fraction (µm)	Percent
1000	100	500-1000	5
500	95	250-500	5
250	90	150-250	15
150	75	100-150	15
100	60	75-100	10
75	50	50-75	5
50	45	20-50	10
20	35	8-20	15
8	20	5-8	10
5	10	2-5	5
2	5	<2	5

Upstream Flow Controlled Results

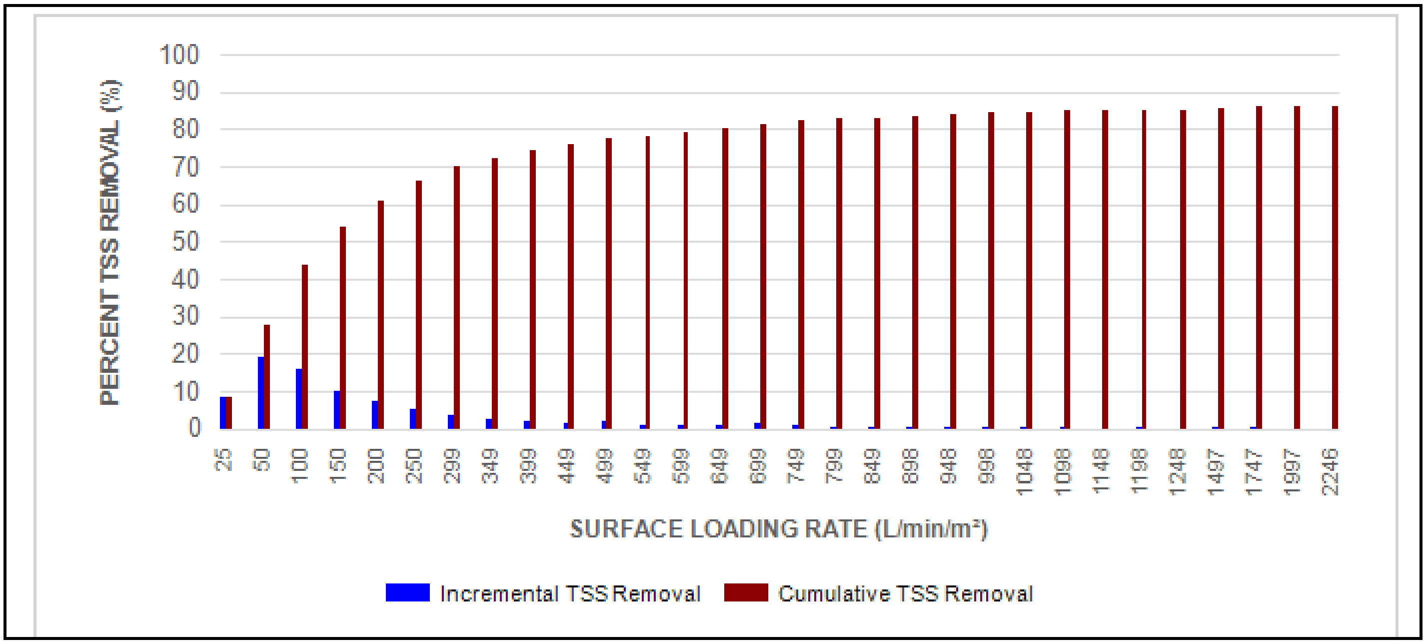
Rainfall Intensity (mm / hr)	Percent Rainfall Volume (%)	Cumulative Rainfall Volume (%)	Flow Rate (L/s)	Flow Rate (L/min)	Surface Loading Rate (L/min/m²)	Removal Efficiency (%)	Incremental Removal (%)	Cumulative Removal (%)
0.50	8.5	8.5	0.50	30.0	25.0	100	8.5	8.5
1.00	19.0	27.5	1.00	60.0	50.0	100	19.0	27.5
2.00	16.8	44.3	2.00	120.0	100.0	96	16.1	43.6
3.00	11.3	55.6	2.99	180.0	150.0	89	10.1	53.7
4.00	8.6	64.2	3.99	240.0	200.0	83	7.1	60.9
5.00	6.7	70.9	4.99	299.0	250.0	81	5.4	66.3
6.00	4.8	75.6	5.99	359.0	299.0	78	3.7	70.0
7.00	3.1	78.7	6.99	419.0	349.0	76	2.3	72.3
8.00	2.8	81.5	7.99	479.0	399.0	74	2.1	74.4
9.00	2.1	83.6	8.98	539.0	449.0	72	1.5	75.9
10.00	2.5	86.1	9.98	599.0	499.0	69	1.7	77.6
11.00	0.9	87.0	10.98	659.0	549.0	67	0.6	78.2
12.00	1.5	88.5	11.98	719.0	599.0	65	0.9	79.2
13.00	11.5	100.0	12.98	779.0	649.0	64	7.4	86.6
14.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
15.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
16.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
17.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
18.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
19.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
20.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
21.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
22.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
23.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
24.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
25.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
30.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
35.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
40.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
45.00	0.0	100.0	13.00	780.0	650.0	64	0.0	86.6
Estimated Net Annual Sediment (TSS) Load Reduction =								**87 %**

Climate Station ID: 6166456 *Years of Rainfall Data*: 15

RAINFALL DATA FROM PETERBOROUGH RAINFALL STATION



INCREMENTAL AND CUMULATIVE TSS REMOVAL FOR THE RECOMMENDED STORMCEPTOR® MODEL



Maximum Pipe Diameter / Peak Conveyance

Stormceptor EF / EFO	Model Diameter		Min Angle Inlet / Outlet Pipes	Max Inlet Pipe Diameter		Max Outlet Pipe Diameter		Peak Conveyance Flow Rate	
	(m)	(ft)		(mm)	(in)	(mm)	(in)	(L/s)	(cfs)
EF4 / EFO4	1.2	4	90	609	24	609	24	425	15
EF6 / EFO6	1.8	6	90	914	36	914	36	990	35
EF8 / EFO8	2.4	8	90	1219	48	1219	48	1700	60
EF10 / EFO10	3.0	10	90	1828	72	1828	72	2830	100
EF12 / EFO12	3.6	12	90	1828	72	1828	72	2830	100

SCOUR PREVENTION AND ONLINE CONFIGURATION

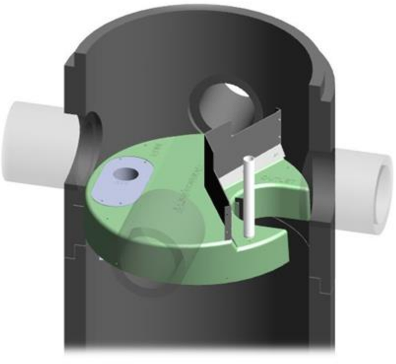
►**Stormceptor® EF and EFO** feature an internal bypass and superior scour prevention technology that have been demonstrated in third-party testing according to the scour testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**, and the exceptional scour test performance has been third-party verified in accordance with the ISO 14034 ETV protocol. As a result, Stormceptor EF and EFO are approved for online installation, eliminating the need for costly additional bypass structures, piping, and installation expense.

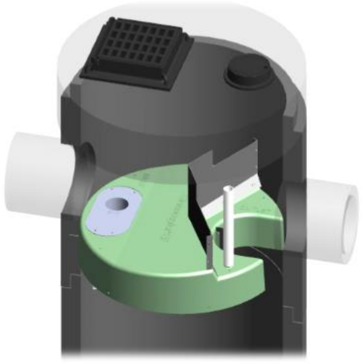
DESIGN FLEXIBILITY

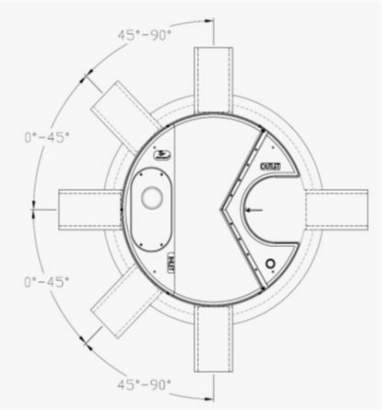
►**Stormceptor® EF** and **EFO** offers design flexibility in one simplified platform, accepting stormwater flow from a single inlet pipe or multiple inlet pipes, and/or surface runoff through an inlet grate. The device can also serve as a junction structure, accommodate a 90-degree inlet-to-outlet bend angle, and can be modified to ensure performance in submerged conditions.

OIL CAPTURE AND RETENTION

►While Stormceptor® EF will capture and retain oil from dry weather spills and low intensity runoff, **Stormceptor® EFO** has demonstrated superior oil capture and greater than 99% oil retention in third-party testing according to the light liquid re-entrainment testing provisions of the Canadian ETV **Procedure for Laboratory Testing of Oil-Grit Separators**. Stormceptor EFO is recommended for sites where oil capture and retention is a requirement.







INLET-TO-OUTLET DROP

Elevation differential between inlet and outlet pipe inverts is dictated by the angle at which the inlet pipe(s) enters the unit.

0° - 45° : The inlet pipe is 1-inch (25mm) higher than the outlet pipe.

45° - 90° : The inlet pipe is 2-inches (50mm) higher than the outlet pipe.

HEAD LOSS

The head loss through Stormceptor EF is similar to that of a 60-degree bend structure. The applicable K value for calculating minor losses through the unit is 1.1. For submerged conditions the applicable K value is 3.0.

Pollutant Capacity

Stormceptor EF / EFO	Model Diameter		Depth (Outlet Pipe Invert to Sump Floor)		Oil Volume		Recommended Sediment Maintenance Depth *		Maximum Sediment Volume *		Maximum Sediment Mass **	
	(m)	(ft)	(m)	(ft)	(L)	(Gal)	(mm)	(in)	(L)	(ft³)	(kg)	(lb)
EF4 / EFO4	1.2	4	1.52	5.0	265	70	203	8	1190	42	1904	5250
EF6 / EFO6	1.8	6	1.93	6.3	610	160	305	12	3470	123	5552	15375
EF8 / EFO8	2.4	8	2.59	8.5	1070	280	610	24	8780	310	14048	38750
EF10 / EFO10	3.0	10	3.25	10.7	1670	440	610	24	17790	628	28464	78500
EF12 / EFO12	3.6	12	3.89	12.8	2475	655	610	24	31220	1103	49952	137875

*Increased sump depth may be added to increase sediment storage capacity

** Average density of wet packed sediment in sump = 1.6 kg/L (100 lb/ft³)

Feature	Benefit	Feature Appeals To
Patent-pending enhanced flow treatment and scour prevention technology	Superior, verified third-party performance	Regulator, Specifying & Design Engineer
Third-party verified light liquid capture and retention for EFO version	Proven performance for fuel/oil hotspot locations	Regulator, Specifying & Design Engineer, Site Owner
Functions as bend, junction or inlet structure	Design flexibility	Specifying & Design Engineer
Minimal drop between inlet and outlet	Site installation ease	Contractor
Large diameter outlet riser for inspection and maintenance	Easy maintenance access from grade	Maintenance Contractor & Site Owner

STANDARD STORMCEPTOR EF/EFO DRAWINGS

For standard details, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD STORMCEPTOR EF/EFO SPECIFICATION

For specifications, please visit http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-ef

STANDARD PERFORMANCE SPECIFICATION FOR “OIL GRIT SEPARATOR” (OGS) STORMWATER QUALITY TREATMENT DEVICE

PART 1 – GENERAL

1.1 <u>WORK INCLUDED</u>

This section specifies requirements for selecting, sizing, and designing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, with third-party testing results and a Statement of Verification in accordance with ISO 14034 Environmental Management – Environmental Technology Verification (ETV).

1.2 <u>REFERENCE STANDARDS & PROCEDURES</u>

ISO 14034:2016 Environmental management – Environmental technology verification (ETV)

Canadian Environmental Technology Verification (ETV) Program’s **Procedure for Laboratory Testing of Oil-Grit Separators**

1.3 <u>SUBMITTALS</u>

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 <u>OGS POLLUTANT STORAGE</u>

The OGS device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The minimum sediment & petroleum hydrocarbon storage capacity shall be as follows:

2.1.1	4 ft (1219 mm) Diameter OGS Units:	1.19 m^3 sediment / 265 L oil
	6 ft (1829 mm) Diameter OGS Units:	3.48 m^3 sediment / 609 L oil
	8 ft (2438 mm) Diameter OGS Units:	8.78 m^3 sediment / 1,071 L oil
	10 ft (3048 mm) Diameter OGS Units:	17.78 m^3 sediment / 1,673 L oil
	12 ft (3657 mm) Diameter OGS Units:	31.23 m^3 sediment / 2,476 L oil

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in the sizing report for the specified device. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol Procedure for Laboratory Testing of Oil-Grit Separators, as follows:

3.2.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.2.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.2.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.2.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 2.1.

3.3 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of third-party scour testing conducted in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.**

3.3.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

3.4 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV **Program's Procedure for Laboratory Testing of Oil-Grit Separators,** with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.4.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

STANDARD SPECIFICATION FOR “OIL GRIT SEPARATOR” (OGS) STORMWATER QUALITY TREAMENT DEVICE WITH THIRD-PARTY VERIFIED LIGHT LIQUID RE-ENTRAINMENT SIMULATION PERFORMANCE TESTING RESULTS

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, designing, maintaining, and constructing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, **specifically an OGS device that has been third-party tested for oil and fuel retention capability using a protocol for light liquid re-entrainment simulation testing, with testing results and a Statement of Verification in accordance with all the provisions of ISO 14034 Environmental Management – Environmental Technology Verification (ETV)**. Work includes supply and installation of concrete bases, precast sections, and the appropriate precast section with OGS internal components correctly installed within the system, watertight sealed to the precast concrete prior to arrival to the project site.

1.2 REFERENCE STANDARDS

1.2.1 For Canadian projects only, the following reference standards apply:

CAN/CSA-A257.4-14: Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets
CAN/CSA-A257.4-14: Precast Reinforced Circular Concrete Manhole Sections, Catch Basins, and Fittings
CAN/CSA-S6-00: Canadian Highway Bridge Design Code

1.2.2 For ALL projects, the following reference standards apply:

ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 891: Standard Practice for Installation of Underground Precast Concrete Utility Structures
ASTM D2563: Standard Practice for Classification of Visual Defects in Reinforced Plastics

1.3 SHOP DRAWINGS

1.3.1 Shop drawings shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail the precast concrete components and OGS internal components prior to shipment, including the sequence for installation.

1.3.2 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record. Any and all changes to project cost estimates, bonding amounts, plan check fees for revision of approved documents, or design impacts due to regulatory requirements as a result of a product substitution shall be coordinated by the Contractor with the Engineer of Record.

1.4 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

1.4.1 OGS internal components supplied by the Manufacturer for attachment to the precast concrete vessel shall be pre-fabricated, bolted to the precast and watertight sealed to the precast vessel surface prior to site delivery to ensure Manufacturer's internal assembly process and quality control processes are fully adhered to, and to prevent materials damage on site.

1.4.2 Follow all instructions including the sequence for installation in the shop drawings during installation.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The OGS vessel shall be cylindrical and constructed from precast concrete riser and slab components.

2.1.2 The precast concrete OGS internal components shall include a fiberglass insert bolted and watertight sealed inside the precast concrete vessel, prior to site delivery. Primary internal components that are to be anchored and watertight sealed to the precast concrete vessel shall be done so only by the Manufacturer prior to arrival at the job site to ensure product quality.

2.1.3 The OGS shall be allowed to be specified and have the ability to function as a 240-degree bend structure in the stormwater drainage system, or as a junction structure.

2.1.4 The OGS to be specified shall have the capability to accept influent flow from an inlet grate and an inlet pipe.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be designed and manufactured to meet highway loading conditions per State/Provincial or local requirements.

2.3 GASKETS

Only profile neoprene or nitrile rubber gaskets that are oil resistant shall be accepted. For Canadian projects only, gaskets shall be in accordance to CSA A257.4-14. Mastic sealants, butyl tape/rope or Conseal CS-101 alone are not acceptable gasket materials.

2.4 JOINTS

The concrete joints shall be watertight and meet the design criteria according to ASTM C-990. For projects where joints require gaskets, the concrete joints shall be watertight and oil resistant and meet the design criteria according to ASTM C-443. Mastic sealants or butyl tape/rope alone are not an acceptable alternative.

2.5 FRAMES AND COVERS

Frames and covers shall be manufactured in accordance with State/Provincial or local requirements for inspection and maintenance access purposes. A minimum of one cover, at least 22-inch (560 mm) in diameter, shall be clearly embossed with the OGS manufacturer's product name to properly identify this asset's purpose is for stormwater quality treatment.

2.6 PRECAST CONCRETE

All precast concrete components shall conform to the appropriate CSA or ASTM specifications.

2.7 FIBERGLASS

The fiberglass portion of the OGS device shall be constructed in accordance with ASTM D2563, and in accordance with the PS15-69 manufacturing standard, and shall only be installed, bolted and watertight sealed to the precast concrete by the Manufacturer prior to arrival at the project site to ensure product quality.

2.8 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a fiberglass insert for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The total sediment storage capacity shall be a minimum 40 ft^3 (1.1 m^3). The total petroleum hydrocarbon storage capacity shall be a minimum 50 gallons (189 liters). The access opening to the sump of the OGS device for periodic inspection and maintenance purposes shall be a minimum 16 inches (406 mm) in diameter.

2.9 LADDERS

Ladder rungs shall be provided upon request or to comply with State/Provincial or local requirements.

2.10 INSPECTION

All precast concrete sections shall be level and inspected to ensure dimensions, appearance, integrity of internal components, and quality of the product meets State/Provincial or local specifications and associated standards.

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 HYDROLOGY AND RUNOFF VOLUME

The OGS device shall be engineered, designed and sized to treat a minimum of 90 percent of the average annual runoff volume, unless otherwise stated by the Engineer of Record, using historical rainfall data. Rainfall data sets should be comprised of a minimum 15-years of rainfall data or a longer continuous period if available for a given location, but in all cases a minimum 5-year period of rainfall data.

3.3 ANNUAL (TSS) SEDIMIMENT LOAD AND STORAGE CAPACITY

The OGS device shall be capable of removing and have sufficient storage capacity for the calculated annual total suspended solids (TSS) mass load and volume without scouring previously captured pollutants prior to maintenance being required. The annual (TSS) sediment load and volume transported from the drainage area should be calculated and compared to the OGS device's available storage capacity by the specifying Engineer to ensure adequate capacity between maintenance cycles. Sediment loadings shall be determined by land use and defined as a minimum of 450 kg (992 lb) of sediment (TSS) per impervious hectare of drainage area per year, or greater based on land use, as noted in Table 1 below.

Annual sediment volume calculations shall be performed using the projected average annual treated runoff volume, a typical sediment bulk density of 1602 kg/m^3 (100 lbs/ft^3) and an assumed Event Mean Concentration (EMC) of 125 mg/L TSS in the runoff, or as otherwise determined by the Engineer of Record.

Example calculation for a 1.3-hectares parking lot site:

- 1.28 meters of rainfall depth, per year
- 1.3 hectares of 100% impervious drainage area
- EMC of 125 mg/L TSS in runoff
- Treatment of 90% of the average annual runoff volume
- Target average annual TSS removal rate of 60% by OGS

Annual Runoff Volume:

- 1.28 m rain depth x 1.3 ha x 10,000 m^2/ha= 16,640 m^3 of runoff volume
- 16,640 m^3 x 1000 L/m^3 = 16,640,000 L of runoff volume
- 16,640,000 L x 0.90 = 14,976,000 L to be treated by OGS unit

Annual Sediment Mass and Sediment Volume Load Calculation:

- 14,976,000 L x 125 mg/L x kg/1,000,000 mg = 1,872 kg annual sediment mass
- 1,872 kg x m^3/1602 kg = 1.17 m^3 annual sediment volume
- 1.17 m^3 x 60% TSS removal rate by OGS = 0.70 m^3 minimum expected annual storage requirement in OGS

As a guideline, the U.S. EPA has determined typical annual sediment loads per drainage area for various sites by land use (see Table 1). Certain States, Provinces and local jurisdictions have also established such guidelines.

Table 1 – Annual Mass Sediment Loading by Land Use

	Commercial	**Parking Lot**	**Residential**			**Highways**	**Industrial**	**Shopping Center**
			High	**Med.**	**Low**			
(lbs/acre/yr)	1,000	400	420	250	10	880	500	440
(kg/hectare/yr)	1,124	450	472	281	11	989	562	494

Source: U.S. EPA Stormwater Best Management Practice Design Guide Volume 1, Appendix D, Table D-1, Burton and Pitt 2002

3.4 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in Table 2, Section 3.5, and based on third-party performance testing conducted in accordance with the Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. Sizing of the OGS shall be determined by use of a minimum ten (10) years of local historical rainfall data provided by Environment Canada. Sizing shall also be determined by use of the sediment removal performance data derived from the ISO 14034 ETV third-party verified laboratory testing data from testing conducted in accordance with the Canadian ETV protocol *Procedure for Laboratory Testing of Oil-Grit Separators*, as follows:

3.4.1 Sediment removal efficiency for a given surface loading rate and its associated flow rate shall be based on sediment removal efficiency demonstrated at the seven (7) tested surface loading rates specified in the protocol, ranging 40 L/min/m^2 to 1400 L/min/m^2, and as stated in the ISO 14034 ETV Verification Statement for the OGS device.

3.4.2 Sediment removal efficiency for surface loading rates between 40 L/min/m^2 and 1400 L/min/m^2 shall be based on linear interpolation of data between consecutive tested surface loading rates.

3.4.3 Sediment removal efficiency for surface loading rates less than the lowest tested surface loading rate of 40 L/min/m^2 shall be assumed to be identical to the sediment removal efficiency at 40 L/min/m^2. No extrapolation shall be allowed that results in a sediment removal efficiency that is greater than that demonstrated at 40 L/min/m^2.

3.4.4 Sediment removal efficiency for surface loading rates greater than the highest tested surface loading rate of 1400 L/min/m^2 shall assume zero sediment removal for the portion of flow that exceeds 1400 L/min/m^2, and shall be calculated using a simple proportioning formula, with 1400 L/min/m^2 in the numerator and the higher surface loading rate in the denominator, and multiplying the resulting fraction times the sediment removal efficiency at 1400 L/min/m^2.

The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 3.3.

3.4.5 The Peclet Number is not an approved method or model for calculating TSS removal, sizing, or scaling OGS devices.

3.4.6 If an alternate OGS device is proposed, supporting documentation shall be submitted that demonstrates:

- Canadian ETV or ISO 14034 ETV Verification Statement which verifies third-party performance testing conducted in accordance with the **Procedure for Laboratory Testing of Oil-Grit Separators,** including the Light Liquid Re-entrainment Simulation Testing.
- Equal or better sediment (TSS) removal of the PSD specified in Table 2 at equivalent surface loading rates, as compared to the OGS device specified herein.
- Equal or better Light Liquid Re-entrainment Simulation Test results (using low-density polyethylene beads as a surrogate for light liquids such as oil and fuel) at equivalent surface loading rates, as compared to the OGS device specified herein. However, an alternative OGS device shall not be allowed as a substitute if the Light Liquid Re-entrainment Simulation Test was performed with screening components within the OGS device that are effective at retaining the low-density polyethylene beads, but would not be expected to retain light liquids such as oil and fuel.
- Equal or greater sediment storage capacity, as compared to the OGS device specified herein.
- Supporting documentation shall be signed and sealed by a local registered Professional Engineer. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.5 PARTICLE SIZE DISTRIBUTION (PSD) FOR SIZING

The OGS device shall be sized to achieve the Engineer-specified average annual percent sediment (TSS) removal based solely on the test sediment used in the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** This test sediment is comprised of inorganic ground silica with a specific gravity of 2.65, uniformly mixed, and containing a broad range of particle sizes as specified in Table 2. No alternative PSDs or deviations from Table 2 shall be accepted.

Table 2
Canadian ETV Program Procedure for Laboratory Testing of Oil-Grit Separators
Particle Size Distribution (PSD) of Test Sediment

Particle Diameter (Microns)	**% by Mass of All Particles**	**Specific Gravity**
1000	5%	2.65
500	5%	2.65
250	15%	2.65
150	15%	2.65
100	10%	2.65
75	5%	2.65
50	10%	2.65
20	15%	2.65
8	10%	2.65
5	5%	2.65
2	5%	2.65

3.6 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party scour testing conducted and have in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. This scour testing is conducted with the device pre-loaded with test sediment comprised of the particle size distribution (PSD) illustrated in Table 2.

> 3.6.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

Data generated from laboratory scour testing performed with an OGS device pre-loaded with a coarser PSD than in Table 2 (i.e. the coarser PSD has no particles in the 1-micron to 50-micron size range, or the D_{50} of the test sediment exceeds 75 microns) shall not be acceptable for the determination of the device's suitability for on-line installation.

3.7 DESIGN ACCOUNTING FOR BYPASS

> 3.7.1 The OGS device shall be specified to achieve the TSS removal performance and water quality objectives without washout of previously captured pollutants. The OGS device shall also have sufficient hydraulic conveyance capacity to convey the peak storm event, in accordance with hydraulic conditions per the Engineer of Record. To ensure this is achieved, there are two design options with associated requirements:
>
> > 3.7.1.1 The OGS device shall be placed **off-line** with an upstream diversion structure (typically in an upstream manhole) that only allows the water quality volume to be diverted to the OGS device, and excessive flows diverted downstream around the OGS device to prevent high flow washout of pollutants previously captured. This design typically incorporates a triangular layout including an upstream bypass manhole with an appropriately engineered weir wall, the OGS device, and a downstream junction manhole, which is connected to both the OGS device and bypass structure. In this case with an external bypass required, the OGS device manufacturer must provide calculations and designs for all structures, piping and any other required material applicable to the proper functioning of the system, stamped by a Professional Engineer.
> >
> > 3.7.1.2 Alternatively, OGS devices in compliance with Section 3.6 shall be acceptable for an **on-line** design configuration, thereby eliminating the requirement for an upstream bypass manhole and downstream junction manhole.
>
> 3.7.2 The OGS device shall also have sufficient hydraulic conveyance capacity to convey the peak storm event, in accordance with hydraulic conditions per the Engineer of Record. If an alternate OGS device is proposed, supporting documentation shall be submitted that demonstrates equal or better hydraulic conveyance capacity as compared to the OGS device specified herein. This documentation shall be signed and sealed by a local registered Professional Engineer. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.8 LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**, with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.8.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

3.9 PETROLEUM HYDROCARBONS AND FLOATABLES STORAGE CAPACITY

Petroleum hydrocarbons and floatables storage capacity in the OGS device shall be a minimum 50 gallons (189 Liters), or more as specified.

3.9.1 The OGS device shall have gasketed precast concrete joints that are watertight, and oil resistant and meet the design criteria according to ASTM C-443 to provide safe oil and other hydrocarbon materials storage and ground water protection. Mastic sealants or butyl tape/rope alone are not an acceptable alternative.

3.10 SURFACE LOADING RATE SCALING OF DIFFERENT MODEL SIZES

The reference device for scaling shall be an OGS device that has been third-party tested in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. Other model sizes of the tested device shall only be scaled such that the claimed TSS removal efficiency of the scaled device shall be no greater than the TSS removal efficiency of the tested device at identical **surface loading rates** (flow rate divided by settling surface area). The depth of other model sizes of the tested device shall be scaled in accordance with the depth scaling provisions within Section 6.0 of the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.10.1 The Peclet Number and volumetric scaling are not approved methods for scaling OGS devices.

PART 4 – INSPECTION & MAINTENANCE

The OGS manufacturer shall provide an Owner's Manual upon request.
Maintenance shall be performed by a professional service provider who has experience in cleaning OGS devices and has been trained and certified in applicable health and safety practices, including confined space entry procedures.

4.1 A Quality Assurance Plan that provides inspection for a minimum of 5 years shall be included with the OGS stormwater quality device, and written into the Environmental Compliance Approval (ECA) or the appropriate State/Provincial or local approval document.

4.2 OGS device inspection shall include determination of sediment depth and presence of petroleum hydrocarbons below the insert. Inspection shall be easily conducted from finished grade through a frame and cover of at least 22 inch (560 mm) in diameter.

4.3 Inspection and pollutant removal shall be conducted periodically. For routine maintenance cleaning activities, pollutant removal shall typically utilize a truck equipped with vacuum apparatus, and shall be easily conducted from finished grade through a frame and cover of at least 22-inches (560 mm) in diameter.

4.4 Diameter of the maintenance access opening to the lower chamber and sump shall be scaled consistently across all model sizes, and shall be 1/3 the inside diameter of the OGS structure, or larger.

4.5 No confined space entry shall be required for routine inspection and maintenance cleaning activities.

4.6 For OGS model sizes of diameter 72 inches (1828 mm) and greater, the access opening to the OGS device's lower chamber and sump shall be large enough to allow a maintenance worker to enter the lower chamber to facilitate non-routine maintenance cleaning activities and repairs, as needed.

4.7 The orifice-containing component (i.e. drop pipe, duct, chute, etc.) of the OGS device used to control flow rate into the lower chamber shall be removable from the insert to facilitate cleaning, repair, or replacement of the orifice-containing component, as needed.

PART 5 – EXECUTION

5.1 PRECAST CONCRETE INSTALLATION

The installation of the precast concrete OGS stormwater quality treatment device shall conform to ASTM C 891, ASTM C 478, ASTM C 443, CAN/CSA-A257.4-14, CAN/CSA-A257.4-14, CAN/CSA-S6-00 and all highway, State/Provincial, or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized below. The Contractor shall furnish all labor, equipment and materials necessary to offload, assemble as needed the OGS internal components as specified in the Shop Drawings.

5.2 EXCAVATION

5.2.1 Excavation for the installation of the OGS stormwater quality treatment device shall conform to highway, State/Provincial or local specifications. Topsoil that is removed during the excavation for the OGS stormwater quality treatment device shall be stockpiled in designated areas and not be mixed with subsoil or other materials. Topsoil stockpiles and the general site preparation for the installation of the OGS stormwater quality device shall conform to highway, State/Provincial or local specifications.

5.2.2 The OGS device shall not be installed on frozen ground. Excavation shall extend a minimum of 12 inch (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

5.2.3 In areas with a high water table, continuous dewatering shall be provided to ensure that the excavation is stable and free of water.

5.3 BACKFILLING

Backfill material shall conform to highway, State/Provincial or local specifications. Backfill material shall be placed in uniform layers not exceeding 12 inches (300 mm) in depth and compacted to highway, State/Provincial or local specifications.

5.4 OGS WATER QUALITY DEVICE CONSTRUCTION SEQUENCE

5.4.1 The precast concrete OGS stormwater quality treatment device is installed and leveled in sections in the following sequence:

- aggregate base
- base slab, or base
- riser section(s) (if required)
- riser section w/ pre-installed fiberglass insert
- upper riser section(s)
- internal OGS device components
- connect inlet and outlet pipes
- riser section, top slab and/or transition (if required)
- frame and access cover

5.4.2 The precast concrete base shall be placed level at the specified grade. The entire base shall be in contact with the underlying compacted granular material. Subsequent sections, complete with oil resistant, watertight joint seals, shall be installed in accordance with the precast concrete manufacturer's recommendations.

5.4.3 Adjustment of the OGS stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets shall be repaired or replaced as necessary. Once the OGS stormwater quality treatment device has been constructed, any lift holes must be plugged with mortar.

5.5 DROP PIPE AND OIL INSPECTION PIPE

Once the upper precast concrete riser has been attached to the lower precast concrete riser section, the OGS device Drop Pipe and Oil Inspection Pipe must be attached, and watertight sealed to the fiberglass insert using Sikaflex 1a. Installation instructions and required materials shall be provided by the OGS manufacturer.

5.6 INLET AND OUTLET PIPES

Inlet and outlet pipes shall be securely set using grout or approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight. Non-secure inlets and outlets will result in improper performance.

5.7 FRAME AND COVER OR FRAME AND GRATE INSTALLATION

Precast concrete adjustment units shall be installed to set the frame and cover/grate at the required elevation. The adjustment units shall be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover/grate should be set in a full bed of mortar at the elevation specified.

5.7.1 A minimum of one cover, at least 22-inch (560 mm) in diameter, shall be clearly embossed with the OGS device brand or product name to properly identify this asset's purpose is for stormwater quality treatment.

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Stormceptor® EF and EFO Oil-Grit Separators

Developed by Imbrium Systems, Inc.,
Whitby, Ontario, Canada

Registration: GPS-ETV_VR2023-11-15_Imbrium-SC

In accordance with

ISO 14034:2016

**Environmental management —
Environmental technology verification (ETV)**

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

November 15, 2023
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
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Technology description and application

The Stormceptor® EF and EFO are treatment devices designed to remove oil, sediment, trash, debris, and pollutants attached to particulates from Stormwater and snowmelt runoff. The device takes the place of a conventional manhole within a storm drain system and offers design flexibility that works with various site constraints. The EFO is designed with a shorter bypass weir height, which accepts lower surface loading rate into the sump, thereby reducing re-entrainment of captured free floating light liquids.

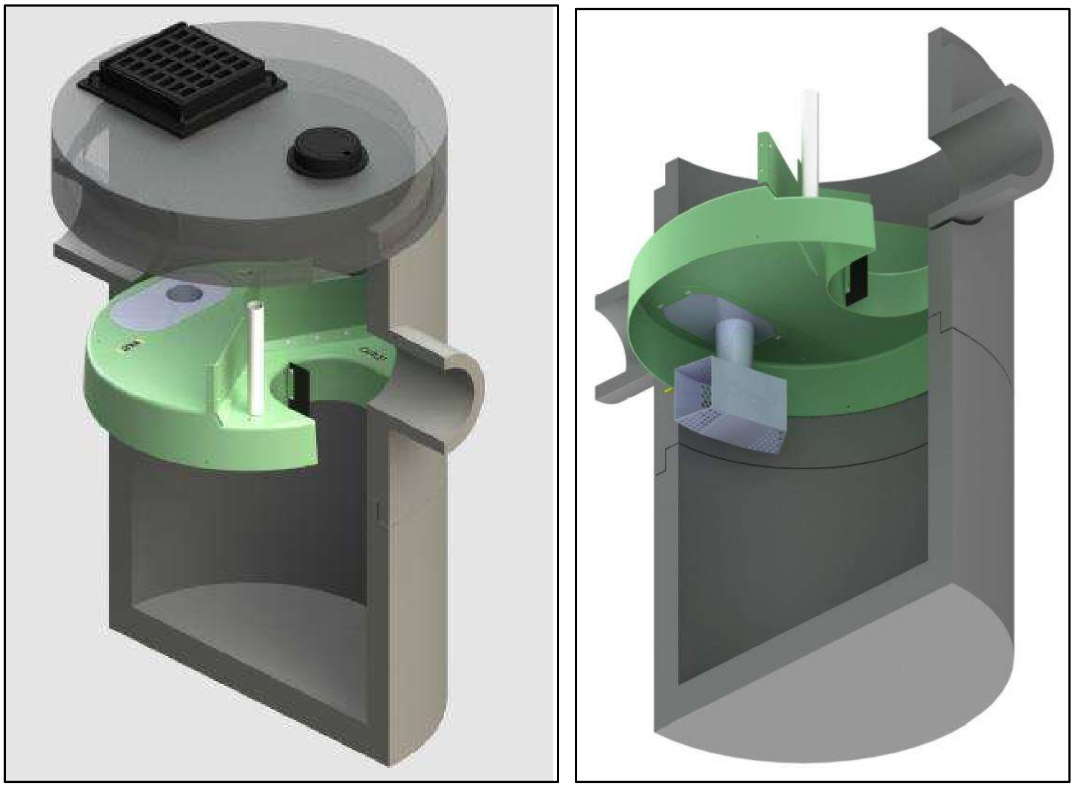

Figure 1. Graphic of typical inline Stormceptor® unit and core components.

Stormwater and snowmelt runoff enters the Stormceptor® EF/EFO's upper chamber through the inlet pipe(s) or a surface inlet grate. An insert divides the unit into lower and upper chambers and incorporates a weir to reduce influent velocity and separate influent (untreated) from effluent (treated) flows. Influent water ponds upstream of the insert's weir providing driving head for the water flowing downwards into the drop pipe where a vortex pulls the water into the lower chamber. The water diffuses at lower velocities in multiple directions through the drop pipe outlet openings. Oil and other floatables rise up and are trapped beneath the insert, while sediments undergo gravitational settling to the sump's bottom. Water from the sump can exit by flowing upward to the outlet riser onto the top side of the insert and downstream of the weir, where it discharges through the outlet pipe.

Maximum flow rate into the lower chamber is a function of weir height and drop pipe orifice diameter. The Stormceptor® EF and EFO are designed to allow a surface loading rate of 1135 L/min/m^2 (27.9 gal/min/ft^2) and 535 L/min/m^2 (13.1 gal/min/ft^2) into the lower chamber, respectively. When prescribed surface loading rates are exceeded, ponding water can overtop the weir height and bypass the lower treatment chamber, exiting directly through the outlet pipe. Hydraulic testing and scour testing demonstrate that the internal bypass effectively prevents scour at all bypass flow rates. Increasing the bypass flow rate does not increase the orifice-controlled flow rate into the lower treatment chamber where sediment is stored. This internal bypass feature allows for in-line installation, avoiding the cost of additional bypass structures. During bypass, treatment continues in the lower chamber at the maximum flow rate. The Stormceptor® EFO's lower design surface loading rate is favorable for minimizing re-entrainment and washout of captured light liquids. Inspection of Stormceptor® EF and EFO devices is performed from grade by inserting a sediment probe through the outlet riser and an oil dipstick through the oil inspection pipe. The unit can be maintained by using a vacuum hose through the outlet riser.

Performance conditions

The data and results published in this Technology Fact Sheet were obtained from the testing program conducted on the Imbrium Systems Inc.'s Stormceptor® EF4 and EFO4 Oil-Grit Separators, in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014). The Procedure was prepared by the Toronto and Region Conservation Authority (TRCA) for Environment Canada's Environmental Technology Verification (ETV) Program. A copy of the Procedure may be accessed on the Canadian ETV website at www.etvcanada.ca.

Performance claim(s)

Capture test [a]:

During the capture test, the Stormceptor® EF4 OGS device, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 46, 44, and 49 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Stormceptor® EFO4, with a false floor set to 50% of the manufacturer's recommended maximum sediment storage depth and a constant influent test sediment concentration of 200 mg/L, removes 70, 64, 54, 48, 42, 40, and 34 percent of influent sediment by mass at surface loading rates of 40, 80, 200, 400, 600, 1000, and 1400 L/min/m^2, respectively.

Scour test [a]:

During the scour test, the Stormceptor® EF4 and Stormceptor® EFO4 OGS devices, 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, generate corrected effluent concentrations of 4.6, 0.7, 0, 0.2, and 0.4 mg/L at 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2, respectively.

Light liquid re-entrainment test[a]:

During the light liquid re-entrainment test, the Stormceptor® EFO4 OGS device with surrogate low-density polyethylene beads preloaded within the lower chamber oil collection zone, representing a floating light liquid volume equal to a depth of 50.8 mm over the sedimentation area, retained 100, 99.5, 99.8, 99.8, and 99.9 percent of loaded beads by mass during the 5-minute duration surface loading rates of 200, 800, 1400, 2000, and 2600 L/min/m^2.

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[a] The claim 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)

Performance results

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%. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 2 indicates that the test sediment used for the capture and scour tests met this condition.

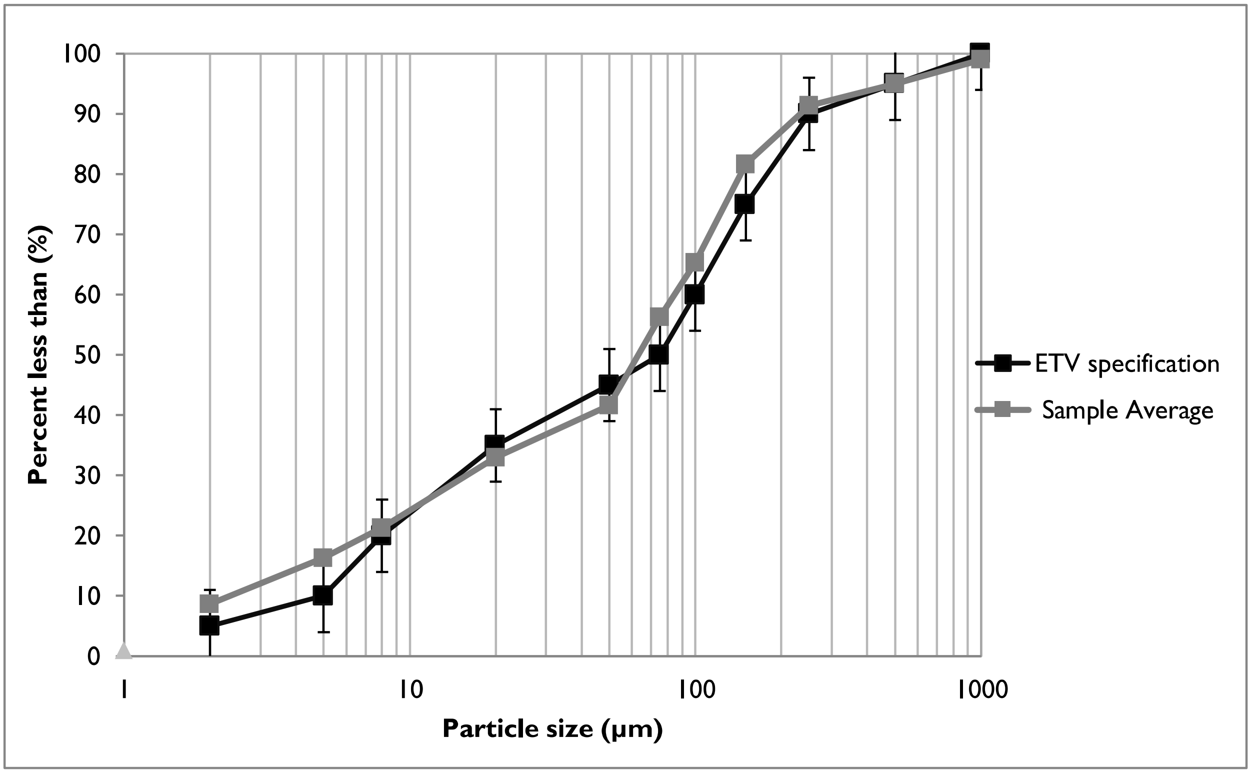

Figure 2. The three sample average particle size distribution (PSD) of the test sediment used for the capture and scour test compared to the specified PSD.

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). Since the EF and EFO models are identical except for the weir height, which bypasses flows from the EFO model at a surface loading rate of 535 L/min/m^2 (13.1 gpm/ft^2), sediment capture tests at surface loading rates from 40 to 400 L/min/m^2 were only performed on the EF unit. Surface loading rates of 600, 1000, and 1400 L/min/m^2 were tested on both units separately. Results for the EFO model at these higher flow rates are presented in Table 2.

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 may be 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 and 2) 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 EF4 at specified surface loading rates

Particle size fraction (µm)	**Surface loading rate (L/min/m^2)**						
	40	80	200	400	600	1000	1400
>500	90	58	58	100*	86	72	100*
250 - 500	100*	100*	100	100*	100*	100*	100*
150 - 250	90	82	26	100*	100*	67	90
105 - 150	100*	100*	100*	100*	100*	100*	100
75 - 105	100*	92	74	82	77	68	76
53 - 75	Undefined [a]	56	100*	72	69	50	80
20 - 53	54	100*	54	33	36	40	31
8 - 20	67	52	25	21	17	20	20
5 – 8	33	29	11	12	9	7	19
<5	13	0	0	0	0	0	4
All particle sizes by mass balance	**70.4**	**63.8**	**53.9**	**47.5**	**46.0**	**43.7**	**49.0**

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[a] An outlier in the feed sample sieve data resulted in a negative removal efficiency for this size fraction.
* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 101 and 171% (average 128%). See text and Bulletin # CETV 2016-11-0001 for more information.

Table 2. Removal efficiencies (%) of the EFO4 at surface loading rates above the bypass rate of 535 L/min/m^2

Particle size fraction (µm)	**Surface loading rate (L/min/m^2)**		
	600	1000	1400
>500	89	83	100*
250 - 500	90	100*	92
150 - 250	90	67	100*
105 - 150	85	92	77
75 - 105	80	71	65
53 - 75	60	31	36
20 - 53	33	43	23
8 - 20	17	23	15
5 – 8	10	3	3
<5	0	0	0
All particle sizes by mass balance	**41.7**	**39.7**	**34.2**

* Removal efficiencies were calculated to be above 100%. Calculated values ranged between 103 and 111% (average 107%). See text and Bulletin # CETV 2016-11-0001 for more information.

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 EF4 at each of the tested surface loading rates. Figure 4 shows the same graph for the EFO4 unit at surface loading rates above the bypass rate of 535 L/min/m^2.

As expected, the capture efficiency for fine particles in both units was generally found to decrease as surface loading rates increased.

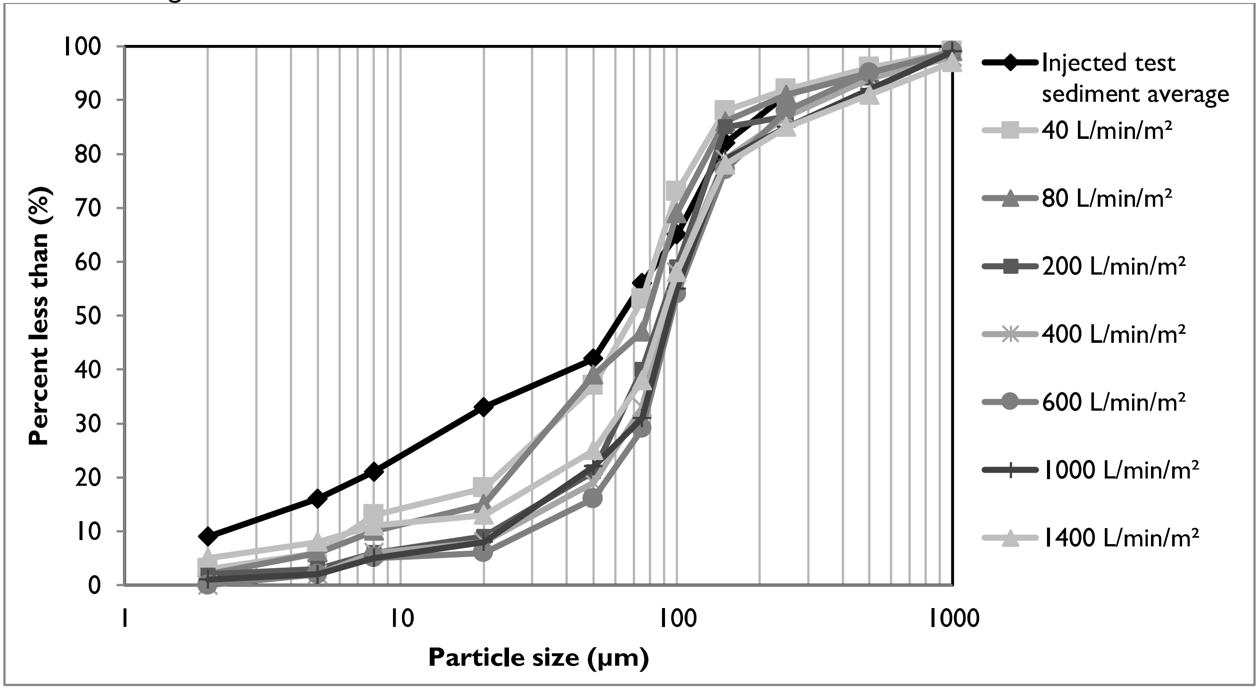

Figure 3. Particle size distribution of sediment retained in the EF4 in relation to the injected test sediment average.

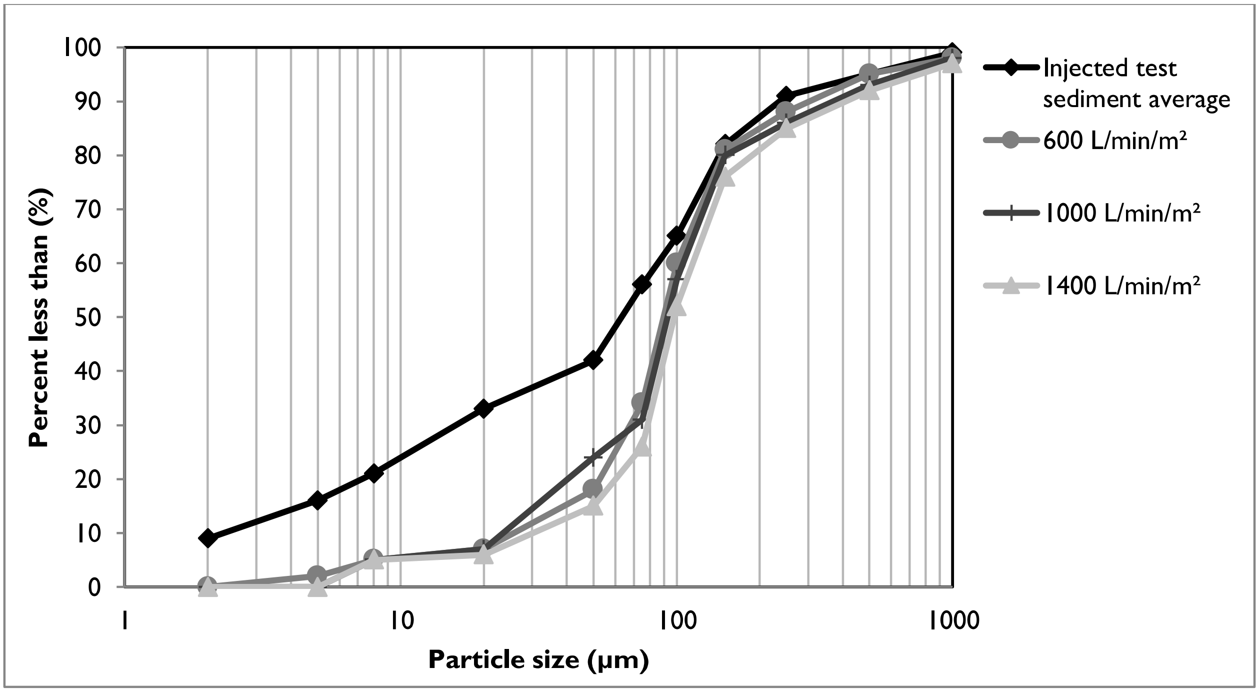

Figure 4. Particle size distribution of sediment retained in the EFO4 in relation to the injected test sediment average at surface loading rates above the bypass rate of 535 L/min/m²

Table 4 shows the results of the sediment scour and re-suspension test for the EF4 unit. The EFO4 was not tested as it was reasonably assumed that scour rates would be lower given that flow bypass occurs at a lower surface loading rate. The scour test involved preloading 10.2 cm 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. Typically, the smallest 5% of particles captured during the 40 L/min/m^2 sediment capture test is also used to adjust the concentration, as per the method described in Bulletin # CETV 2016-09-0001. However, since the composites of effluent concentrations were below the Reporting Detection Limit of the Laser Diffraction PSD methodology, this adjustment was not made. Results showed average adjusted effluent sediment concentrations below 5 mg/L at all tested surface loading rates.

It should be noted that the EF4 starts to internally bypass water at 1135 L/min/m^2, potentially resulting in the dilution of effluent concentrations, which would not normally occur under typical field conditions because the field influent concentration would contain a much higher sediment concentration than during the lab test. Recalculation of effluent concentrations to account for dilution at surface loading rates above the bypass rate showed sediment effluent concentrations to be below 1.6 mg/L.

Table 4. Scour test adjusted effluent sediment concentration.

Run	Surface loading rate (L/min/m^2)	Run time (min)	Background sample concentration (mg/L)	Adjusted effluent suspended sediment concentration (mg/L) [a]	Average (mg/L)
1	200	1:00	<RDL	11.9	4.6
		2:00		7.0	
		3:00		4.4	
		4:00		2.2	
		5:00		1.0	
		6:00		1.2	
2	800	7:00	<RDL	1.1	0.7
		8:00		0.9	
		9:00		0.6	
		10:00		1.4	
		11:00		0.1	
		12:00		0	
3	1400	13:00	<RDL	0	0
		14:00		0.1	
		15:00		0	
		16:00		0	
		17:00		0	
		18:00		0	
4	2000	19:00	1.2	0.2	0.2
		20:00		0	
		21:00		0	
		22:00		0.7	
		23:00		0	
		24:00		0.4	

5	2600	25:00	1.6	0.3	0.4
		26:00		0.4	
		27:00		0.7	
		28:00		0.4	
		29:00		0.2	
		30:00		0.4	

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[a] The adjusted effluent suspended sediment concentration represents the actual measured effluent concentration minus the background concentration. For more information see Bulletin # CETV 2016-09-0001.

The results of the light liquid re-entrainment test used to evaluate the unit's capacity to prevent re-entrainment of light liquids are reported in Table 5. The test involved preloading 58.3 L (corresponding to a 5 cm depth over the collection sump area of 1.17m^2) of surrogate low-density polyethylene beads within the oil collection skirt and running clean water through the device continuously at five surface loading rates (200, 800, 1400, 2000, and 2600 L/min/m^2). Each flow rate was maintained for 5 minutes with approximately 1 minute transition time between flow rates. The effluent flow was screened to capture all re-entrained pellets throughout the test.

Table 5. Light liquid re-entrainment test results for the EFO4.

Surface Loading Rate (L/min/m2)	Time Stamp	Amount of Beads Re-entrained			
		Mass (g)	Volume (L)[a]	% of Pre-loaded Mass Re-entrained	% of Pre-loaded Mass Retained
200	62	0	0	0.00	100
800	247	168.45	0.3	0.52	99.48
1400	432	51.88	0.09	0.16	99.83
2000	617	55.54	0.1	0.17	99.84
2600	802	19.73	0.035	0.06	99.94
Total Re-entrained		295.60	0.525	0.91	--
Total Retained		32403	57.78	--	99.09
Total Loaded		32699	58.3	--	--

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[a] Determined from bead bulk density of 0.56074 g/cm^3

Variances from testing Procedure

The following minor deviations from the *Procedure for Laboratory Testing of Oil-Grit Separators* (Version 3.0, June 2014) have been noted:

1. During the capture test, the 40 L/min/m^2 and 80 L/min/m^2 surface loading rates were evaluated over 3 and 2 days respectively due to the long duration needed to feed the required minimum of 11.3 kg of test sediment into the unit at these lower flow rates. Pumps were shut down at the end of each intermediate day, and turned on again the following morning. The target flow rate was re-established within 30 seconds of switching on the pump. This procedure may have allowed sediments to be captured that otherwise may have exited the unit if the test was continuous. On the basis of practical considerations, this variance was approved by the verifier prior to testing.

2. During the scour test, the coefficient of variation (COV) for the lowest flow rate tested (200 L/min/m²) was 0.07, which exceeded the specified limit of 0.04 target specified in the OGS Procedure. A pump capable of attaining the highest flow rate of 3036 L/min had difficulty maintaining the lowest flow of 234 L/min but still remained within +/- 10% of the target flow and is viewed as having very little impact on the observed results. Similarly, for the light liquid re-entrainment test the COV for the flow rate of the 200 L/min/m² run was 0.049, exceeding the limit of 0.04, but is believed to introduce negligible bias.

3. Due to pressure build up in the filters, the runs at 1000 L/min/m² for the Stormceptor® EF4 and 1000 and 1400 L/min/m² for the Stormceptor® EFO4 were slightly shorter than the target. The run times were 54, 59 and 43 minutes respectively, versus targets of 60 and 50 minutes. The final feed samples were timed to coincide with the end of the run. Since >25 lbs of sediment was fed, the shortened time did not invalidate the runs.

Verification

The verification was completed by the Verification Expert, Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***. Data and information provided by Imbrium Systems Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories, and dated September 8, 2017; the report is based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

What is ISO14034:2016 Environmental management – Environmental technology verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

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Limitation of verification - Registration: GPS-ETV_VR2023-11-15_Imbrium-SC
GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

Appendix E

Hydrogeological Report

Project No.: 22088

February 2024

Small Scale Hydrogeological Assessment
Proposed Residential Development
45 Bishop Street,
Lakefield Ontario

Report #6638 – Raed Lakefield
August 14, 2023

Prepared for:
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EXECUTIVE SUMMARY

A & A Environmental Consultants Inc. (A&A) was retained by Alaa Yousif Personal Real Estate Corporation (the client), to evaluate the potential impact from the proposed residential development on local groundwater/surface water resources by conducting a small-scale hydrogeological study. The site lies in the southeast area of Lakefield, Ontario at ’45 Bishop Street. The site is bound by residential to the east and west, by Bishop Street, followed by residential to the north and to the south of the site is vacant property. The area of the site is approximately 10,197 m^2 (2.519 acres). At the time of the investigation, the site was vacant.

The topography in the vicinity of the subject site (a 100-meter radius) was observed to be mostly flat with the slight slope to the south for most of the subject site. The slope increases significantly near the south end of the site to the south boundary. The subject site elevation varies, but is recorded as being approximately 247 masl to 243 masl, with the surrounding subject study area sloping from approximately 252 masl to the east to 238 masl to the southwest. Surface water drainage on the site is expected to infiltrate the permeable ground surface and/or flow towards the south boundary of the site. Groundwater flow direction may also be influenced by utility trenches or other subsurface structures and may preferentially migrate in these subsurface utility trenches.

Geological maps identified the site to be Till characterized by predominantly sandy silt to silt matrix, commonly poor in clasts, often high in total matrix carbonate content. The physiographic landform of the site is identified as till plains (drumlinized). The surficial geology identified the site is identified as sandy silt to silt-textured deposits. Bedrock in the area of the site is part of the Verulam formation, characterized limestone and shale. These rocks were formed from weathering of the Precambrian surface (shales) and from the calcareous marine creature skeletons.

A search of the Ministry of Environment, Conservation, and Parks (MECP) well records show a total of sixteen wells located within 500 meters of the subject site, consisting of one well with no use listed, ten domestic wells, three monitoring test-holes, one not used, and one public well.

It is clear from the MECP water well database and the information obtained during the field survey that the local residents obtain their water from a regional water supply system. The subject site is also expected to utilize the Lakefield water system when redeveloped. The MECP well records show groundwater was found between approximately 1.52 – 6.40 mbgs, for a well drilled in the unconfined aquifer to a depth of approximately 3.05 – 9.14 mbgs. The MECP well records show groundwater was found between 13.11 – 27.73 mbgs, for wells drilled in the bedrock to approximate depths of 13.11 – 33.53 mbgs. It should be noted that the water levels provided in these tables do not represent current water level depths because those wells more likely measured at the time of drilling. However, the drilling program completed at this site show the groundwater was found between 243.479 – 242.170 masl

The water table in the study area was defined by installing a total of three monitoring wells in the area of the proposed development. The selection of the monitoring wells was based on the predicted water flow direction, taking into consideration the site location and accessibility for the drill crew. During the drilling program, fourteen different boreholes were attempted in order to reach the aquifer. This was due to the large boulders on site and the nature of the gravelly clayey sand. The monitoring wells installed by A&A were drilled to a maximum depth of 6.0 mbgs. There were four groundwater monitoring events that took place between May 2023 and July 2023. It was concluded that groundwater was present on site at elevations between 243.479 – 242.170 masl.

A groundwater contour map was plotted using “Golden Software” (Surfer 8) and the measurements of groundwater levels taken on May 26, 2023 from three monitoring wells. This map shows well MW-2 and MW-3 being at the lowest water elevation compared with the other wells used. The general direction of groundwater flow was found to be in south direction.

The total precipitation (rainfall plus snowfall) in 2022 was 800 mm, with the greatest amounts falling in June and August. June and August show the highest mean daily temperatures during the year and the lowest temperatures were recorded in January. The average annual precipitation from 1992 – 2022 was calculated using historical data collected at the meteorological station "Peterborough Trent U" located in Peterborough, Ontario. The average annual precipitation over the thirty-year period was 882 mm. For the same period, it was calculated that approximately 564 mm/year would be lost to evapotranspiration (Environment Canada, 2023); leaving a total of approximately 317 mm/year available for groundwater recharge and surface runoff.

Based on the water balance assessment, moderate changes are anticipated in the infiltration and runoff due to the proposed development at the subject site. There will be an increase in surface runoff due to the development on-site, and a stormwater management plan will be needed to manage the stormwater runoff on site.

The analysis results indicate that all health and non-health related parameters were below the standards as outlined in the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

RECOMMENDATION

Based on the obtained information from this study, A&A has the following recommendations:

1. Due to the increased runoff rate on site post development, a stormwater management plan is recommended. Proper planning as well as implementing LIDs will mitigate the stormwater that accumulates.

2. Due to the water levels being below the foundation bottom, the excavation area will NOT need to undergo in-construction and post-construction dewatering.

3. No adverse impact on the groundwater resources is expected to occur during the development of the subject site with the implementations of these recommended actions.

1.0 INTRODUCTION

A & A Environmental Consultants Inc. (A&A) was retained by Alaa Yousif Personal Real Estate Corporation (the client), to evaluate the potential impact from the proposed residential development on local groundwater/surface water resources by conducting a small-scale hydrogeological study. The subject site is located at 45 Bishop Street, Lakefield, Ontario (Figure 1). The area of the site is approximately 10,197 m^2 (2.519 acres). At the time of the investigation, the site was vacant.

This study describes a small-scale hydrogeological study to obtain a better understanding of the groundwater resources within the study area and includes the characterization of the site using all available geological and hydrogeological information; a discussion of the groundwater quality and a report for the site with conclusions and recommendations.

There is no relationship between the client and A&A other than third-party independent assessor.

1.1 Scope of Work

The scope of work included the following where applicable:

- Perform visual/olfactory examination of the site and a walk-through inspection of the property to look for signs of any environmental issues.
- Characterize the site's geological, topography, meteorology, hydrogeology, and groundwater conditions.
- Determination of current activities at the site.
- Obtain utility line locates for all public and private utility lines.
- Drill three boreholes to a maximum depth of 6.175 m in selected locations. The boreholes will be drilled with a hydraulic soil drill fitted with 4-inch augers. Six borehole was used solely for the geotechnical investigation completed by A&A on the site.
- Install three groundwater monitoring well. The well will be constructed of 51 mm (2") PVC risers with 3.05m long Schedule 40 PVC slotted well screen. Slip end cap will be installed at the end of the riser pipe with threaded drive-points at the bottom of the well. The

borehole annulus will be backfilled with silica sand to approximately 0.3 m above the well screen. A bentonite seal will be placed on the sand pack with a second seal at about 0.3 mbgs. The well will be fitted with a dedicated peristaltic low-flow sample tubing. The well will be installed by a licensed well technician, tagged in accordance with Regulation 903 and recorded on the Ministry of the Environment, Conservation and Park's (MECP) water well information system (WWIS).

- A level survey will be conducted at the site, which consists of measuring the elevation of the top of the well, relative to an arbitrary benchmark. This level survey will be conducted to provide the information used to calculate the groundwater table elevation.
- The groundwater will be sampled and analyzed for selected parameters of concerns.
- Groundwater samples will be evaluated using information obtained from the newly installed monitoring wells following MECP sampling protocol and procedures.
- Evaluate the potential impact of the proposed development on the ground water and surface water resources and their users.
- Provision of a reasonable conclusion regarding the environmental condition of the site.
- Development of recommendations for follow-up investigations if needed.

1.2 Changes to Scope of Work

During the drilling program, fourteen different boreholes were attempted in order to reach the aquifer. This was due to the large boulders on site and the nature of the gravelly clayey sand.

2.0 DESCRIPTION OF THE SUBJECT SITE

The subject site is an irregular shaped lot with an area of 10,197 m^2. The site lies in the southeastern area of Lakefield, Ontario at 45 Bishop Street. The site is bound by residential to the east and west, by Bishop Street, followed by residential to the north and to the south of the site is vacant property. The subject study area is located within the Otonabee watershed which contains the Otonabee River.

The approximate UTM coordinates are Zone 17T; 717934 m Easting; 4922300 m Northing. The site is zoned as being " R1 – Residential" as quoted from The Corporation of the Township of Selwyn Zoning By-Law 2009-021, as amended, and is located east of the intersection of Bishop Street and Concession Steet. The site is currently vacant.

3.0 DEVELOPMENT PLAN

It is understood that the proposed residential development will consist of the following:

- A cul-de-sac residential subdivision that consists of 16 dwellings.
- Block 1 and block 3 will consist of 4 townhouse units per block.
- Block 2 will consist of eight semi-detached homes.
- There will be one access to the cul-de-sac off of Bishop Street.
- The general arrangement of the proposed development is illustrated in Figure 6, (Appendix A).

The total site area is 10,197 m^2 with a total of 4163 m^2 being developed as impermeable surfaces.

4.0 PHYSICAL SETTING

4.1 Topography

The regional topography, which is an area within a 5 km radius from the site, has a slope towards the Otonabee River. The site sits approximately 500 meters to the east of the Otonabee River. Lands to the east of the river slope to the west. Lands to the west of the river slope to the east. The site sits in the Otonabee River Watershed that consists of the main channel, the Otonabee River, and then several small lakes. This river is apart of the Trent-Severn Waterway. The Otonabee River begins as a drain from several lakes such as: Katchewanooka Lake, Lovesick Lake, Clear Lake, and Stoney Lake. Water flows south from these lakes into the Otonabee River. Otonabee River drains into Rice Lake.

The topography in the vicinity of the subject site (a 100-meter radius) was observed to be mostly flat with the slight slope to the south for most of the subject site. The slope increases significantly near the south end of the site to the south boundary. The subject site elevation varies, but is recorded as being approximately 247 masl to 243 masl on the topographic map (Figure 3), with the surrounding subject study area sloping from approximately 252 masl to the east to 238 masl to the southwest. Surface water drainage on the site is expected to infiltrate the permeable ground surface and/or flow towards the south boundary of the site.

4.2 Geology

The surface deposit in this region, like all of Ontario, was once covered by massive glaciers during the late Wisconsin glacial period. The grinding action of the moving ice masses produced a considerable amount of rock materials, ranging in size from boulders to rock flour which was distributed over the landscape.

Quaternary Geology: The sedimentary record of southern Ontario provides evidence for three distinct climatic stages during the Quaternary period: the Illinoisan glacial stage (130-180,000 years before present (y.b.p), Sangamonian interglacial stage (110-130,000 y.b.p.) and the Wisconsinan glacial stage (110-10,000 y.b.p; Johnson et al, 1997).

The Quaternary geology identified the site to be Till consisting of predominantly sandy silt to silt matrix, high in matrix carbonate content and clast poor during the Pleistocene epoch.

Paleozoic Geology: Bedrock in the area of the site is part of the Verulam formation, characterized as limestone and shale. These rocks were formed from weathering of the Precambrian surface (shales) and from the calcareous marine creature skeletons.

Physiography of Southern Ontario: The physiography of southern Ontario was altered considerably by the glacial and interglacial episodes that took place throughout the Quaternary period (2 million years to present). Southern Ontario's glacial history is very complex and has been interpreted and discussed by many (Barnett 1992; Karrow 1967; Chapman and Putnam 1984; Dreimanis and Goldthwait 1973; etc.). The site is identified on the Till Plains (drumlinized) landform within the Peterborough Drumline Field.

Surficial Geology: The site is identified as sandy silt to silt-textured till deposits derived from Paleozoic terrain.

4.2.1 Overburden Detailed Summary

The drilling program conducted for this study indicates the overburden deposits are generally consistent across the property. All boreholes revealed underlain the surface to be characterized as follows:

- **Topsoil**
    - Topsoil layer was encountered at the ground surface with approximate thickness of 150 mm. The data provided here pertaining to the topsoil thickness is confirmed at the borehole locations only and may vary between and beyond the boreholes.

- **Gravelly Clayey Sand (Native Soil):**
    - The surficial topsoil layer was underlain by the following layers of gravelly clayey sand. The native soil at borehole locations was encountered at depths ranging from 0.15 to 6.175 m below the original ground surface. Colours vary from brown to grey with depth.

5.0 HYDROGEOLOGICAL CONDITIONS

5.1 Hydrogeology

Groundwater and surface water are expected to flow towards the natural slope of the ground surface. Although the surface topography typically has great influence on the groundwater flow it has been observed in several areas that bedrock topography also has a significant influence on the flow, in some cases more so than surface topography. In the latter case, this is believed to be due to relatively impermeable bedrock underlying a much more permeable silt overburden. Based on the regional topography, groundwater flow is inferred to be in a south-southeast direction. The groundwater flow direction may also be influenced by utility trenches and other subsurface structures and may migrate in the bedding stone of the subsurface utility trenches.

During the hydrogeological investigation on the site, three groundwater monitoring wells were installed within the annulus of borehole BH-1, BH-2, and BH-3 (Figure 4). The wells were constructed of 51 mm (2") PVC risers with a 3.05m long Schedule 40 PVC slotted well screen. A ‘J-plug’ secure end cap was installed at the top of the riser pipe with a threaded drive-point at the bottom of the well screen. The borehole annulus was backfilled with silica sand to approximately 0.3m above the well screen. A bentonite seal was placed on the sand pack to about 0.3mbgs. Each well was fitted with a dedicated low-flow sampling tubing and a protective, a steel well protector was installed around the riser. The wells were installed by A&A Environmental Consultants Inc., licensed well technicians in accordance with Ontario Regulation 903.

These wells are used to determine the direction of groundwater flow and quality of the groundwater. A level survey was conducted at the site, which consisted of measuring the elevation of the top of the well casings, relative to a benchmark. This level survey was conducted to provide information used to calculate the groundwater table elevation, hydraulic gradient and flow direction. Groundwater levels were obtained on May 26, 2023, June 9, 2023, June 23, 2023, and July 7, 2023. They were recorded to the nearest 0.01 m accuracy, using an electronic water-table level tape. The total depth of each well was measured and recorded. The groundwater elevations are shown in the well logs (see Tables 1-2 below). These show the highest elevation near MW-1 near the north end of the site and the lowest at MW-2 and MW3 near the middle of the subject site.

During the drilling program, fourteen different boreholes were attempted in order to reach the aquifer. This was due to the large boulders on site and the nature of the gravelly clayey sand.

Table 1 – Monitoring Well Details May 26, 2023

Project #6638 - Raed Lakefield			
45 Bishop Street, Lakefield, Ontario			
Date Logged: May 26, 2023		Logged by: T. Thornton	
Monitoring Well #	**MW-1**	**MW-2**	**MW-3**
Location	North Area of Subject Site, Near Site Access	Northwest middle area of Subject Site	East Area near Middle of Subject Site
Pipe Size (mm)	51	51	51
UTM Zone	17T	17T	17T
Easting	717936	717919	717959
Northing	4922323	4922299	4922311
Top of Pipe (masl)	247.234	246.592	246.318
Water Level (m)	3.755	3.872	3.598
Water Level (masl)	243.479	242.72	242.72
Total Depth (m)	7.5	6.00	4.55
BM = 246.35 masl, Asphalt surface near Entrance of Subject Site			

Table 2 – Groundwater Monitoring Program Levels

Monitoring Well	Elevation (masl)	Groundwater Elevations (masl)			
		26-May-23	09-Jun-23	23-Jun-23	07-Jul-23
MW-1	247.234	243.479	243.167	242.952	243.103
MW-2	246.592	242.720	242.531	242.371	242.172
MW-3	246.318	242.720	242.529	242.370	242.170

MW-1 has a much higher ground level elevation than MW-2 and MW-3 and much higher groundwater elevation than MW-2 and MW3. The MW-2 and MW-3 have very close ground level elevation.

The seasonal change in groundwater hydraulic gradient due to rainfall and spring runoff have a significant influence on the groundwater flow velocities. The groundwater flow velocities were calculated using a hydraulic gradient of 0.0258 m/m (MW-1 to MW-3), using May 26, 2023 groundwater elevation and the hydraulic conductivity of 1 x 10^{-5} cm/s for clayey sand materials, with an estimated porosity of 35% (Fetter 2001). The average linear velocity can thus be calculated using the following equation:

$$v = \frac{ki}{n}$$

Where “k” is the hydraulic conductivity, “i” is the hydraulic gradi3ent, and “n “the porosity. By using the above information, the average linear velocities for the clayey sand materials are estimated to be 0.233 m/year.

A groundwater contour map, shown below in Figure 5, was plotted using Golden Surfer™ (Surfer 8) and the measurements of groundwater levels taken on May 26, 2023 from three monitoring wells installed in the unconfined aquifer. This map shows MW-2 and MW3 being at the lowest water elevation compared with the other wells used. The general direction of groundwater flow was found to be in a south direction.

5.2 Meteorological Conditions

Meteorological conditions, such as precipitation (rainfall and snowfall) and temperature are of particular interest for understanding the existing surface water regime; the amount of water available for groundwater recharge; and for developing a surface water management system at the subject site. Data for 2022 describing the climatic variables was obtained from the Environment Canada meteorological station “Peterborough Trent U”, located in Peterborough, Ontario (Table 3). However, climate varies across large area both spatially and temporally with local variation created by such factors as topography and prevailing winds. Human activities can also affect local climate. Deforestation may increase stream and peak flood flows while decreasing evapotranspiration. Urbanization can increase cloudiness, precipitation and extreme winter temperatures while decreasing relative humidity, incident radiation and wind speed (Phillips and McCulloch, 1972).

The total precipitation (rainfall plus snowfall) in 2022 was 800 mm, with the greatest amounts falling in June and August. July and August show the highest mean daily temperatures during the year and the lowest temperatures were recorded in January.

Table 3 – 2022 Meteorological Data (Peterborough, ON)

MONTH	TOTAL PRECIPITATION (mm)	MEAN TEMPERATURE (°C)
JANUARY	**55.7**	**-12.4**
FEBRUARY	**80.2**	**-7.9**
MARCH	**46.8**	**-1.3**
APRIL	**56.8**	**5.8**
MAY	**57.2**	**13.7**
JUNE	**99.2**	**17.2**
JULY	**55.7**	**20.1**
AUGUST	**103.6**	**20.3**
SEPTEMBER	**47.1**	**15.4**
OCTOBER	**45.6**	**8.2**
NOVEMBER	**57.1**	**3.1**
DECEMBER	**94.9**	**-2.4**
SUM	**800**	
AVERAGE		**6.7**

*Denotes incomplete data

Climate is usually defined as normals (or averages) of weather variable over a 30-year period as defined by the World Meteorological Organization (WMO). These "climate normals" refer to arithmetic calculations based on observed climate values for a given location over a specified time period. Climate normals are often used to classify a region's climate and for research in many environmental fields. There are many ways to calculate "climate normals" and the most useful ones adhere to accepted standards. The WMO considers thirty years long enough to eliminate year-to-year variations. Thus, the WMO climatological standard period for normal's calculations are computed over a 30-year period of consecutive records, starting January 1st and ending December 31st. In addition, the WMO established that normal's should be arithmetic means calculated for each month of the year form daily data with a limited number of allowable missing values.

The average annual precipitation from 1992-2022 was calculated using historical data collected at the “Peterborough Trent U” meteorological station, located in Peterborough, Ontario. The average annual precipitation was used to estimate the total amount of water available for surface water and groundwater resources. The average annual precipitation over the thirty-year period was 882 mm. For the same period, it was calculated that approximately 564 mm/year would be lost to evapotranspiration leaving a total of approximately 318 mm/year available for groundwater recharge and surface runoff (Environment Canada, 2023).

The natural freeze-thaw cycle, which occurs each year in southern Ontario, significantly impacts the rate and timing of surface water runoff and groundwater recharge. Typically, watercourses in the Peterborough area are frozen over by mid to late January and clear by late March to mid April. There is usually snow on the ground by the end of December, with the greatest accumulations in January and February. By late March, warmer spring temperatures melt the snow pack and normally there is little or no snow cover remaining by the end of April. From January to early March surficial soils are normally frozen and relatively impervious to infiltration. Most of the spring melt waters end up as surface runoff, contributing to high flows in the water bodies near the site.

Climate change has had a significant impact on this region and other regions of Canada. In recent years, it has been noted that snow does not accumulate on the ground until January, rather than in late December. In a warming climate, more precipitation will fall in the form of rain rather than snow, filling reservoirs to capacity earlier than normal. Additionally, a warming climate will result in snow melting earlier in the year than in previous decades, disrupting the traditional timing of melt water runoff. Together, these changes mean less snow accumulation in the winter and earlier snow-derived water runoff in the spring, challenging the capacities of existing water reservoirs.

5.3 Groundwater Recharge

Recharge or infiltration to the groundwater system occurs by the migration of precipitation through the surficial soil. The amount of recharge or infiltration at a specific site depends on the amount of precipitation evaporated back into the atmosphere, the amount of water transpired from natural vegetation to the air, site topography, type of vegetation and surficial soil type. Surficial geology influences recharge rates. Areas of hummocky topography exhibit higher recharge rates since soil run-off collects in depressions where it can then infiltrate through the surficial soils. Reduction in recharge within urban settings occur due to paved driveways/roads or impermeable rooftop surfaces.

5.4 Hydraulic Properties

The amount and rate of groundwater flow through porous media is determined by the hydraulic properties of the unit, particularly hydraulic conductivity (K), the hydraulic gradient and porosity. The response of a flow system to various stresses is largely determined by the previously mentioned parameters along with storage. Hydraulic conductivity is a key hydraulic parameter that can be estimated by numerous field and laboratory methods including grain-size analysis and hydrometer testing on soil, slug tests and pumping tests.

5.5 Site-Level Water Balance

The basic water balance for a particular area can be expressed as:

$P = ET + R + I + \Delta S$

(Thornthwaite and Mather, 1957)

Where:

P = Precipitation (mm/year)

ET = Evapotranspiration (mm/year)

R = Runoff (mm/year)

I = Infiltration (mm/year)

ΔS = Change in groundwater storage (taken as zero under steady state conditions) (mm/year)

Based on the Thornthwaite and Mather methodology, the water balance is accounting water in the hydrologic cycle. Precipitation (P) falls as rain and snow. It can run off towards lakes and streams (R), infiltrate to the groundwater table (I), or evaporate from surface water and vegetation (ET). When long-term average values of P, R, I, and ET are used there is minimal or no net change to groundwater storage (ΔS).

5.5.1 Precipitation and Evapotranspiration

Based on the Canada Climate normal's data from Environment Canada for "Peterborough Trent U" station between 1992 and 2022 (Environment Canada, 2023); the average annual precipitation was 882 mm. For the same period, it was calculated that approximately 564 mm/year would be lost to evapotranspiration; leaving a total of approximately 318 mm/year available for groundwater recharge and surface runoff.

5.5.2 Infiltration and Runoff

As indicated, there is a water surplus of 318 mm/year at the Site, which becomes the infiltration and runoff components of the water balance. The rate of infiltration at a site is expected to vary, based on a number of factors to be considered in any infiltration model. To partition the available water surpluses into infiltration and surface runoff, the MECP infiltration factor was used. The MECP Stormwater Management (SWM) Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used and a corresponding runoff component was calculated for the soil moisture storage conditions. The calculated volumes of infiltration and runoff in the stage of pre-development and post-development are presented in Appendix F and are discussed as follows.

5.5.2.1 Pre-Development

Considering the fact that the site is slightly sloped to the south, medium combination of silt and clay, and is currently a vacant property; the site may have an infiltration factor of 0.4, i.e., 40% of water surplus (127.2 mm/year). In the meantime, a total of 190.8 mm/year will become the runoff. Based on the Site's area of 10,197 m², a total of 1297.1 m³ per year will infiltrate, while a total volume of 1945.6 m³ per year will become runoff.

5.5.2.2 Post-Development

Based on the information provided by the site plan, it is anticipated that after development, approximately 41% of the site area will be the impervious and hard surface area occupied by the buildings and parking area and 59% will be the pervious area, unpaved areas represent landscaped and green area.

Assuming that 20% of the precipitation will become the evaporation in the non-permeable surface areas, the infiltration volume was calculated to be 767.5 m^3 per year, which is a deficit of 529.5 m^3 per year after the development, while the runoff volume was calculated to be 4088.7 m^3 per year, which is a surplus of 2143.1 m^3 per year after the development.

Based on the water balance assessment, moderate changes are anticipated in the infiltration and runoff due to the proposed development at the subject site. There will be an increase in surface runoff due to the development on-site, and a stormwater management plan will be needed to manage the stormwater runoff on site.

5.5.2.3 Low Impact Developments (LIDs)

Low impact development (LID) practices have been used to reduce peak storm flows, provide water retention and water quality treatment. From a SWM plan, an LID can be used to alter the post development water balance. This will reduce the post-development impact by increasing the infiltration and reducing the runoff. The SWM plan will contain details in design for the LIDs to equalize the pre development to post development.

5.6 Groundwater Discharge

As part of the water cycle, groundwater is a major contributor to flow in many streams and rivers and strongly influences river and wetland habitats for plants and animals. Groundwater enters the ground in recharge areas and leaves the ground at discharge points. Discharge is continuous as long as sufficient water is available above the discharge point. The most visible evidence of groundwater discharge occurs as seepage or springs along watercourse banks and is also noted within stream beds as upwellings and boiling creek bed sediments. Based on the groundwater elevation encounter during this investigation groundwater discharge will not be required during the construction at this site.

5.6.1 Construction Dewatering Requirements

Construction dewatering is intended to lower the groundwater levels in the excavation areas in order to provide a “dry” working condition for excavations and construction of foundations and/or associated sewer systems.

The construction dewatering generally depends on the design specifications of the foundation and footings, and the proposed sewer system (invert elevation, length and size of underground utility pipes), and the site hydrogeological conditions such as existing ground water levels and flow regime. Drawdown levels are not required and dewatering discharge rates are not needed to achieve the required drawdown levels for maintaining a dry working condition and stable excavation bottom and slopes for the subject site.

5.6.2 Pre-construction Dewatering

Based on the proposed design plan, the new development consists of construction of a single-storey residences with a basement. The building will be built as slab on grade with footings being put no deeper than 3.1 mbgs. The developed area at the Site is approximately 4,163 m^2. The ground surface is estimated to be at 247 masl but drops slowly at it approaches the southern property boundary. With the site grading, it is assumed that the ground level will be raised in order to flatten the subject site for development. This allows the 247 masl to be a worst-case-scenario.

5.6.3 In-Construction Dewatering

Based on the proposed development, the excavation for construction of the building footings will mainly take place in the till deposits. The till deposit as described before is characterized by predominantly clayey silt matrix, high in matrix carbonate content and clast poor. The lowest proposed footing elevation is at approximately 243.9 masl. The highest water level measured within the footprint of the proposed building was 243.479 in monitoring well MW-1, which is below the proposed designed footing and the target water level for construction. The site grade will be raised with construction of the proposed development which will ensure that the groundwater will not have an impact on the development. The groundwater level on site would not impact construction to the point of needing a planned dewatering discharge flow for dry conditions. Groundwater isn’t expected to impact construction, however if groundwater does rise due to wetter than expected seasons, water can be pumped from the excavation pit to another lower lying area on site.

5.6.4 Post-Construction Dewatering

Based on the proposed development, the excavation for construction of the building footings will mainly take place in the overburden materials (clayey sand and silt). The lowest proposed floor elevation is at approximately 244.2 masl. The highest water level measured in the till deposits was 243.479 masl at monitoring well MW-1, which is below the proposed designed floor slab and the target water level for post-construction. Based on the obtain information, no long-term groundwater management is required because no post-construction discharge of groundwater is needed for the proposed development.

5.7 Permit-To-Take-Water/EASR Posting

Any construction dewatering or water takings in Ontario is governed by Ontario Regulation 387/04 – the Water Taking and Transfer, an Ontario Regulation made under the Ontario Water Resources Act (OWRA), and/or Ontario Regulation 63/16 – Registrations under Part II.2 of the Act – Water Taking, made under Environmental Protection Act.

According to O. Reg. 387/04, any water taking over 50,000 litres per day should not take place without a valid permit, which shall be applied in accordance with the MECP's Permit-to-Take-Water (PTTW) Manual, dated April 2005. According to O. Reg. 63/16, the construction site dewatering between 50,000 L/day and 400,000 L/day shall be registered through Environmental Activity and Sector Registry (EASR).

Based on the site condition, positive dewatering will not be workable at the Site for the building footings construction. The construction dewatering (likely by sump pumping) and post construction drainage were evaluated to be in a mount below 50,000 L/day. Therefore, a PTTW or EASR posting will not be required.

6.0 POTENTIAL CONSTRUCTION DEWATERING IMPACTS

6.1 Local Water Use

A search of the MECP well records show a total of sixteen wells located within 500 meters of the subject site as follows:

- One well with no use listed,
- Ten domestic wells,
- Three monitoring test-holes,
- One not used.
- One public well.

It is clear from the MECP water well database and the information obtained during the field survey that the local residents obtain their water from a municipal water supply system. Table 4 presents the summary of the wells from the well records, showing the UTM coordinates, drilling date, total depth and water found elevation. The MECP well records show groundwater was found between approximately 1.52 – 6.40 mbgs, for a well drilled in the unconfined aquifer to a depth of approximately 3.05 – 9.14 mbgs. The MECP well records show groundwater was found between 13.11 – 27.73 mbgs, for wells drilled in the bedrock to approximate depths of 13.11 – 33.53 mbgs. It should be noted that the water levels provided in these tables do not represent current water level depths because those wells more likely measured at the time of drilling. However, the drilling program completed at this site show the groundwater was found between 3.755 – 4.221 mbgs for monitoring wells drilled between 2.73 – 6.175 mbgs.

The site and the surrounding properties are expected to be serviced by the municipal water system. Therefore, there should be no impact on the domestic water wells.

Table 4 – Water Wells on and within 0.5 km of the Proposed Development

Well No.	UTM Coordinate Zone 17T		Date Drilled	Total Depth	Water Level	Water Use
	Easting	Northing		(mbgs)	(mbgs)	
7044826	717691	4922222	2007	21.34	18.29	No Use Listed
5109505	718165	4921973	1979	26.21	25.91	Domestic
5101948	717456	4922673	1954	13.11	13.11	Domestic
5101956	717897	4922055	1964	18.90	17.37	Domestic
5104059	717576	4921791	1957	9.14	6.40	Domestic
5104999	718015	4922003	1969	32.61	15.24	Domestic
5105803	717595	4921803	1971	7.01	6.71	Domestic
5101933	717510	4922551	1952	17.37	6.10	Domestic
5109420	717915	4922473	1978	13.41	14.63	Domestic
5120367	718254	4922624	2005	4.88	Unknown	Domestic
5109388	717765	4922573	1978	33.53	27.43	Domestic
7221818	717621	4921945	2014	3.35	1.83	Monitoring Test-Hole
7221816	717583	4921976	2014	3.96	2.13	Monitoring Test-Hole
7221817	717553	4922028	2014	3.05	1.52	Monitoring Test-Hole
5120436	717486	4922126	2005	4.57	3.05	Not Used
7121518	717962	4922057	2008	19.81	6.71	Public

6.2 Hydrological Evaluation

6.2.1 Wellhead Protection Sensitivity Area

The site and the neighboring properties are located within a wellhead protection area. Due to no dewatering during or after construction, there should be no impact on the public wells due to the construction dewatering.

6.2.2 Surface Water

During the site visits, no standing water was visible. After development of this site, a slight increase to the amount of runoff water will be created. This should be considered during the creation of a SWM plan.

6.2.3 Potential Sources of Contamination

No sources of apparent environmental concern were noted on the site.

6.2.4 Ground Subsidence in Adjacent Structures

Under certain conditions, dewatering activities can cause ground settlement which results from the increase in effective stresses caused by the lowering of groundwater level and subsequent decrease in pore pressure. Based on obtained groundwater levels during this investigation, no influence is anticipated due to the new development.

7.0 GROUNDWATER QUALITY

7.1 Groundwater Sampling Protocol

Groundwater samples were collected from one of the monitoring wells using dedicated inertial samplers. Clean nitrile gloves were used to minimize the potential for secondary contamination of the samples. Sampling of the monitoring well, MW-1 was conducted December 16, 2022. The groundwater sampling was compared to the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

Specific Quality Assurance/Quality Control (QA/QC) measures were undertaken to ensure that the groundwater samples collected and the subsequent chemical analysis of the samples provided representative results. Upon arrival at each well site, the well was inspected for signs of damage or interference, the well cap removed and the top-of-pipe depth to the water table and to the bottom of the well measured using a Solinst electric depth meter. The top-of-pipe to ground level was also measured. This data was recorded on the field monitoring log sheets and any abnormalities were noted. The volume of the water in the well was calculated and three times this volume was purged from the well using the pre-installed Waterra low-flow tubing. The samples were taken using low-flow peristaltic pumps. All samples were collected into the appropriate bottles, each supplied by the laboratory. Groundwater samples were kept on ice in coolers until delivered to AGAT Laboratories Ltd. (AGAT), of Mississauga, Ontario. AGAT is accredited by the Standards Council of Canada (SCC) and Canadian Association of Laboratory Accreditation (CALA) and is licensed for these tests by the MECP. All samples submitted to the laboratory were identified by a unique sample number. In addition, the laboratory carried out its own internal QA/QC procedures. The results of the chemical analyses are shown in the Certificates of Analysis in Appendix C.

7.2 Assessment of Water Quality

The following observations were made after careful review of the results of analysis. The health-related parameters tested were Arsenic; Cadmium; Chromium; Lead; and Fluoride. The non-health related parameters tested were pH; Total Suspended Solids; Aluminum; Copper; Manganese; Titanium and Zinc.

7.2.1 Health Related Parameters

- **Total Arsenic:** Arsenic is a semi-metal, a member of the nitrogen family occurring naturally in the environment. It is odorless and tasteless. Consumption in food and water are the major sources of arsenic exposure for the majority of North American citizens. People may also be exposed from industrial sources, as arsenic is used in semiconductor manufacturing, petroleum refining, wood preservatives, animal feed additives, and herbicides. Arsenic can combine with other elements to form inorganic and organic arsenicals. In general, inorganic derivatives are regarded as more toxic than the organic forms and it is primarily the inorganic forms which are present in water. Exposure to arsenic at high levels poses serious health effects as it is a known human carcinogen. In addition, it has been reported to affect the vascular system in humans and has been associated with the development of diabetes. In the monitoring wells, indication of levels of arsenic fell well below the allowable limit for the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.
- **Total Cadmium:** Cadmium is a rare element that is extremely unlikely to be present as a significant natural contaminant in drinking water. Cadmium compounds used in electroplated materials and electroplating wastes may be a significant source of drinking water contamination. Other than occupational exposure and inhalation from cigarette smoke, food is the main source of cadmium intake. In the monitoring wells, indication levels of cadmium fell far below the allowable limit of 0.7 mg/L for the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.
- **Total Chromium:** If Chromium is present in raw water, it may be oxidized to a more harmful hexavalent form during chlorination. Chromium in the more highly oxidized form may be present in older yellow paints and in residues from plating operations and around old re-circulating water cooling systems. In the monitoring wells, indication levels of total chromium fell far below the allowable limit of 3 mg/L for the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

- **Lead:** Lead is typically only present as a result of corrosion of lead solder, lead containing brass fittings or lead pipes which are found close to or in domestic plumbing and the service connection to buildings. Lead ingestion should be avoided particularly by pregnant women and young children, who are the most susceptible. It is recommended that only the cold-water supply be used for drinking/consumption and only after five minutes of flushing to rid the system of standing water. Corrosion inhibitor addition or other water chemistry adjustments may be made at the treatment plant to reduce lead corrosion rates where necessary. In the monitoring wells, levels of lead fell far below the allowable limit of 1 mg/L for the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.
- **Fluoride:** When fluoride is added to drinking water, it is recommended that the concentration be adjusted to 0.5-0.8 mg/L, the optimum level for control of tooth decay. Where supplies contain naturally occurring fluoride at levels higher than 1.5 mg/L but less than 2.4 mg/L the Ministry of the Health and Long-Term Care recommends an approach through local boards of health to raise public and professional awareness to control excessive exposure to fluoride from other sources. In the monitoring wells, indication levels of Fluoride fell far below the allowable limit of 10 mg/L for the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

7.2.2 Non-health Related Parameters

- **pH:** pH is a parameter that indicates the acidity of a water sample. The principal objective in controlling pH is to produce a water that is neither corrosive nor produces incrustation. In the monitoring well tested, indication of pH levels fell within the appropriate range set out by the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.
- **Total Suspended Solids (TSS):** TSS are particles that are larger than 2 microns found in the water column. Most suspended solids are made up of inorganic materials, though bacteria and algae can also contribute to the total solid’s concentration. Pollutants such as dissolved metals and pathogens can attach to suspended particles and enter the water. TSS was found to be below the standard of 350 mg/L, set out by the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

- **Total Aluminum:** Aluminum in untreated water is present in the form of fine particles of alumino-silicate clay. These clay particles are effectively removed in coagulation/filtration. Aluminum found in coagulant treated water is due to the presence of aluminum left over from use of the coagulant. High aluminum can cause coating of the pipes resulting in increased energy requirements for pumping, interference with certain industrial processes and flocculation. Medical studies have not provided clear evidence that residual aluminum has any effect on health. The total aluminum found in the monitoring wells sampled, does not exceeded Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.
- **Total Copper:** Copper occurs naturally in the environmental but is rarely present in raw water. Copper is used extensively in domestic plumbing in tubing and fittings and is an essential trace component in food. Although the intake of large doses of copper has resulted in adverse health effects such as stomach upsets, the levels at which this occurs are much higher than regulated limits. In the monitoring wells, copper was below the standard set by Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.
- **Total Manganese:** Manganese is objectionable in water supplies because it stains black and produces an undesirable taste. Manganese is present in some groundwater because of chemically reducing underground conditions coupled with presence of manganese mineral deposits. Manganese is also occasionally present, seasonally, in surface waters when anaerobic decay processes in sediments occurring. Total Manganese in the samples collected from the monitoring well fell below the standards set out by Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.
- **Total Titanium:** Titanium is an element found naturally in many igneous and sedimentary rocks. Titanium compounds are stable in soil, so only small amounts of titanium end up in water from the weathering of rocks. Titanium may also be present in groundwater due to manufacturing effluent. Titanium is relatively non-toxic. It does not accumulate in the human body. Total Titanium in the samples collected from the monitoring well fell below the limits set out by Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

- **Total Zinc:** Zinc occurs in small amounts in almost all igneous rocks. The natural zinc content in soil is estimated to be 1-300 mg/kg. Zinc can impart an undesirable taste to drinking water. In natural surface water the concentration of zinc is usually below 10µg/L and in groundwater is between 10-40 µg/L. Acute toxicity can occur in humans if excessive amounts of zinc are ingested. Total Zinc in the groundwater samples analyzed fell below the guidelines set out by the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

Results of analysis were compared to Peterborough Sanitary and Combined Sewer Discharge Limits 15-075. The results can be found below in Table 5.

Table 5 – Summary of Groundwater Samples

Sample Description	**5054608**			
Date Sampled	**12/16/2022**			
Parameter	**Unit**	**G / S**	**RDL**	**MW-1**
City of Peterborough Sanitary - Organics				
Oil and Grease (animal/vegetable) in water	mg/L	150	0.5	<0.5
Oil and Grease (mineral) in water	mg/L	15	0.5	<0.5
Methylene Chloride	mg/L	NA	0.0003	<0.0003
cis-1,2-Dichloroethylene	mg/L	4	0.0002	<0.0002
Chloroform	mg/L	0.04	0.0002	<0.0002
Benzene	mg/L	0.01	0.0002	0.0012
Trichloroethylene	mg/L	0.4	0.0002	<0.0002
Toluene	mg/L	0.4	0.0002	0.0021
Tetrachloroethene	mg/L	0.016	0.0002	<0.0002
Ethylbenzene	mg/L	0.16	0.0001	<0.0001
1,4-Dichlorobenzene	mg/L	0.08	0.0001	<0.0001
1,1 Dichloroethene	mg/L		0.0003	<0.0003
Trans 1,2-Dichloroethylene	mg/L		0.0002	<0.0002
Vinyl Chloride	mg/L	0.002	0.0002	<0.0002
m & p-Xylene	mg/L		0.0002	0.0006
o-Xylene	mg/L		0.0001	0.0005
Xylenes (Total)	mg/L	1.4	0.0001	0.0011
Toluene-d8	% Recovery		1	116
4-Bromofluorobenzene	% Recovery		1	83
NP2EO	mg/L		0.01	<0.01
NP1EO	mg/L		0.01	<0.01
4n-NP	mg/L		0.001	<0.001

Sample Description	**5054608**			
Date Sampled	**12/16/2022**			
Parameter	**Unit**	**G / S**	**RDL**	**MW-1**
NP	mg/L		0.001	<0.001
Nonylphenols	mg/L		0.001	<0.001
Nonylphenol Ethoxylates	mg/L		0.01	<0.01
Peterborough Sanitary/Combined Sewer Use By-law				
BOD (5)	mg/L	300	2	2
pH	pH Units	6.0-10.0	NA	8.24
Total Suspended Solids	mg/L	350	10	176
Fluoride	mg/L	10	0.05	<0.05
Chloride	mg/L	1500	0.10	54.2
Sulphate	mg/L	1500	0.10	20.7
Cyanide, SAD	mg/L	2	0.002	<0.002
Total Kjeldahl Nitrogen	mg/L	100	0.10	0.22
Phenols	mg/L	1	0.002	0.006
Total Phosphorus	mg/L	10	0.02	0.12
Total Aluminum	mg/L	50	0.010	2.25
Total Antimony	mg/L	5	0.020	<0.020
Total Arsenic	mg/L	1	0.020	<0.020
Total Bismuth	mg/L	5	0.010	<0.010
Total Cadmium	mg/L	0.7	0.020	<0.020
Total Chromium	mg/L	3	0.020	<0.020
Total Cobalt	mg/L	5	0.010	<0.010
Total Copper	mg/L	2	0.020	<0.020
Total Iron	mg/L	50	0.05	2.34
Total Lead	mg/L	1	0.020	<0.020
Total Manganese	mg/L	5	0.020	0.178
Total Mercury	mg/L	0.01	0.0002	<0.0002
Total Molybdenum	mg/L	5	0.020	<0.020
Total Nickel	mg/L	3	0.030	<0.030
Total Selenium	mg/L	5	0.002	<0.002
Total Silver	mg/L	5	0.020	<0.020
Total Tin	mg/L	5	0.020	<0.020
Total Titanium	mg/L	5	0.010	0.128
Total Vanadium	mg/L	5	0.020	<0.020
Total Zinc	mg/L	2	0.020	<0.020
Total Zirconium	mg/L	5	0.020	<0.020

Comments: RDL - Reported Detection Limit;

G / S - Guideline / Standard: Refers to Peterborough Sanitary and Combined Sewer Discharge Limits 15-075

NOTE: Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

8.0 CONCLUSIONS AND RECOMMENDATION

The assessment of the available data indicates that:

- A&A was retained by the client, to evaluate the potential impact from the proposed residential development on local groundwater/surface water resources by conducting a small-scale hydrogeological study. The site lies in the southeastern area of Lakefield, Ontario at 45 Bishop Street. The area of the site is approximately 10,197 m^2 (2.519 acres). At the time of the investigation, the site was vacant.
- The topography in the vicinity of the subject site (a 100-meter radius) ranges from approximately 247 masl to 243 masl, with the surrounding subject study area sloping from approximately 252 masl to the east to 238 masl to the southwest.
- The MECP well records show groundwater was found at between approximately 1.52 – 6.40 mbgs, for a well drilled in the unconfined aquifer to a depth of approximately 3.05 – 9.14 mbgs. The MECP well records show groundwater was found between 13.11 – 27.73 mbgs, for wells drilled in the bedrock to approximate depths of 13.11 – 33.53 mbgs. The drilling program completed at this site confirms the groundwater was measured between 243.479 – 242.170 masl.
- The water table in the study area was defined by installing a total of three monitoring wells in the area of the proposed development and monitoring these wells on the subject site. The monitoring wells installed by A&A were drilled to a maximum depth of 6.00 mbgs. There were four groundwater monitoring events that took place between May 2023 and July 2023. It was concluded that groundwater was present on site at elevations between 243.479 – 242.170 masl.
- A groundwater contour map was plotted using “Golden Software” (Surfer 8) and the measurements of groundwater levels taken on May 26, 2023 from three monitoring wells. This map shows well MW-2 and MW-3 being at the lowest water elevation compared with the other well used. The general direction of groundwater flow was found to be in south direction.
- The total precipitation (rainfall plus snowfall) in 2022 was 800 mm. The average annual precipitation over the last thirty-year period was 882 mm. For the same period, it was

calculated that approximately 564 mm/year would be lost to evapotranspiration; leaving a total of approximately 318 mm/year available for groundwater recharge and surface runoff.

- Based on the water balance assessment, moderate changes are anticipated in the infiltration and runoff due to the proposed development at the subject site. There will be an increase in surface runoff due to the development on-site, and a stormwater management plan will be needed to manage the stormwater runoff on site.
- The analysis results indicate that all health and non-health related parameters were below the standards as outlined in the Peterborough Sanitary and Combined Sewer Discharge Limits 15-075.

Based on the obtained information from this study, A&A has the following recommendations:

1. Due to the increased runoff rate on site post development, a stormwater management plan is recommended. Proper planning as well as implementing LIDs will mitigate the stormwater that accumulates.

2. Due to the water levels being below the foundation bottom, the excavation area will NOT need to undergo in-construction and post-construction dewatering.

3. No adverse impact on the groundwater resources is expected to occur during the development of the subject site with the implementations of these recommended actions.

SIGNED:

Thomas Demers, P. Eng., QP_{ESA}
Project Manager

SIGNED:

PROFESSIONAL GEOSCIENTIST
ALI H. ABDUL RASOUL
PRACTISING MEMBER
0993
ONTARIO

Dr. Ali A. Rasoul, Ph.D., EP, P. Geo.
Senior Hydrogeologist

9.0 REFERENCES

Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey,

Barnett, P.J., 1992. Quaternary geology of Ontario, p. 1011-1088. **In** P.C. Thurston, H.R. Williams, R.H. Sutcliffe and G.M. Stott, eds., Geology of Ontario. Ontario Geological Survey, Toronto, Special Volume 4, Part 2, 1525 p.

Chapman, L.J. and Putnam, D.F. 2007. Physiography of southern Ontario; Ontario Geological Survey,

Cooper, H.H., Jr. and Jacob, C.E., 1946. A generalized graphical method for evaluating formation constant and summarizing well-field history: American Geophysics Union Transactions, v. 27, no.4, p526-534.

Environmental and Climate Change Canada, 2022, Historical Weather Data. Obtained from: https://climate.weather.gc.ca/historical_data/search_historic_data_e.html Accessed on June 24, 2023

Farmwest, 2021. Evapotranspiration. Obtained from: https://farmwest.com/climate/calculators/evapotranspiration/. Accessed on June 24, 2023. Data from Environment and Climate Change Canada

Earthfx. 2006. ViewLog modeled GRD output files dated June 9, 2006.

Fetter, C. W., 2001, Applied Hydrogeology, Upper Saddle River, New Jersey 07458, Fourth Edition.

Geological Survey of Canada Map 1263A,

Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Expert. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50

Ministry of the Environment, Conservation and Parks, Province of Ontario, 2003, Stormwater Management Planning and Design Manual, Obtained from: https://www.ontario.ca/document/stormwater-management-planning-and-design-manual-0. Access on August 8, 2023

Otonabee Conservation, Watershed Report Card 2023, 2023. Obtained from: http://www.otonabeeconservation.com/wp-content/uploads/2023/03/WRC_Otonobee_Conservation_FINAL-AODA2023.pdf. Accessed on: July 28, 2023

Ontario Geological Survey 2010. Surficial geology of Southern Ontario;

Ontario Geological Survey 2000. Quaternary geology, seamless coverage of the Province of Ontario;

Ontario Geological Survey 2011. 1:250 000 scale bedrock geology of Ontario;

Phillips, D.W. and McCulloch, J.A.W., 1972, The Climate of the Great Lakes Basin: Climatological Studies, Number 20, Environment Canada, Atmospheric Environment Service.

Thornthwaite, C. W., and J. R. Mather published the first version entitled "The Water Balance," *Publications in Climatology* VIII (1): 1-104, Drexel Institute of Climatology, Centerton, NJ.

University of Waterloo Southern Ontario Paleozoic Rocks, 2017, https://uwaterloo.ca/earth-sciences-museum/resources/minerals-ontario/southern-ontario-paleozoic-rocks Accessed on: August 8, 2023

Waterloo Hydrogeological, Inc. 2004. Six Conservation Authorities FEFLOW Groundwater Model, Conceptual Model Report. Obtained from: http://thamesriver.on.ca/wp-content/uploads/Groundwater/ModelingProject/Concept_Model_Report_Final.pdf. Accessed on: June 24, 2023

City of Peterborough. The Corporation of the City of Peterborough By-Law Number 15-075. Obtained from: https://www.peterborough.ca/en/city-services/resources/Documents/15-075---City-of-Peterborough-Sewer-Bylaw.pdf Accessed on: August 8, 2023

10.0 QUALIFICATIONS OF THE ASSESSORS

A & A Environmental Consultants Inc. is a multi-disciplinary environmental consulting firm offering consulting services in the fields of site assessments (Phase I-II), cleanups, water resource studies, aggregate permitting, landfill design and monitoring, geotechnical studies, air quality studies, designated substances surveys and environmental impact studies. A&A has more than 20 years of experience in environmental consulting in the province of Ontario, Alberta, Saskatchewan, British Columbia and have preformed thousands of projects from small scale Phase I ESAs to large scale landfill design, hydro-geological studies and groundwater management plans. We have a number of senior, experienced staff who consult in a variety of disciplines and offer our clients expert knowledge in both the technical aspects of a project and the environmental regulations applicable.

Dr. Ali A. Rasoul, Ph.D., EP, P. Geo., QP

Principal Consultant

The report was reviewed by Dr. Ali A. Rasoul, a Principal Consultant with A&A. He has over 20 years experience in his field. He has completed hundreds of environmental projects including Phase I/II/III ESAs, mould assessments, hydrogeological investigations, designated substances surveys and water management plans. He is a licensed Professional Geoscientist with the Association of Professional Geoscientists of Ontario and a licensed Well Technician in the Province of Ontario (Ministry of the Environment, Conservation and Parks). He is also a licensed Professional Geoscientist in Alberta, Saskatchewan and British Columbia. Dr. Rasoul is registered as a “Qualified Person” for conducting ESAs as defined under Ontario Regulation 153/04 and 511/09.

11.0 LIMITATIONS

The report was prepared for the exclusive use of the client. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third party. Should additional parties require reliance on this report, written authorization from A&A will be required. With respect to third parties, A&A has no liability or responsibility for losses of any kind whatsoever including direct or consequential financial effects on transactions or property values, or requirement for follow-up actions and costs.

The investigation undertaken by A&A with respect to this report and any conclusions or recommendations made in this report reflect A&A's judgment based on the site conditions observed at the time of the site inspection on the date(s) set out in this report and on information available at the time of preparation of this report. This report has been prepared for specific application to this site and it is based, in part, upon visual observations of the site as described in this report. Unless otherwise stated, the findings cannot be extended to previous or future site conditions, or portions of the site, which were unavailable for direct investigation. A&A has used professional judgment in analysing this information and formulating these conclusions.

A&A makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in this report, including, but not limited to, ownership of any property, or the application of any law to the facts set forth herein. With respect to regulatory compliance issues, regulatory statutes are subject to interpretation and change. Such interpretations and regulatory changes should be reviewed with legal counsel.

APPENDIX A – Site Maps

Figure 1 – Map Showing the Site Location

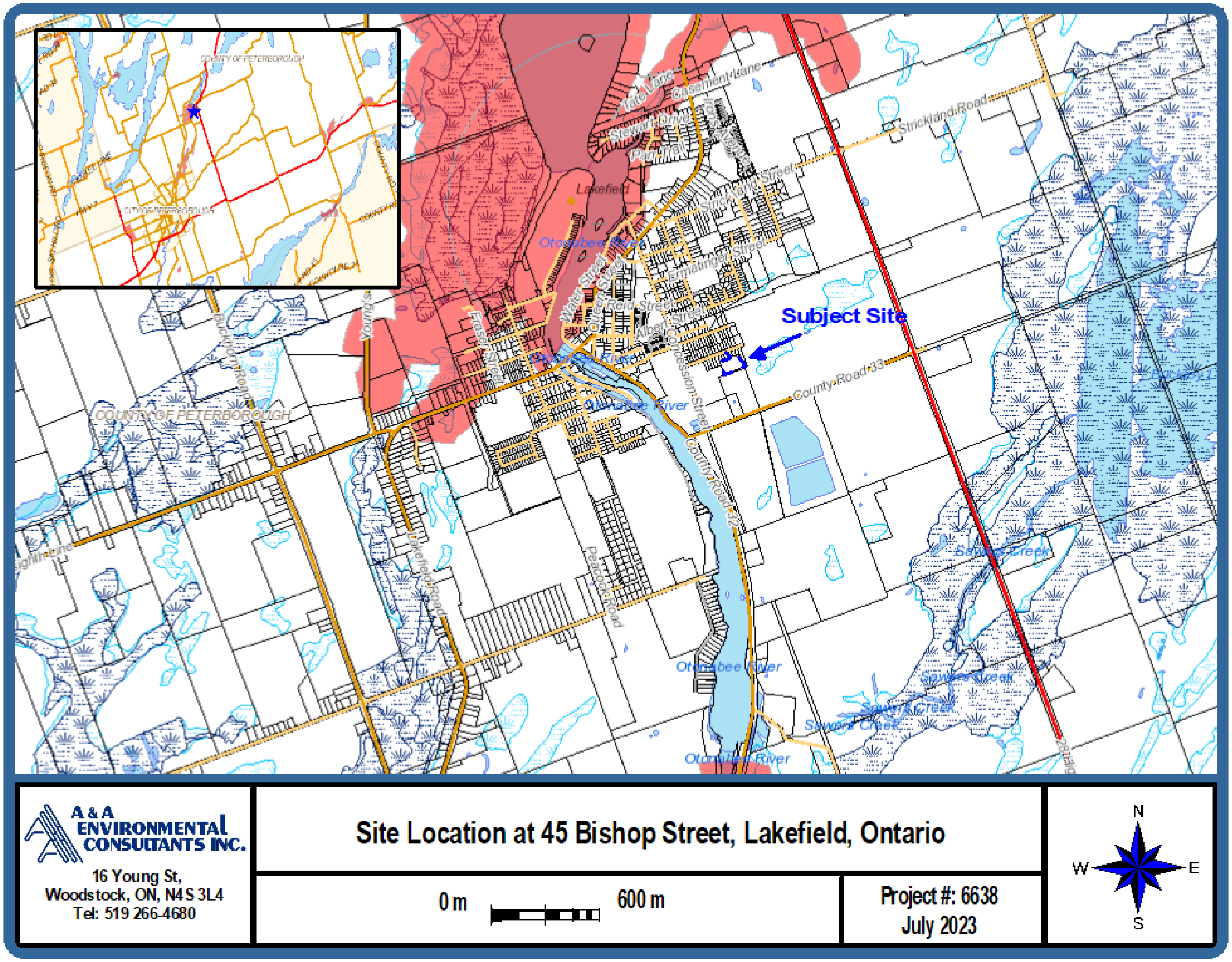


Figure 2 – Satellite Map of Site and Subject Study Area

Figure 3 – Topographic Map

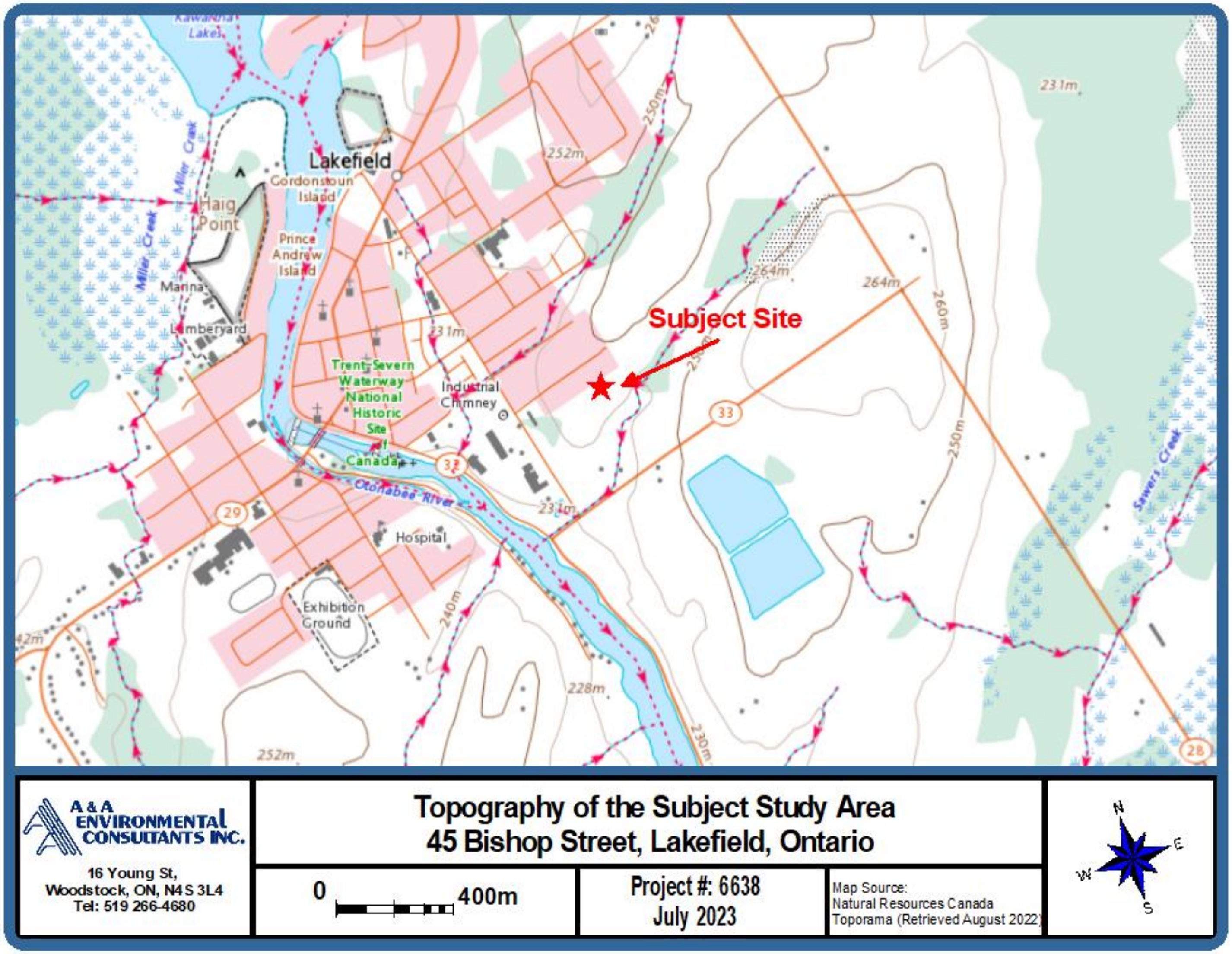


Figure 4 – Monitoring Wells Location Map – Satellite Image

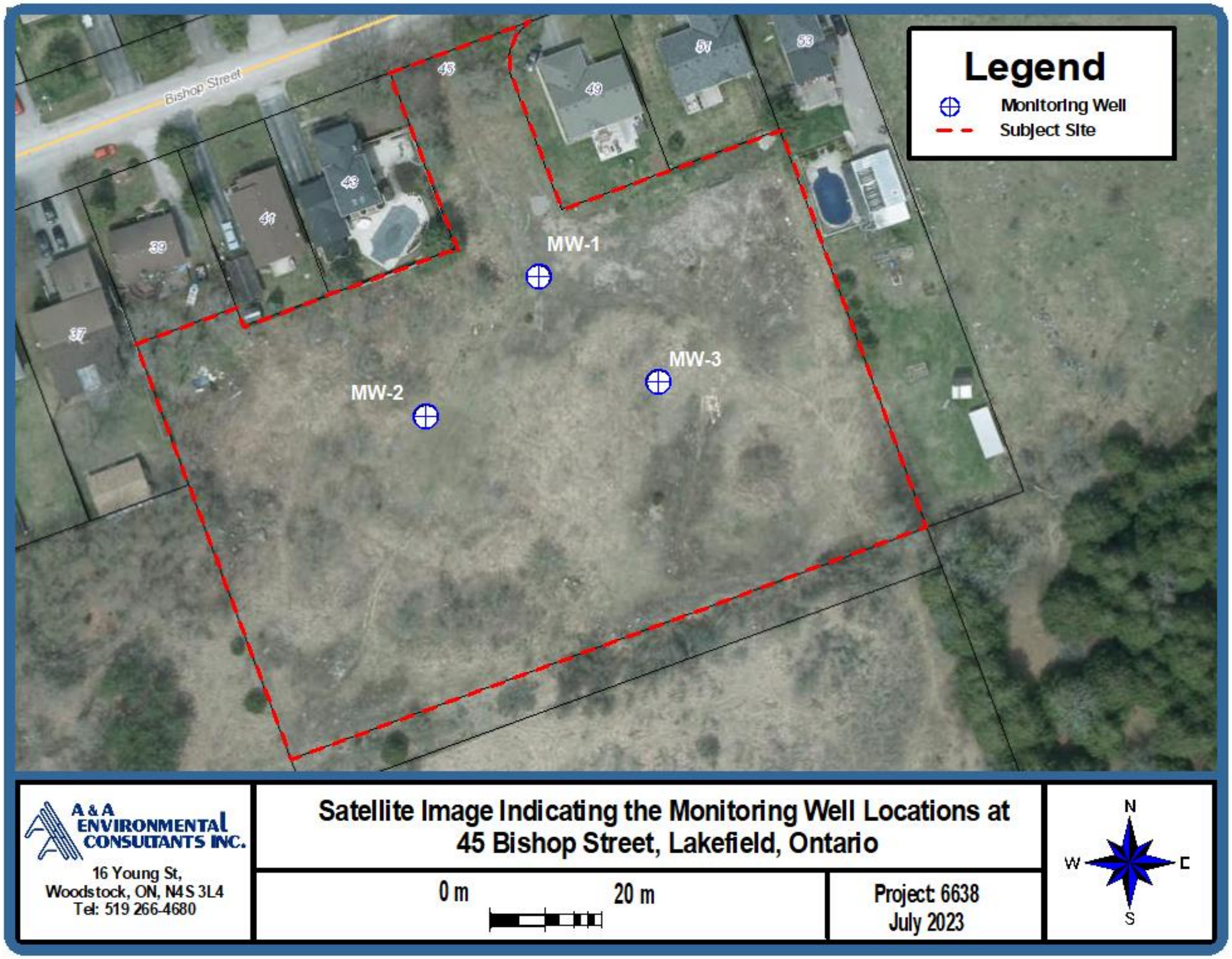


Figure 5 – Groundwater Contour Map

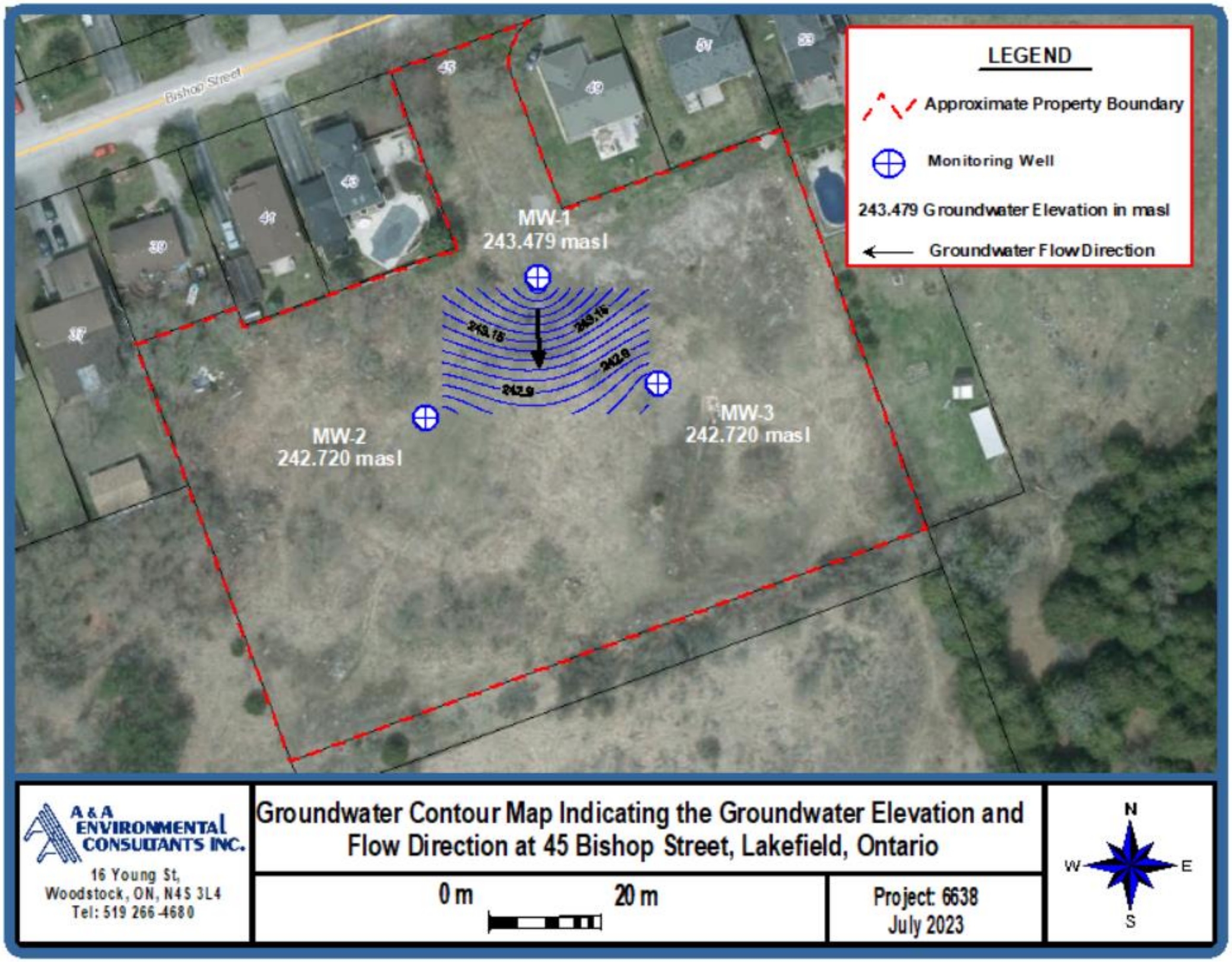
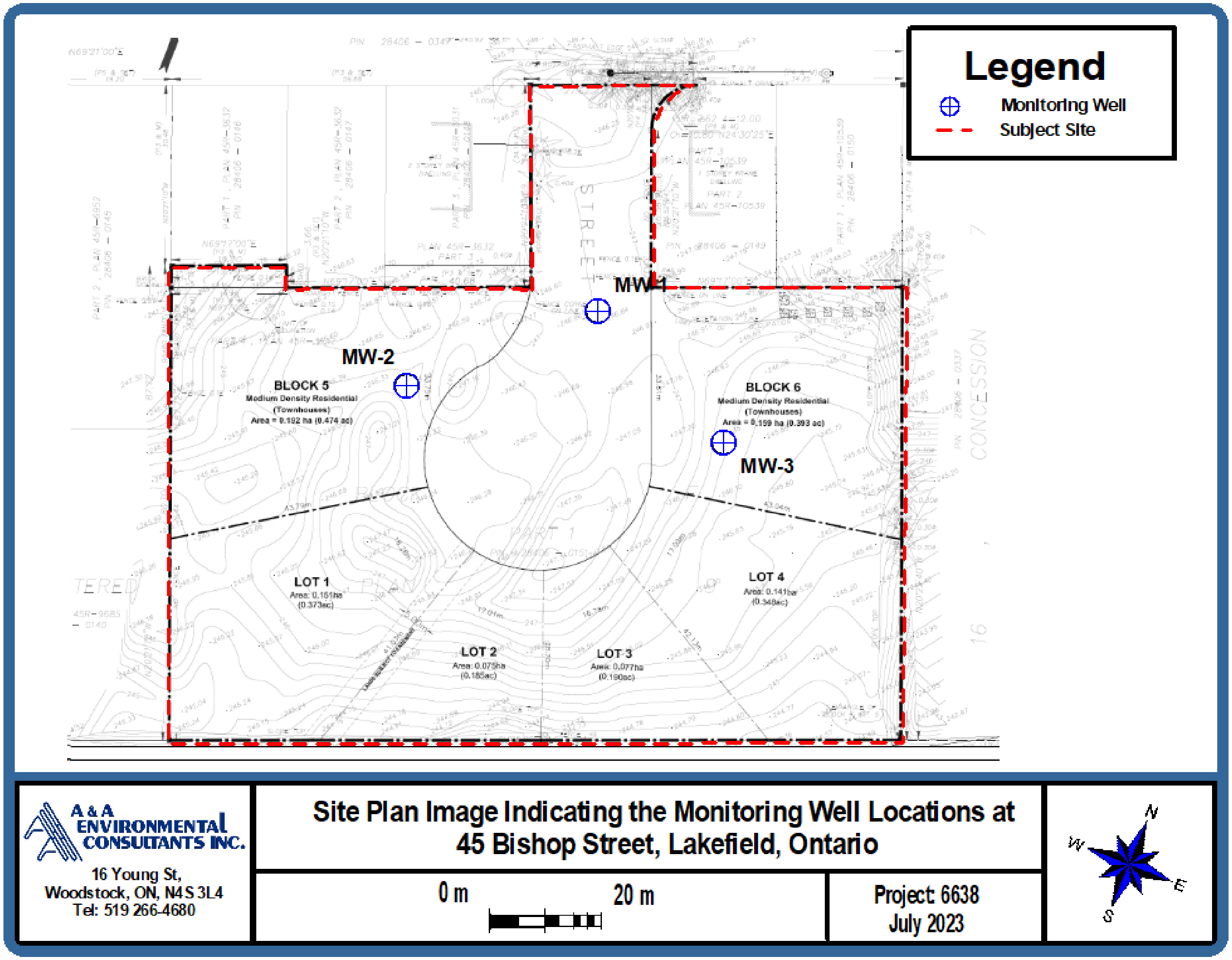
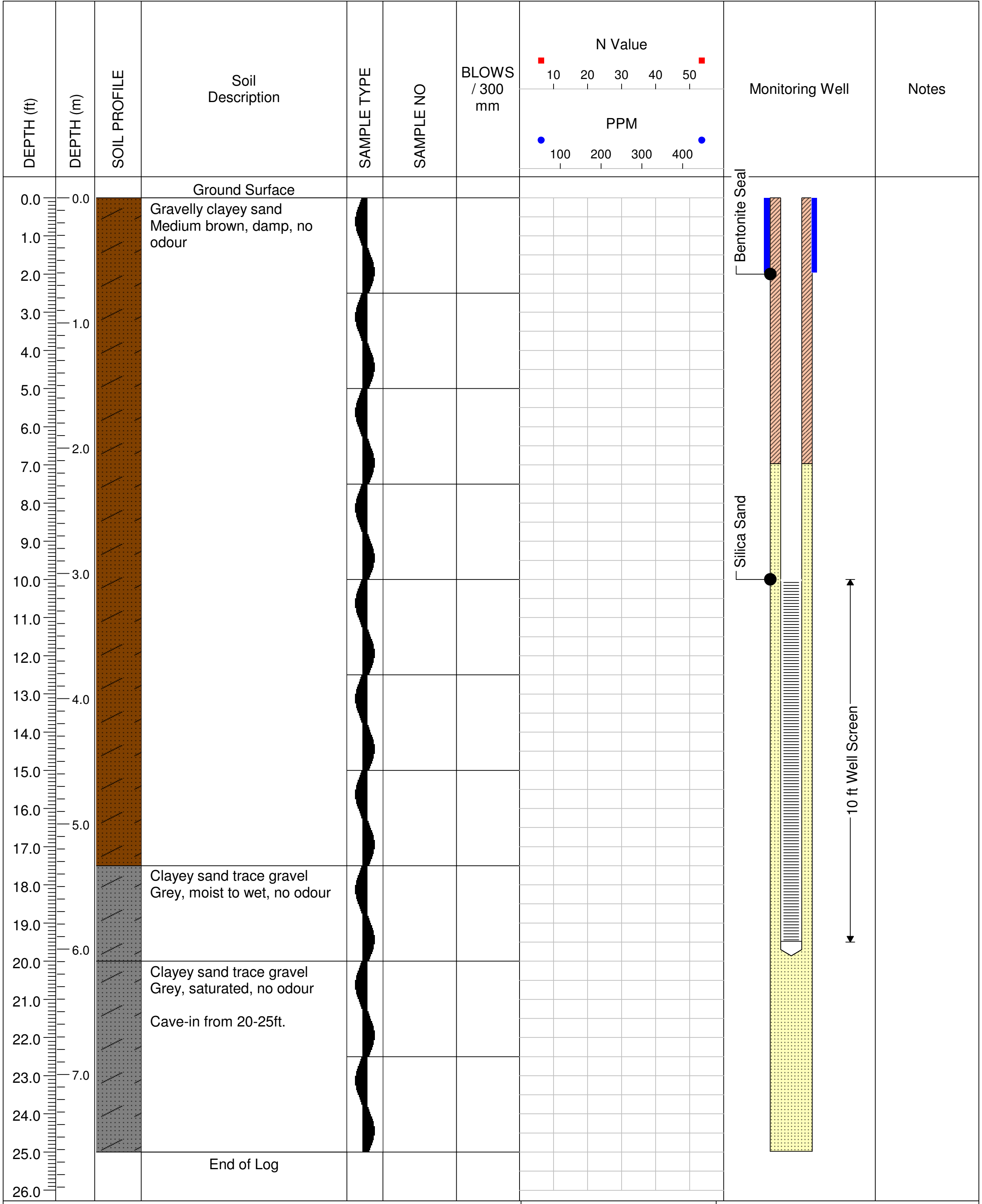


Figure 6 – Monitoring Wells Location Map – Site Plan Image



APPENDIX B – Borehole Logs

PROJECT: PFP Lakefield	**BH LOCATION:**	**BOREHOLE NO: BH/MW1**
PROJECT NO: 6638	**LOCATION:** 45 Bishop St., Selwyn ON	
PROJECT MANAGER: T. Demers	**COMPANY NAME:** A&A Environmental Consultants Inc,	



Ground Surface

Gravelly clayey sand
Medium brown, damp, no odour

Clayey sand trace gravel
Grey, moist to wet, no odour

Clayey sand trace gravel
Grey, saturated, no odour

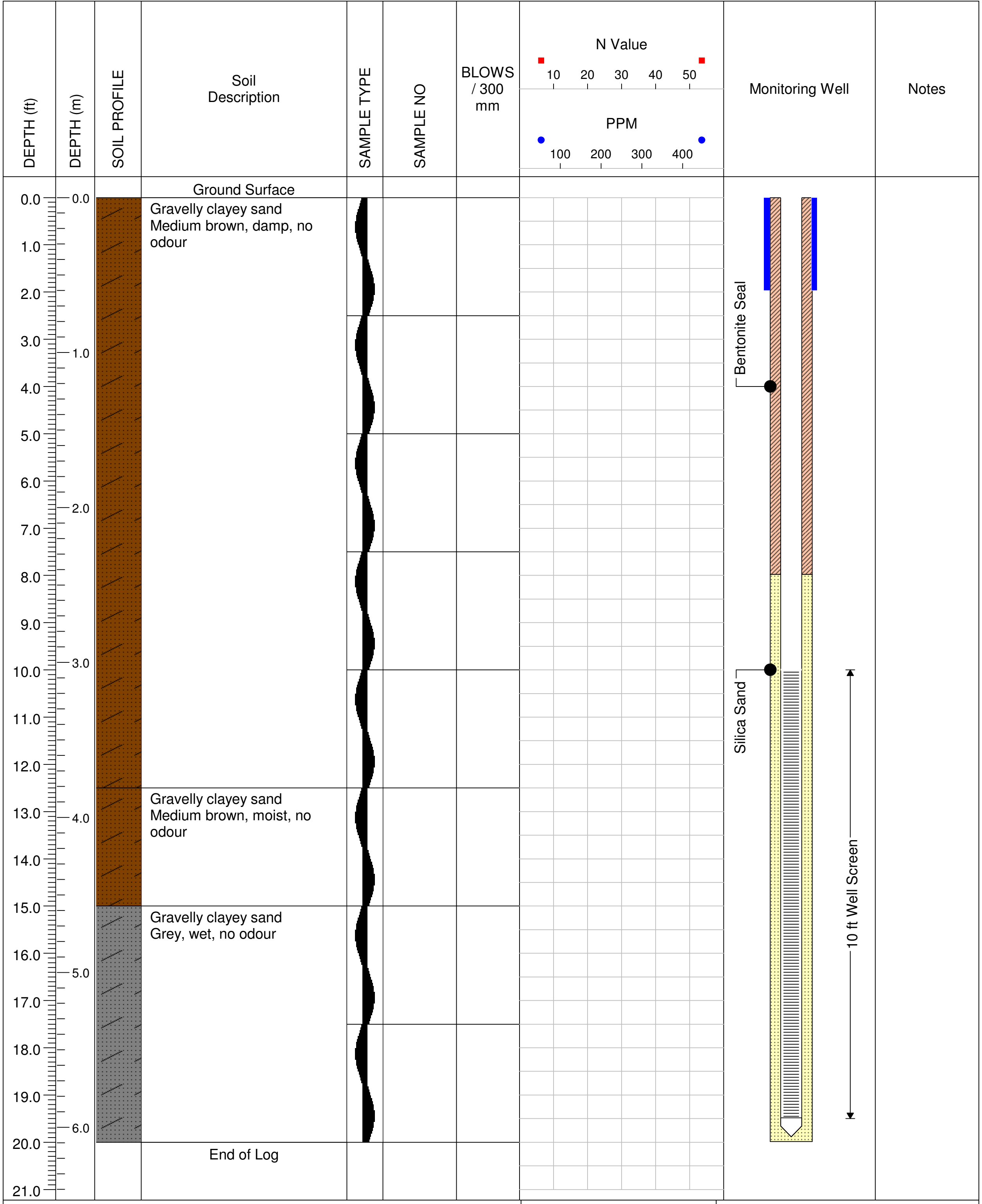
Cave-in from 20-25ft.

End of Log

A & A ENVIRONMENTAL CONSULTANTS INC.
16 Young Street Woodstock, ON

LOGGED BY: T. Thornton	**COMPLETION DEPTH:** 25ft.
REVIEWED BY: A. Rasoul	**DRILL METHOD:** H.S.A.
DRILL DATE: 05/03/2023	**PAGE:** 1 of 1

PROJECT: PFP Lakefield	**BH LOCATION:**	**BOREHOLE NO: BH/MW2**
PROJECT NO: 6638	**LOCATION:** 45 Bishop St., Selwyn ON	
PROJECT MANAGER: T. Demers	**COMPANY NAME:** A&A Environmental Consultants Inc.	



Soil Description

Ground Surface

Gravelly clayey sand
Medium brown, damp, no odour

Gravelly clayey sand
Medium brown, moist, no odour

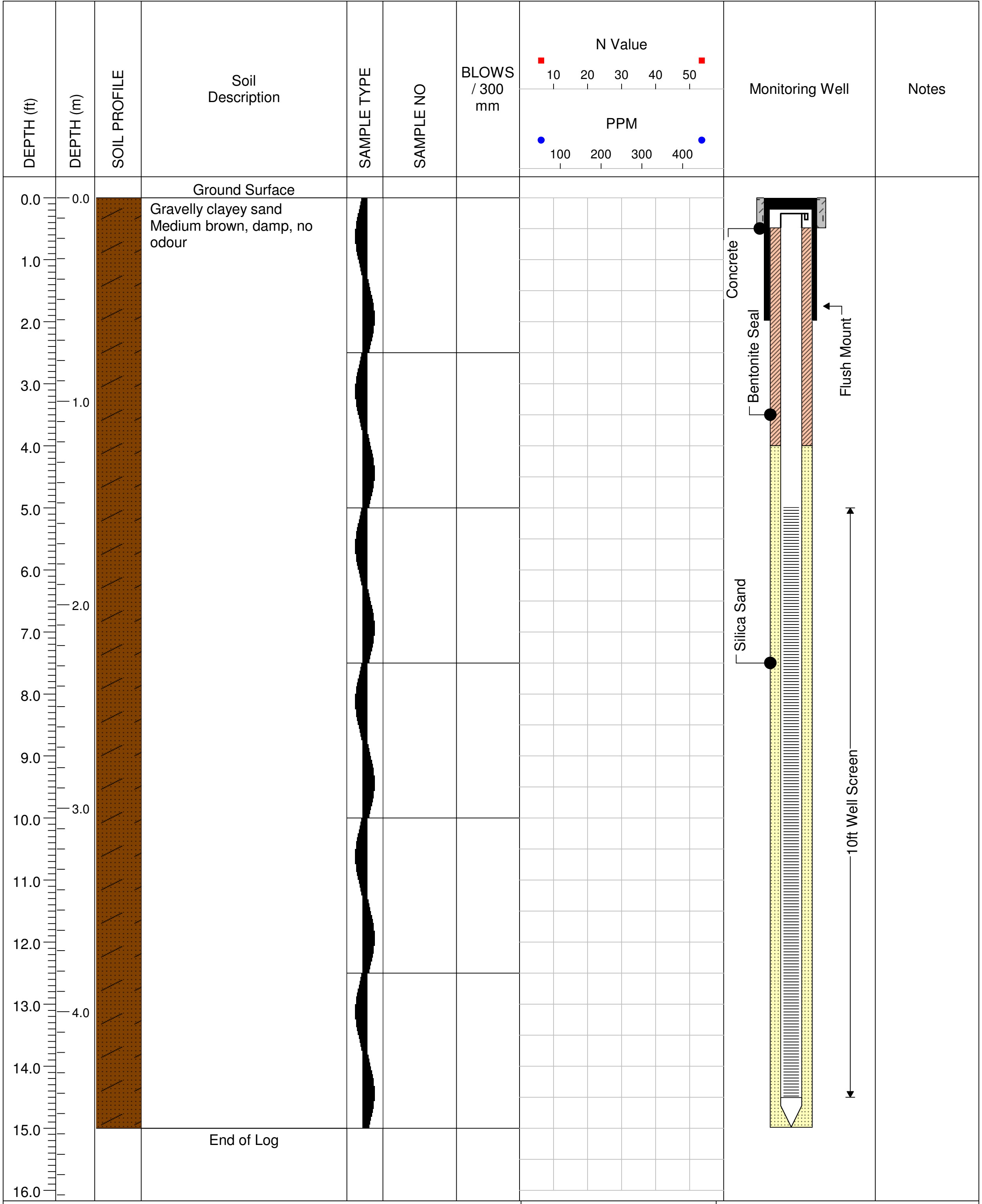
Gravelly clayey sand
Grey, wet, no odour

End of Log

A & A ENVIRONMENTAL CONSULTANTS INC.
16 Young Street Woodstock, ON

LOGGED BY: T. Thornton	**COMPLETION DEPTH:** 20ft.
REVIEWED BY: A. Rasoul	**DRILL METHOD:** H.S.A.
DRILL DATE: 05/03/2023	**PAGE:** 1 of 1

PROJECT: PFP Lakefield	**BH LOCATION:**	**BOREHOLE NO: BH/MW3**
PROJECT NO: 6638	**LOCATION:** 45 Bishop St., Selwyn ON	
PROJECT MANAGER: T. Demers	**COMPANY NAME:** A&A Environmental Consultants Inc.	



Ground Surface

Gravelly clayey sand
Medium brown, damp, no odour

End of Log

A & A ENVIRONMENTAL CONSULTANTS INC.
16 Young Street Woodstock, ON

LOGGED BY: T. Thornton	**COMPLETION DEPTH:** 15ft.
REVIEWED BY: A. Rasoul	**DRILL METHOD:** H.S.A.
DRILL DATE: 05/03/2023	**PAGE:** 1 of 1

APPENDIX C – Certificate of Chemical Analysis

CLIENT NAME: **A & A ENVIRONMENTAL CONSULTANTS INC**
16 Young Street
WOODSTOCK, ON N4S3L4
(519) 266-4680
ATTENTION TO: **Ali Rasoul**
PROJECT: **6638-Lakefield**
AGAT WORK ORDER: **23T034318**
TRACE ORGANICS REVIEWED BY: **Oksana Gushyla, Trace Organics Lab Supervisor**
WATER ANALYSIS REVIEWED BY: **Nivine Basily, Inorganics Report Writer**
DATE REPORTED: **Jun 14, 2023**
PAGES (INCLUDING COVER): **12**
VERSION*: **2**

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

*Notes

VERSION 2:V2: BOD reported

Disclaimer:

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

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. Measurement Uncertainty is not taken into consideration when stating conformity with a specified requirement.

Certificate of Analysis

AGAT WORK ORDER: 23T034318

PROJECT: 6638-Lakefield

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC

ATTENTION TO: Ali Rasoul

SAMPLING SITE:

SAMPLED BY:T. Thornton

City of Peterborough Sanitary - Organics

DATE RECEIVED: 2023-06-09

DATE REPORTED: 2023-06-14

			SAMPLE DESCRIPTION:	MW1
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2023-06-09 11:00
Parameter	**Unit**	**G / S**	**RDL**	**5054608**
Oil and Grease (animal/vegetable) in water	mg/L	150	0.5	<0.5
Oil and Grease (mineral) in water	mg/L	15	0.5	<0.5
Methylene Chloride	mg/L	NA	0.0003	<0.0003
cis-1,2-Dichloroethylene	mg/L	4	0.0002	<0.0002
Chloroform	mg/L	0.04	0.0002	<0.0002
Benzene	mg/L	0.01	0.0002	0.0012
Trichloroethylene	mg/L	0.4	0.0002	<0.0002
Toluene	mg/L	0.4	0.0002	0.0021
Tetrachloroethene	mg/L	0.016	0.0002	<0.0002
Ethylbenzene	mg/L	0.16	0.0001	<0.0001
1,4-Dichlorobenzene	mg/L	0.08	0.0001	<0.0001
1,1 Dichloroethene	mg/L		0.0003	<0.0003
Trans 1,2-Dichloroethylene	mg/L		0.0002	<0.0002
Vinyl Chloride	mg/L	0.002	0.0002	<0.0002
m & p-Xylene	mg/L		0.0002	0.0006
o-Xylene	mg/L		0.0001	0.0005
Xylenes (Total)	mg/L	1.4	0.0001	0.0011
NP2EO	mg/L		0.01	<0.01
NP1EO	mg/L		0.01	<0.01
4n-NP	mg/L		0.001	<0.001
NP	mg/L		0.001	<0.001
Nonylphenols	mg/L		0.001	<0.001
Nonylphenol Ethoxylates	mg/L		0.01	<0.01
Surrogate	**Unit**	**Acceptable Limits**		
Toluene-d8	% Recovery	50-140		116
4-Bromofluorobenzene	% Recovery	50-140		83

Certified By:

City of Peterborough Sanitary - Organics

DATE RECEIVED: 2023-06-09

DATE REPORTED: 2023-06-14

Comments:	RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Peterborough Sanitary and Combined Sewer Discharge Limits 15-075 Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.
5054608	Oil and Grease animal/vegetable is a calculated parameter. The calculated value is the difference between Total O&G and Mineral O&G. Xylenes total is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Certificate of Analysis

AGAT WORK ORDER: 23T034318

PROJECT: 6638-Lakefield

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

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC

ATTENTION TO: Ali Rasoul

SAMPLING SITE:

SAMPLED BY:T. Thornton

Peterborough Sanitary/Combined Sewer Use By-law

DATE RECEIVED: 2023-06-09

DATE REPORTED: 2023-06-14

			SAMPLE DESCRIPTION:	MW1
			SAMPLE TYPE:	Water
			DATE SAMPLED:	2023-06-09 11:00
Parameter	**Unit**	**G / S**	**RDL**	**5054608**
BOD (5)	mg/L	300	2	2
pH	pH Units	6.0-10.0	NA	8.24
Total Suspended Solids	mg/L	350	10	176
Fluoride	mg/L	10	0.05	<0.05
Chloride	mg/L	1500	0.10	54.2
Sulphate	mg/L	1500	0.10	20.7
Cyanide, SAD	mg/L	2	0.002	<0.002
Total Kjeldahl Nitrogen	mg/L	100	0.10	0.22
Phenols	mg/L	1	0.002	0.006
Total Phosphorus	mg/L	10	0.02	0.12
Total Aluminum	mg/L	50	0.010	2.25
Total Antimony	mg/L	5	0.020	<0.020
Total Arsenic	mg/L	1	0.020	<0.020
Total Bismuth	mg/L	5	0.010	<0.010
Total Cadmium	mg/L	0.7	0.020	<0.020
Total Chromium	mg/L	3	0.020	<0.020
Total Cobalt	mg/L	5	0.010	<0.010
Total Copper	mg/L	2	0.020	<0.020
Total Iron	mg/L	50	0.05	2.34
Total Lead	mg/L	1	0.020	<0.020
Total Manganese	mg/L	5	0.020	0.178
Total Mercury	mg/L	0.01	0.0002	<0.0002
Total Molybdenum	mg/L	5	0.020	<0.020
Total Nickel	mg/L	3	0.030	<0.030
Total Selenium	mg/L	5	0.002	<0.002
Total Silver	mg/L	5	0.020	<0.020
Total Tin	mg/L	5	0.020	<0.020
Total Titanium	mg/L	5	0.010	0.128
Total Vanadium	mg/L	5	0.020	<0.020

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
NIVINE BASILY
CHEMIST

Certified By: Nivine Basily

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC **ATTENTION TO: Ali Rasoul**

SAMPLING SITE: **SAMPLED BY:T. Thornton**

Peterborough Sanitary/Combined Sewer Use By-law

DATE RECEIVED: 2023-06-09 **DATE REPORTED: 2023-06-14**

			SAMPLE DESCRIPTION:	**MW1**
			SAMPLE TYPE:	**Water**
			DATE SAMPLED:	**2023-06-09 11:00**
Parameter	**Unit**	**G / S**	**RDL**	**5054608**
Total Zinc	mg/L	2	0.020	<0.020
Total Zirconium	mg/L	5	0.020	<0.020

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Peterborough Sanitary and Combined Sewer Discharge Limits 15-075
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

5054608 Year 2005 Sanitary and Combined Sewers Discharge guidelines.
Bylaw 05-104

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

NIVINE BASILY

Quality Assurance

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC

AGAT WORK ORDER: 23T034318

PROJECT: 6638-Lakefield

ATTENTION TO: Ali Rasoul

SAMPLING SITE:

SAMPLED BY:T. Thornton

Trace Organics Analysis

RPT Date: Jun 14, 2023			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
City of Peterborough Sanitary - Organics															
Oil and Grease (animal/vegetable) in water	5029315		< 0.5	< 0.5	NA	< 0.5	86%	70%	130%	91%	70%	130%	111%	70%	130%
Oil and Grease (mineral) in water	5029315		< 0.5	< 0.5	NA	< 0.5	90%	70%	130%	87%	70%	130%	80%	70%	130%
Methylene Chloride	5055924		<0.0003	<0.0003	NA	< 0.0003	76%	50%	140%	77%	60%	130%	97%	50%	140%
cis-1,2-Dichloroethylene	5055924		<0.0002	<0.0002	NA	< 0.0002	81%	50%	140%	80%	60%	130%	90%	50%	140%
Chloroform	5055924		<0.0002	<0.0002	NA	< 0.0002	76%	50%	140%	77%	60%	130%	89%	50%	140%
Benzene	5055924		<0.0002	<0.0002	NA	< 0.0002	72%	50%	140%	72%	60%	130%	110%	50%	140%
Trichloroethylene	5055924		<0.0002	<0.0002	NA	< 0.0002	75%	50%	140%	77%	60%	130%	103%	50%	140%
Toluene	5055924		<0.0002	<0.0002	NA	< 0.0002	84%	50%	140%	103%	60%	130%	105%	50%	140%
Tetrachloroethene	5055924		<0.0002	<0.0002	NA	< 0.0002	74%	50%	140%	75%	60%	130%	80%	50%	140%
Ethylbenzene	5055924		<0.0001	<0.0001	NA	< 0.0001	78%	50%	140%	78%	60%	130%	82%	50%	140%
1,4-Dichlorobenzene	5055924		<0.0001	<0.0001	NA	< 0.0001	99%	50%	140%	101%	60%	130%	114%	50%	140%
1,1 Dichloroethene	5055924		<0.0003	<0.0003	NA	< 0.0003	78%	50%	140%	79%	60%	130%	76%	50%	140%
Trans 1,2-Dichloroethylene	5055924		<0.0002	<0.0002	NA	< 0.0002	95%	50%	140%	99%	60%	130%	85%	50%	140%
Vinyl Chloride	5055924		<0.0002	<0.0002	NA	< 0.0002	117%	50%	140%	118%	50%	140%	94%	50%	140%
m & p-Xylene	5055924		<0.0002	<0.0002	NA	< 0.0002	82%	50%	140%	82%	60%	130%	90%	50%	140%
o-Xylene	5055924		<0.0001	<0.0001	NA	< 0.0001	82%	50%	140%	83%	60%	130%	96%	50%	140%
NP2EO	5032384	5032384	< 10	< 10	NA	< 0.01	101%	50%	130%	105%	50%	130%	102%	50%	130%
NP1EO	5032384	5032384	< 10	< 10	NA	< 0.01	113%	50%	130%	108%	50%	130%	96%	50%	130%
4n-NP	5032384	5032384	< 1	< 1	NA	< 0.001	88%	50%	130%	112%	50%	130%	102%	50%	130%
NP	5032384	5032384	< 1.0	< 1.0	NA	< 0.001	115%	50%	130%	116%	50%	130%	112%	50%	130%
Nonylphenols	5032384	5032384				< 0.001									
Nonylphenol Ethoxylates	5032384	5032384				< 0.01									

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By:

Quality Assurance

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC
PROJECT: 6638-Lakefield
SAMPLING SITE:

AGAT WORK ORDER: 23T034318
ATTENTION TO: Ali Rasoul
SAMPLED BY:T. Thornton

Water Analysis

RPT Date: Jun 14, 2023			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Peterborough Sanitary/Combined Sewer Use By-law															
BOD (5)	5050202		2410	2360	2.4%	< 2	102%	75%	125%						
pH	5053986		7.75	7.83	1.0%	NA	99%	90%	110%						
Total Suspended Solids	5045497		98	98	0.0%	< 10	98%	80%	120%						
Fluoride	5049991		<0.05	<0.05	NA	< 0.05	99%	70%	130%	94%	80%	120%	90%	70%	130%
Chloride	5049991		137	137	0.0%	< 0.10	93%	70%	130%	94%	80%	120%	NA	70%	130%
Sulphate	5049991		5.91	5.94	0.5%	< 0.10	95%	70%	130%	95%	80%	120%	95%	70%	130%
Cyanide, SAD	5045497		0.005	0.006	NA	< 0.002	107%	70%	130%	108%	80%	120%	124%	70%	130%
Total Kjeldahl Nitrogen	5050099		0.72	0.75	4.1%	< 0.10	100%	70%	130%	102%	80%	120%	90%	70%	130%
Phenols	5053454		0.002	0.002	NA	< 0.001	96%	90%	110%	98%	90%	110%	91%	80%	120%
Total Phosphorus	5053503		0.02	<0.02	NA	< 0.02	101%	70%	130%	96%	80%	120%	98%	70%	130%
Total Aluminum	5054608	5054608	2.25	2.00	11.8%	< 0.010	109%	70%	130%	108%	80%	120%	NA	70%	130%
Total Antimony	5054608	5054608	<0.020	<0.020	NA	< 0.020	103%	70%	130%	111%	80%	120%	109%	70%	130%
Total Arsenic	5054608	5054608	<0.020	<0.020	NA	< 0.020	96%	70%	130%	102%	80%	120%	102%	70%	130%
Total Bismuth	5054608	5054608	<0.010	<0.010	NA	< 0.010	98%	70%	130%	106%	80%	120%	101%	70%	130%
Total Cadmium	5054608	5054608	<0.020	<0.020	NA	< 0.020	100%	70%	130%	102%	80%	120%	100%	70%	130%
Total Chromium	5054608	5054608	<0.020	<0.020	NA	< 0.020	99%	70%	130%	101%	80%	120%	98%	70%	130%
Total Cobalt	5054608	5054608	<0.010	<0.010	NA	< 0.010	101%	70%	130%	101%	80%	120%	100%	70%	130%
Total Copper	5054608	5054608	<0.020	<0.020	NA	< 0.020	102%	70%	130%	98%	80%	120%	94%	70%	130%
Total Iron	5054608	5054608	2.34	2.46	5.0%	< 0.05	103%	70%	130%	97%	80%	120%	NA	70%	130%
Total Lead	5054608	5054608	<0.020	<0.020	NA	< 0.020	94%	70%	130%	94%	80%	120%	92%	70%	130%
Total Manganese	5054608	5054608	0.178	0.185	3.9%	< 0.020	99%	70%	130%	100%	80%	120%	101%	70%	130%
Total Mercury	5053503		<0.0002	<0.0002	NA	< 0.0002	101%	70%	130%	104%	80%	120%	92%	70%	130%
Total Molybdenum	5054608	5054608	<0.020	<0.020	NA	< 0.020	101%	70%	130%	101%	80%	120%	100%	70%	130%
Total Nickel	5054608	5054608	<0.030	<0.030	NA	< 0.030	103%	70%	130%	99%	80%	120%	93%	70%	130%
Total Selenium	5054608	5054608	<0.002	0.004	NA	< 0.002	91%	70%	130%	105%	80%	120%	99%	70%	130%
Total Silver	5054608	5054608	<0.020	<0.020	NA	< 0.020	98%	70%	130%	95%	80%	120%	91%	70%	130%
Total Tin	5054608	5054608	<0.020	<0.020	NA	< 0.020	106%	70%	130%	108%	80%	120%	104%	70%	130%
Total Titanium	5054608	5054608	0.128	0.132	3.1%	< 0.010	97%	70%	130%	96%	80%	120%	99%	70%	130%
Total Vanadium	5054608	5054608	<0.020	<0.020	NA	< 0.020	103%	70%	130%	103%	80%	120%	103%	70%	130%
Total Zinc	5054608	5054608	<0.020	<0.020	NA	< 0.020	98%	70%	130%	102%	80%	120%	93%	70%	130%
Total Zirconium	5054608	5054608	<0.020	<0.020	NA	< 0.020	98%	70%	130%	97%	80%	120%	94%	70%	130%

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

Matrix spike NA: Spike level < native concentration. Matrix spike acceptance limits do not apply and are not calculated.

Quality Assurance

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC
PROJECT: 6638-Lakefield
SAMPLING SITE:

AGAT WORK ORDER: 23T034318
ATTENTION TO: Ali Rasoul
SAMPLED BY:T. Thornton

Water Analysis (Continued)

RPT Date: Jun 14, 2023			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Certified By:

CHARTERED
NIVINE BASILY
CHEMIST

Method Summary

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC
PROJECT: 6638-Lakefield
SAMPLING SITE:

AGAT WORK ORDER: 23T034318
ATTENTION TO: Ali Rasoul
SAMPLED BY:T. Thornton

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Oil and Grease (animal/vegetable) in water	VOL-91-5011	EPA SW-846 3510C & SM5520	BALANCE
Oil and Grease (mineral) in water	VOL-91-5011	EPA SW-846 3510C & SM 5520	BALANCE
Methylene Chloride	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
cis-1,2-Dichloroethylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Chloroform	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Benzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Trichloroethylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Toluene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Tetrachloroethene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,4-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
1,1 Dichloroethene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Trans 1,2-Dichloroethylene	VOL 5001	EPA SW-846 5230B & 8260	(P&T)GC/MS
Vinyl Chloride	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
m & p-Xylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
o-Xylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Xylenes (Total)	VOL-91-5001	modified from EPA 5030B & EPA 8260D	CALCULATION
Toluene-d8	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
NP2EO	ORG-91-5122	modified ASTM D7485-16	HPLC
NP1EO	ORG-91-5122	modified ASTM D7485-16	HPLC
4n-NP	ORG-91-5122	modified ASTM D7485-16	HPLC
NP	ORG-91-5122	modified ASTM D7485-16	HPLC
Nonylphenols	ORG-91-5122	modified ASTM D7485-16	CALCULATION
Nonylphenol Ethoxylates	ORG-91-5122	modified ASTM D7485-16	CALCULATION

Method Summary

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC
PROJECT: 6638-Lakefield
SAMPLING SITE:

AGAT WORK ORDER: 23T034318
ATTENTION TO: Ali Rasoul
SAMPLED BY:T. Thornton

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
BOD (5)	INOR-93-6006	Modified from SM 5210 B	DO METER
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
Total Suspended Solids	INOR-93-6028	modified from EPA 1684,ON MOECC E3139,SM 2540C,D	BALANCE
Fluoride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Chloride	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Cyanide, SAD	INOR-93-6051	modified from MOECC E3015; SM 4500-CN- A, B, & C	SEGMENTED FLOW ANALYSIS
Total Kjeldahl Nitrogen	INOR-93-6048	modified from EPA 351.2 and SM 4500-NORG D	LACHAT FIA
Phenols	INOR-93-6072	modified from SM 5530 D	LACHAT FIA
Total Phosphorus	INOR-93-6022	modified from SM 4500-P B and SM 4500-P E	SPECTROPHOTOMETER
Total Aluminum	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Antimony	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Arsenic	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Bismuth	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cadmium	MET -93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Chromium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cobalt	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Copper	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Iron	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Lead	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Manganese	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Mercury	MET-93-6100	modified from EPA 245.2 and SM 3112 B	CVAAS
Total Molybdenum	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Nickel	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Selenium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Silver	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Tin	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Titanium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Vanadium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Zinc	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

Method Summary

CLIENT NAME: A & A ENVIRONMENTAL CONSULTANTS INC **AGAT WORK ORDER: 23T034318**

PROJECT: 6638-Lakefield **ATTENTION TO: Ali Rasoul**

SAMPLING SITE: **SAMPLED BY:T. Thornton**

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Total Zirconium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

AGAT Laboratories

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

Chain of Custody Record

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

Laboratory Use Only

Work Order #: 23T034318

Cooler Quantity: 1 large

Arrival Temperatures: 9.2 | 9.3 | 9.5

Custody Seal Intact: ☐ Yes ☐ No ☒ N/A

Notes: bagged ice

Report Information:

Company: A & A Environmental Consultants Inc.
Contact: Dr. Ali Rasoul
Address: 16 Young St
Woodstock, ON
Phone: 519-266-4680 Fax: 519-266-3666
Reports to be sent to:
1. Email: arasoul@aaenvironmental.ca, vsowden@aaenvironmental.ca
2. Email: sscott@aaenvironmental.ca,

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☑ Regulation 153/04

Table ____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☒ Sanitary
☐ Storm
Region Peterborough *Indicate One*

☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ *Indicate One*

Is this submission for a **Record of Site Condition**?
☐ Yes ☑ No

Report Guideline on *Certificate of Analysis*
☑ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☐ 5 to 7 Business Days

Rush TAT **(Rush Surcharges Apply)**

☐ 3 Business Days ☐ 2 Business Days ☒ Next Business Day

OR Date Required (Rush Surcharges May Apply): ____

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 6638 - Lakefield
Site Location:
Sampled By: T.Thornton
AGAT Quote #: 368057 PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI	O. Reg 153			Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	Metals O.Reg 153 Soil	Metals Water 93-196	CCME F1-F4/VOCs Soil 91-248	CCME F1-F4/VOCs Water 91-249	CCME F1-F4/ BTEX Water 91-205	Sieve & texture (75 Micron)
						Y / N	Metals and Inorganics	☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)	ORPs: ☐ B-HWS ☐ Cl^- ☐ CN^- ☐ Cr^{6+} ☑ EC ☐ FOC ☐ Hg ☑ pH ☐ SAR																	
MW1	June9/23	11.00am	19	GW	Peterborough Sanitary	N																				

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time	
T.Thornton, Tyler Thornton	June9/23	1:00pm	T.	Jun 9	12:55pm	
Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time	Page 1 of 1
Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time	N°:

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

APPENDIX D – MECP Well Records

Water Well Records - Report #6638

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
LAKEFIELD VILLAGE 07 016	17 717691 4922222 W	2007-04 1844	20.0				0057 13	7044826 (Z58361) A051292	BRWN SAND GRVL FILL 0005 BRWN SAND GRVL SILT 0010 GREY LMSN 0070
									1
DOURO TOWNSHIP CON 07 015	17 718165 4921973 W	1979-05 5102	6	UK 0085	12/82/3/4:15	DO		5109505 ()	BLCK LOAM 0001 BRWN CLAY STNS 0011 GREY SHLE 0016 GREY LMSN 0086
LAKEFIELD VILLAGE	17 717456 4922673 W	1954-05 4713	6 6	FR 0043	6/30/5/2:0	DO		5101948 ()	LOAM 0002 BRWN CLAY STNS 0018 GREY LMSN 0043
LAKEFIELD VILLAGE	17 717897 4922055 W	1964-05 2113	6 6	FR 0057	17/38/15/2:0	DO		5101956 ()	LOAM 0001 BRWN CLAY STNS 0005 GREY CLAY STNS 0020 GREY LMSN 0062
SMITH TOWNSHIP CON 07 028	17 717576 4921791 W	1957-10 3532	6 6	FR 0021	10/10/10/2:0	DO		5104059 ()	LMSN 0030
DOURO TOWNSHIP CON 07 015	17 718015 4922003 W	1969-08 2104	6	FR 0050 FR 0070	50/102/1/3:0	DO		5104999 ()	LOAM 0001 BRWN CLAY STNS 0006 BRWN STNS 0009 BRWN CLAY STNS 0019 GREY LMSN 0087 BRWN LMSN 0107
SMITH TOWNSHIP CON 07 028	17 717595 4921803 W	1971-07 4713	6	FR 0023	6/15/10/1:0	DO		5105803 ()	BRWN CLAY STNS 0014 GREY LMSN 0023
LAKEFIELD VILLAGE	17 717510 4922551 W	1952-06 2113	6 6	FR 0020 FR 0057	7/50/1/:	DO		5101933 ()	CLAY MSND STNS 0011 LMSN 0057
DOURO TOWNSHIP CON 07 016	17 717915 4922473 W	1978-12 4923	6	SU 0044	25/40/3/2:30	DO		5109420 ()	GREY STNS CLAY 0028 GREY LMSN LYRD 0048
DOURO TOWNSHIP 015	17 718254 4922624 W	2005-07 9999		FR 0016	16/20//0:50	DO		5120367 (Z34731) A	PRDG

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PETERBOROUGH CITY (S CON 07 016	17 717765 4922573 W	1978-06 1455	6	FR 0090	4/100/3/1:0	DO		5109388 ()	LOAM 0001 BRWN CLAY STNS 0005 GREY LMSN STNS 0110
									DO 10
DOURO TOWNSHIP	17 717621 4921945 W	2014-04 7241	1.59			MT	0004	7221818 (Z187806) A157967	BLCK LOAM SOFT 0002 GREY LMSN FCRD 0011
DOURO TOWNSHIP	17 717583 4921976 W	2014-04 7241	1.59			MT	0004 9	7221816 (Z187804) A157970	BRWN SAND SOFT 0002 GREY LMSN FCRD 0013
DOURO TOWNSHIP	17 717553 4922028 W	2014-04 7241	1.59			MT	0004 6	7221817 (Z187805) A156404	BRWN SAND SOFT 0002 GREY LMSN FCRD 0010
									MT 3
LAKEFIELD VILLAGE	17 717486 4922126 W	2005-10 6809	2			NU	0010 5	5120436 (Z34013) A023257	BRWN SAND 0003 GREY LMSN 0015
									NU 1
DOURO TOWNSHIP CON 07 016	17 717962 4922057 W	2008-04 1455	6.25		22/33/8/1:0	PS		7121518 (Z80910) A067029	BRWN LOAM 0002 BRWN CLAY STNS 0008 BRWN CLAY BLDR STNS 0013 GREY LMSN STNS 0065
									PS 1

Total Wells: 16

Notes:
UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code

PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag . A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
BLDR	BOULDERS	FCRD	FRACTURED	IRFM	IRON FORMATION	PORS	POROUS	SOFT	SOFT
BSLT	BASALT	FGRD	FINE-GRAINED	LIMY	LIMY	PRDG	PREVIOUSLY DUG	SPST	SOAPSTONE
CGRD	COARSE-GRAINED	FGVL	FINE GRAVEL	LMSN	LIMESTONE	PRDR	PREV. DRILLED	STKY	STICKY
CGVL	COARSE GRAVEL	FILL	FILL	LOAM	TOPSOIL	QRTZ	QUARTZITE	STNS	STONES
CHRT	CHERT	FLDS	FELDSPAR	LOOS	LOOSE	QSND	QUICKSAND	STNY	STONEY
CLAY	CLAY	FLNT	FLINT	LTCL	LIGHT-COLOURED	QTZ	QUARTZ	THIK	THICK
CLN	CLEAN	FOSS	FOSILIFEROUS	LYRD	LAYERED	ROCK	ROCK	THIN	THIN
CLYY	CLAYEY	FSND	FINE SAND	MARL	MARL	SAND	SAND	TILL	TILL
CMTD	CEMENTED	GNIS	GNEISS	MGRD	MEDIUM-GRAINED	SHLE	SHALE	UNKN	UNKNOWN TYPE
CONG	CONGLOMERATE	GRNT	GRANITE	MGVL	MEDIUM GRAVEL	SHLY	SHALY	VERY	VERY
CRYS	CRYSTALLINE	GRSN	GREENSTONE	MRBL	MARBLE	SHRP	SHARP	WBRG	WATER-BEARING
CSND	COARSE SAND	GRVL	GRAVEL	MSND	MEDIUM SAND	SHST	SCHIST	WDFR	WOOD FRAGMENTS
DKCL	DARK-COLOURED	GRWK	GREYWACKE	MUCK	MUCK	SILT	SILT	WTHD	WEATHERED
DLMT	DOLOMITE	GVLY	GRAVELLY	OBDN	OVERBURDEN	SLTE	SLATE		
DNSE	DENSE	GYPS	GYPSUM	PCKD	PACKED	SLTY	SILTY		
DRTY	DIRTY	HARD	HARD	PEAT	PEAT	SNDS	SANDSTONE		
DRY	DRY	HPAN	HARDPAN	PGVL	PEA GRAVEL	SNDY	SANDYOAPSTONE		

2. Core Color

Code	Description
WHIT	WHITE
GREY	GREY
BLUE	BLUE
GREN	GREEN
YLLW	YELLOW
BRWN	BROWN
RED	RED
BLCK	BLACK
BLGY	BLUE-GREY

3. Well Use

Code	Description	Code	Description
DO	Domestic	OT	Other
ST	Livestock	TH	Test Hole
IR	Irrigation	DE	Dewatering
IN	Industrial	MO	Monitoring
CO	Commercial	MT	Monitoring TestHole
MN	Municipal		
PS	Public		
AC	Cooling And A/C		
NU	Not Used		

4. Water Detail

Code	Description	Code	Description
FR	Fresh	GS	Gas
SA	Salty	IR	Iron
SU	Sulphur		
MN	Mineral		
UK	Unknown		

APPENDIX E – Water Balance Calculation

	Area (m^2)	Infiltration Factors				Precipitation Data		Calculated	
		Topography	Soil	Cover	Accumulative Infiltration Factors	P	E	I	R
						(mm/y)	(mm/y)	(mm/y)	(mm/y)
						(m^3/y)	(m^3/y)	(m^3/y)	(m^3/y)
Pre-development									
Impervious Area	0					882	176	0	706
						0.0	0.0	0.0	0.0
Pervious Area	10197	0.15	0.2	0.05	0.4	882	564	127.2	190.8
		(Fairly Hilly)	(Clayey Silt)			8993.8	5751.1	1297.1	1945.6
Inputs		**m^3/year**			**Outputs**			**m^3/year**	
Total Precipitation		8993.8			Total Evapotranspiration			5751.1	
					Total Infiltration			1297.1	
					Total Runoff			1945.6	
Total		8993.8			Total			8993.8	
Difference (Inputs-Outputs)					0				
Post Development									
Impervious Area	4163					882	176	0	706
						3671.8	734.4	0.0	2937.4
Pervious Area	6034	0.15	0.2	0.05	0.4	882	564	127.2	190.8
		(Fairly Hilly)	(Clayey Silt)			5322.0	3403.2	767.5	1151.3
Inputs		**m^3/year**			**Outputs**			**m^3/year**	
Total Precipitation		8993.8			Total Evapotranspiration			4137.5	
					Total Infiltration			767.5	
					Total Runoff			4088.7	
Total		8993.8			Total			8993.8	
Difference (Inputs-Outputs)					0				
Developmental Impacts					**Infiltration**			**Runoff**	
Sub-Total Post-Development (m^3/year)					767.5			4088.7	
Impacts from Pre to Post Development (m^3/year)					-529.5			2143.1	