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37 Years

Forest and Nature School
411 Corkstown Road

Site Servicing and Stormwater Management Report

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City of Ottawa

Site Servicing and

Stormwater Management Report

Prepared By:

NOVATECH
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario
K2M 1P6

Revised: May 4, 2020
Submitted: April 15, 2020

Novatech File: 119045
Ref: R-2020-055

May 4, 2020

City of Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West
Ottawa, ON K1P 1J1

Attention: Eric Surprenant, Project Manager Infrastructure Approvals

Dear Eric:

Reference: 411 Corkstown Road – Forest and Nature School
Site Servicing and Stormwater Management Report
Our File No.: 119045

Please find enclosed the Site Servicing and Stormwater Management Brief for the proposed Forest and Nature School located on the site of the existing Wesley Clover Campground at 411 Corkstown Road in the City of Ottawa. A preliminary version of this report was submitted to the National Capital Commission (NCC) for review on April 15, 2020.

This report is submitted in support of a Site Plan Control application.

Please contact the undersigned, should you have any questions or require additional information.

Sincerely,

NOVATECH

Greg MacDonald, P.Eng.
Director, Land Development and Public Sector Infrastructure

Copy: Jessie Smith, CSV Architects

Suite 200, 240 Michael Cowpland Drive, Ottawa ON K2M 1P6 Tel: 613.254.9643 Fax: 613.254.5867 www.novatech-eng.com

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1.0 INTRODUCTION

Andrew Fleck Children's Services is proposing to develop a new childcare facility building, approximately 420m^2 in area, adjacent to the existing campground facility on the site located at 411 Corkstown Road. This site is within the Greenbelt owned by the National Capital Commission (NCC) in the City of Ottawa. Novatech has been retained by CSV Architects to complete a Site Servicing and Stormwater Management report for the proposed development.

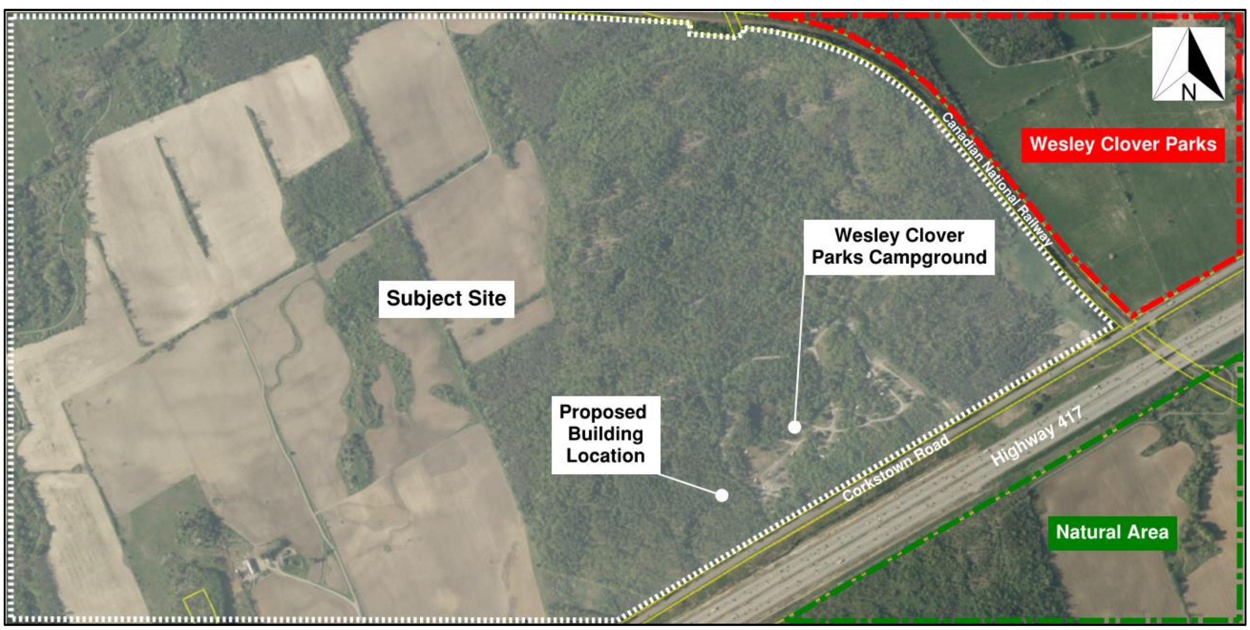
This report addresses the approach to site servicing and stormwater management for the proposed development and is being submitted in support of a site plan control application.

1.1 Location and Site Description

The subject site is located within the property known as 411 Corkstown Road in the City of Ottawa (Ward 7-Bay), as shown in **Figure 1 (Aerial Plan)**. The subject site is situated in the Greenbelt and falls within the jurisdiction and responsibility of the National Capital Commission (NCC). The area of land leased from the NCC is approximately 81.2 ha with 844 metres of frontage along Corkstown Road. There is an existing campground facility on the subject property, operated by Wesley Clover Foundation who have a long-term lease agreement with the NCC.

The property is bounded by Corkstown Road (and Highway 417) to the south, the Canadian National Railway corridor and Trans Canada Trail to the north, and the edge of a forested ridge to the west as shown on **Figure 1**. The site of the proposed development is located to the west of the existing Wesley Clover Campground.

Figure 1 - Aerial Plan provides an aerial view of the site.



The site of the proposed development is currently undeveloped. The legal plan of the site prepared by Annis, O'Sullivan, Vollebekk Ltd., is attached to this report.

1.2 Pre-application Meetings

Pre-consultation meetings were held with staff from the City of Ottawa on April 30, 2019 as well as the NCC on May 1, 2019 to discuss the details of the proposed development. Refer to **Appendix A** for a summary of the correspondence related to the proposed development.

1.3 Geotechnical Investigation

A Geotechnical Investigation Report [1] has been prepared by Gemtec. Refer to the Geotechnical Report for sub-surface conditions, construction recommendations and geotechnical inspection requirements.

2.0 PROPOSED DEVELOPMENT

The proposed development will consist of a two (2) storey childcare facility building, proposed to cater for a total of 49 students, 12 staff members and 14 research facility staff. A two-way access road with two parking bays is proposed to connect the proposed building to the existing Wesley Clover campground access road.

Refer to **Appendix B** for a copy of the latest Site Plan (by CSV Architects) showing the general layout of the proposed development.

3.0 SITE SERVICING

The objective of the site servicing design is to conform to the requirements of the City of Ottawa, to provide suitable sewage outlets and to ensure that a domestic water supply and appropriate fire protection are provided for the proposed development.

Servicing criteria and expected sewage flows and water demands for the proposed development have been established using the City of Ottawa design guidelines for sewer systems and water distribution.

3.1 Proposed Servicing Overview

In general, the proposed development will be serviced for water by extending a new private water service to the existing municipal watermain in Corkstown Road, and for sanitary by extending a new private sanitary sewer to the existing private sanitary sewer system in Wesley Clover Campground. The stormwater management approach for the proposed development is described in the stormwater section of this report.

Refer to the subsequent sections of the report and to the attached Grading and Servicing Plan **(119066-GS)** for further details.

4.0 WATER

There is an existing 406mm dia. municipal watermain located adjacent to the site in Corkstown Road. There is also an existing 150 mm dia. private watermain in the Wesley Clover campground access road.

[1] Geotechnical Investigation Proposed Forest and Nature Child Care Centre 411 Corkstown Road, by GEMTEC, dated April 23, 2020

The proposed development will be serviced by extending a new private 150mm dia. watermain from the proposed development to the existing 406mm dia. municipal watermain in Corkstown Road. The proposed watermain will be 150mm dia. up to a proposed private fire hydrant, then a 50mm dia. water service to the proposed building.

4.1 Water Demands

The theoretical domestic water demands for the proposed development are given in **Table 4.1.** Refer to **Appendix C** for the design criteria used, taken from Section 4 of the Ottawa Design Guidelines – Water Distribution.

Table 4.1: Theoretical Water Demands for Proposed Development

Average Water Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)
0.12	0.18	0.32

4.2 Water Supply for Fire-Fighting

The Fire Underwriters Survey (FUS) was used to estimate fire flow requirements for the proposed development. The following building construction details were confirmed with the architect:

- Wood frame construction
- 2-storey
- Non-combustible occupancy type
- Non-sprinklered

It should be noted that fire flow requirements calculated using the FUS method tend to generate higher values when compared to flows being calculated using the Ontario Building Code (OBC).

The calculated fire flow demand for the proposed residential building is 150 L/s (9,000L/min). Refer to **Appendix C** for a copy of the FUS fire flow calculations.

There is one (1) existing municipal fire hydrant and one (1) existing private fire hydrant within 150m of the proposed building. A new private fire hydrant is proposed near the proposed building, with fire truck access provided by the proposed access road. Refer to attached drawing **119066-GS** for their locations.

4.3 Municipal Boundary Conditions

The preliminary water demand and fire flow calculations presented above were provided to the City of Ottawa to request municipal watermain network boundary conditions and multi hydrant analysis results. At the time of writing, boundary conditions had not yet been received. Detailed fire flow analysis will be completed once these are received.

It is expected that the existing municipal watermain system can provide adequate water supply (domestic and fire) to the proposed development.

5.0 SANITARY SEWER

5.1 Existing Sanitary Infrastructure

There is no existing municipal sanitary sewer system within the vicinity of the proposed development. There is an existing private sanitary sewer system on the subject site that services the Wesley Clover Campground.

5.2 Proposed Sanitary Servicing

The proposed development will be serviced by extending a new private 200mm dia. sanitary sewer from the proposed building to the existing 200mm dia. private sewer in the Wesley Clover Campground access road.

The theoretical sanitary flows for the proposed development are summarized below in **Table 5.1.** Refer to **Appendix D** for detailed calculations and design criteria.

Table 5.2: Sanitary Design Flows for the Proposed Development

Building Area	Design Population (people)	Average Flow [1]	Peak Flow [2, 3]
700 m2	49 x students 26 X staff	0.13 L/s	0.23 L/s

[1] Average Dry Weather Flow
[2] Peak Wet Weather Flow, includes an infiltration allowance of 0.33 L/s/gross ha over 0.16 ha.
[3] Institutional Peaking Factor = 1.5

Based on Manning's Equation, a 200mm dia. sanitary gravity sewer at a slope of 0.5% has a full flow conveyance capacity of approximately 24 L/s, which is sufficient to convey the theoretical sanitary design flows calculated above.

6.0 STORMWATER MANAGEMENT

6.1 Existing Conditions

Under existing conditions, storm runoff from the subject site sheet drains in a northwesterly direction partially towards a vernal pool, as indicated by the existing overland flow arrows on the attached drawing **119045-GS**.

From the geotechnical report [1], soils on site are generally described as follows:

- 100 mm topsoil
- 100 mm – 500 mm thick layer of sand and gravel (overburden soil)
- Grey brown slightly weathered sandstone bedrock at depths beyond 200-500 mm below surface.

The site is currently treed and undeveloped. The pre-development runoff coefficient is estimated to be 0.25.

6.2 Stormwater Management Criteria

The site is located within the jurisdiction of the Mississippi Valley Conservation Authority. The following stormwater management criteria and objectives for the site have been developed based on recommendations in the NCC *Stormwater Management Implementation and Application Policy (NCC, April 2018)*, the City of Ottawa Sewer Design Guidelines (October 2012) and associated Technical Bulletins.

Water Quality

- Provide an *Enhanced* (80% long-term TSS removal) level of water quality control;
- Mitigate thermal impacts of stormwater runoff;
- Implement lot level and conveyance Best Management Practices to promote infiltration and treatment of storm runoff;
- Utilize Low Impact Development measures (LIDs) where feasible.

Water Quantity

- Control post-development peak flows for all events up to and including the 100-year storm event;
  - Ensure the post-development peak flows match the smaller of the pre-development peak offsite discharge rate or the downstream conveyance capacity of the receiving system;
  - Demonstrate no adverse impacts to the receiving system;
- Demonstrate that the potential impacts of climate change have been considered in the SWM strategy;
- Provided a minimum volume control for the first 25mm of storm runoff;
  - The runoff control volume is to be retained on-site through LIDs;
- Prevent negative drainage impacts to federal lands;

Erosion Control

- Implement best practice erosion & sediment control (ESC) measures during construction.

Water Balance

- Perform a pre- and post-development water balance to determine the method(s) to be used to meet the runoff control volume requirements.

6.3 Overall Stormwater Management Approach

As the site is a natural setting, the approach to stormwater management will be to minimize the disruption to the site as much as possible. In this regard, existing grades and flow patterns will be maintained as much as possible.

The entrance road and parking bays will hug existing grades and will be constructed of gravel rather than asphalt. The pathways will be constructed of stone dust and hug existing grades as much as possible. The finished floor elevation (FFE) of the new building will be close to existing grades, founded on the shallow bedrock.

Roof runoff is proposed to be collected by eavestroughs and downspouts which discharge into rain barrels around the perimeter of the building. These rain barrels are proposed to be fitted with perforated spitter hoses that would slowly discharge the collected stormwater to the surface. Once the capacity of the rain barrels is reached, they will overflow to vegetated infiltration swales. The vegetated infiltration swales will be shallow (120 mm depth) and will allow the runoff to slowly infiltrate into the ground. This low impact stormwater management approach would also be an educational experience for the children.

6.4 Water Balance Study

To meet the design requirements provided by the NCC, a water balance study has been performed to determine the impact of the proposed development on the hydrological cycle.

A detailed water balance study was performed to determine the change in runoff and infiltration from pre-development to post-development conditions. The pre-development infiltration volume can be used as an infiltration target for post-development conditions. Additionally, the increase in runoff under post-development conditions can be used to determine the volume of water to be retained on-site to prevent negative impacts to the vernal pool. Water balance calculations were performed following the methodology presented in **Appendix E**.

Under existing pre-development conditions, the site area outlined on Figure 2 (**Appendix E**) sheet drains in a northwesterly direction, partially towards an existing vernal pool. Vernal pools are seasonal wet areas that are filled by spring rains and snow melt. Vernal pools dry up in the summer months but serve as breeding habitat for amphibians and insects throughout the spring. It is important that the vernal pool adjacent to the proposed development continues to receive a similar amount of runoff under post-development conditions in order to maintain the habitat. Too much or too little runoff can alter the habitat in the vernal pool. The site is currently occupied by a forested area. Refer to Figure 3 – Existing Conditions (**Appendix E**).

From the geotechnical report [1] by Gemtec, soils on site are generally sand and gravel. Typically sand and gravel are considered to be classified as Hydrological Soil Group (HSG) Soil Type 'A', but in order to account for infiltration through the topsoil, the on-site soils are considered as HSG Soil Type 'B' fine sandy loam.

Under proposed post-development conditions, runoff from the site development area (0.38 ha) will increase. It is proposed to capture and control runoff on-site prior to sheet surface drainage from the site to the vernal pool or other low-lying wet areas adjacent to the site, per existing conditions.

Available water-holding capacity (AWC) values have been assigned based on land use and soil type, as outlined in the Stormwater Management Planning and Design Manual (MOE, March 2003). Refer to Figure 4 – Existing Land Use and Figure 5 – Proposed Land Use (**Appendix E**). Impervious areas have been given an AWC value of 1.57mm, based on the City of Ottawa default infiltration values outlined in the Ottawa Sewer Design Guidelines (City of Ottawa, 2012). This accounts for any evapotranspiration that occurs from the impervious areas, such as roofs, gravel roads, and stone dust paths.

The post-development water balance calculations were performed assuming no Low Impact Development (LID) measures are installed. A summary of the annual infiltration and runoff rates calculated from the water balance model are outlined in **Table 6.4.**

Table 6.4: Water Balance Results Summary

Result	Annual Rate (mm/yr)			Annual Volume (m^3/yr)		
	Pre-Dev.	Post-Dev.	Change	Pre-Dev.	Post-Dev.	Change
Infiltration	243	148	- 95	923	562	- 361
Runoff	104	232	+ 128	395	882	+ 487

The water balance calculations show that without any LID measures, there would be an expected increase in runoff volume from the site of 487 m^3/year.

Refer to **Appendix E** for detailed water balance calculations.

6.4.1 Infiltration Volume Target

The proposed development will implement best management practices (BMPs) to mitigate the reduction in infiltration and increase in runoff resulting from development. Proposed BMPs for groundwater infiltration include rain barrels and vegetated swales.

For the proposed development to have the least impact on the site and surrounding areas, the pre-development infiltration volume will be the target for post-development conditions. To meet this target, the volume of rainfall infiltrated across the site should be 923 m^3/year. The proposed site without BMPs or LIDs is estimated to infiltrate 562 m^3/year; therefore, an additional 361 m^3/year should be infiltrated using BMPs and/or LIDs.

Annual Rainfall and Volume Captured

Based on thirty (30) years of climate data (1988-2017) from the Environment Canada Station at the Ottawa International Airport, the average annual precipitation in Ottawa is 914mm (rain + snow). The average annual rainfall between May and October is 515mm.

The total average annual rainfall volume over the site area (0.38 ha) is 1,957 m^3/year. Therefore, to infiltrate an additional 361 m^3/year, the proposed infiltration system would need to capture 100% of the runoff from approximately 18% of the site, or 0.07 ha (700 m^2).

As the roof of the proposed building is 0.07 ha, 100% of the roof runoff is proposed be captured and infiltrated using a combination of rain barrels and vegetated swales. By capturing and infiltrating 100% of the runoff from the roof, it is possible to capture and infiltrate an additional 361 m^3/year, meeting the pre-development infiltration rate.

The infiltration rate of the on-site soils provided in the Gemtec geotechnical report [1] is 140 mm/hour. In order to account for sediment accumulation, 50% of the infiltration rate was used in calculations (70 mm/hour). Based on the total available infiltration rate from the bottom of the vegetated swales and the runoff from the roof during the 100-year storm event, using the Modified Rational Method the storage volume required was calculated to be 27.4 m^3.

For detailed infiltration volume calculations, refer to **Appendix E**.

6.5 Water Quality Control

Runoff from the building's roof is considered clean and does not require treatment. Water quality treatment will be provided for the proposed gravel access road using a treatment train approach. It is expected that this access road will have a low volume of vehicle traffic as only eight (8) parking spots are provided.

Runoff from the gravel access road will flow over a grassed level flow spreader. The flow spreader will allow runoff to uniformly flow through a vegetated filter strip area, an existing flat area occupied by trees. The runoff will then make its way to the northern vegetated swale.

Refer to attached drawing **119066-GS** for details.

6.6 Water Quantity Control

6.6.1 Peak Flows

Rational Method calculations were performed to determine the pre-development and post-development peak flows from the site. Due to the small size of the site (0.38 ha), the time of concentration for both the pre-development and post-development conditions was assumed to be 10 minutes.

The runoff coefficients used for the site are as follows:

- Vegetated areas C = 0.25
- Stone dust paths C = 0.60
- Gravel access road C = 0.70
- Building roof C = 0.90

The uncontrolled peak flows for the site are summarized in **Table 6.6-A** below. Refer to **Appendix E** for detailed calculations.

Table 6.6-A: Pre- and Post-Development Uncontrolled Peak Flow Summary

Scenario	Uncontrolled Peak Flow (L/s)		
	2-year	5-year	100-year
Pre-Development	20	27	58
Post-Development	37	50	104

There will be an increase in peak flows from the site under post-development conditions. With no stormwater management measures, the peak flows from the site would increase by approximately 85%.

To reduce the peak flows from the site, runoff from the roof area will be stored and infiltrated by a combination of rain barrels and vegetated swales. As the vegetated swales have been sized to capture all runoff from the roof for up to and including the 100-year storm event, all runoff from the roof is considered to be infiltrated and will not contribute to total runoff from the site.

The controlled post-development peak flows for the site are summarized in **Table 6.6-B** below. Refer to **Appendix E** for detailed calculations.

Table 6.6-B: Post-Development Peak Flow Summary

Scenario	Controlled Peak Flow (L/s)		
	2-year	5-year	100-year
Post-Development	24	32	68

Overall, the peak flows from the site are expected to increase by approximately 18% on average.

6.6.2 Minimum Volume Control

Based on the NCC *Stormwater Management Implementation and Application Policy*, the required volume control target is to be, at a minimum, the runoff generated from a 25 mm event.

The runoff volume generated from a 25 mm rain event over the roof area is as follows:

Runoff Volume Control Target = 25 mm * 0.07 ha
= 17.5 m^3

The storage volume required to meet the infiltration target (27.4 m^3) is greater than the runoff volume control target (17.5 m^3); therefore, the minimum volume control criteria is met.

6.7 Vegetated Swale Sizing

The proposed vegetated swales have been sized to store and infiltrate storm runoff from the site. Based on the water balance calculations outlined in Section 6.4 and provided in **Appendix E**, a storage volume of 27.4 m^3 is required to meet the quantity control and water balance criteria.

Based on the required storage volume and the infiltration rate of the soil, the vegetated swales are to have the following dimensions:

- North Vegetated Swale
  - 90 m length
  - 1 m bottom width
  - 3H:1V side slopes
  - 120 mm depth
- South Vegetated Swale
  - 90 m length
  - 1 m bottom width
  - 3H:1V side slopes
  - 120 mm depth

The total storage volume provided by the vegetated swales is 29.4 m^3, which exceeds the required storage as determined by the water balance. Refer **Appendix E** for detailed calculations and to attached drawing **119045-GS** for details of proposed vegetated swales.

7.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control measures will be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987):

- All erosion and sediment control measures are to be installed to the satisfaction of the engineer, the municipality and the conservation authority prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and remain present during all phases of site preparation and construction.
- A qualified inspector should conduct daily visits during construction to ensure that the contractor is working in accordance with the design drawings and that mitigation measures are being implemented as specified:
  - A light duty silt fence is to be installed as per OPSS 577 and OPSD 219.110 along the surrounding construction limits.
  - Street sweeping and cleaning will be performed, as required, to suppress dust and to provide safe and clean roadways adjacent to the construction site.
  - After complete build-out, all sewers are to be inspected and cleaned and all sediment and construction fencing is to be removed.
- The contractor shall immediately report to the engineer or inspector any accidental discharges of sediment material into any ditch or sewer system. Appropriate response measures shall be carried out by the contractor without delay.

The proposed temporary erosion and sediment control measures will be implemented prior to construction and will remain in place during all phases of construction.

8.0 CONCLUSIONS

This report has been prepared in support of a site plan control application for the proposed Canadian Centre for Outdoor Plan at 411 Corkstown Road. The proposed development will consist of a 2-storey childcare facility building, with access via a new two-way access from Wesley Clover Campground.

The conclusions are as follows:

- The proposed development will be serviced for water by extending a new private 150mm dia. watermain from the proposed building to the existing 405mm dia. municipal watermain located in Corkstown Road. A new private fire hydrant will be provided close to the proposed building.
- It is expected that the existing municipal watermain system can provide adequate water supply (domestic and fire) to the proposed development.
- The proposed development will be serviced for sanitary by extending a new 200mm dia. private sanitary sewer from the proposed building to the existing 200mm dia. private sanitary sewer in Wesley Clover Campground access road.
- The theoretical peak sanitary flow from the proposed development is minimal (0.23 L/s). As such the existing sanitary sewer system is expected to have sufficient capacity to accommodate the proposed development.

- The stormwater management approach for the proposed development will be to minimize the disruption to the site as much as possible. Existing grades and flow patterns will be maintained as much as possible, and the access road and parking will be gravel and the pathways will be constructed of stone dust to minimize imperviousness. The pre-development annual infiltration volume across the site will be the target infiltration volume for post-development conditions.
- Runoff from the roof of the proposed building will be collected and discharged into rain barrels fitted with perforated spitter hoses that slowly discharge the stormwater to the surface. Once the capacity of the rain barrels is reached, they will overflow to vegetated swales that allow the runoff to slowly infiltrate into the ground.
- The vegetated swales have been sized to capture and store all runoff from the proposed building roof, for all design events up to and including the 100-year event.
- Temporary erosion and sediment controls will be provided during construction.

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Sanitary/Water

Prepared by:

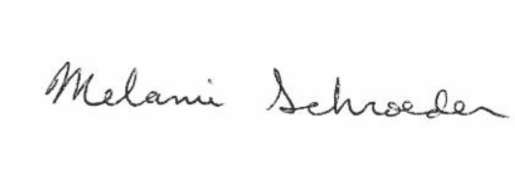
Lydia Bolam, P. Eng.
Project Engineer

Reviewed/Approved by:

Greg MacDonald, P. Eng.
Director | Land Development and
Public Sector Infrastructure

Stormwater Management

Prepared by:



Melanie Schroeder, E.I.T.
Water Resources E.I.T.

Reviewed by:

Kallie Auld, P. Eng.
Project Coordinator | Water Resources

Appendix A

Subject: RE: Pre-Consultation Follow-up: 411 Corkstown Road
Date: Monday, May 6, 2019 at 4:20:22 PM Eastern Daylight Time

---

From: Robert Tran
Sent: Monday, May 06, 2019 11:53 AM
To: Kim Hiscott <khiscott@afchildrensservices.ca>; smith@csv.ca; froom@csv.ca
Cc: Greg Winters <G.Winters@novatech-eng.com>
Subject: FW: Pre-Consultation Follow-up: 411 Corkstown Road

Hello all,

Please see the email below for the comments from the pre-consult with the City. Thanks.

Robert Tran, M.PL., Planner
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 I Tel: 613.254.9643 Ext. 272 I Fax: 613.254.5867
The information contained in this email message is confidential and is for exclusive use of the addressee.

From: McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Sent: Monday, May 6, 2019 10:59 AM
To: Robert Tran <r.tran@novatech-eng.com>
Cc: Greg Winters <G.Winters@novatech-eng.com>
Subject: Pre-Consultation Follow-up: 411 Corkstown Road

Hello Robert,

Please refer to the below regarding the Pre-Application Consultation Meeting held on Tuesday April 30, 2019 for the property at 411 Corkstown Road for a Site Plan Control Application and a Lifting of a Holding Provision in order to allow the development of a childcare facility and office space. I have also attached the required Plans & Study List for application submission.

Below are staff's preliminary comments based on the information available at the time of pre-consultation meeting:

<u>Planning</u>

- Site currently zoned for proposed uses
- A Lifting of Holding By-law is required as per Rural Exception 868 that requires an EIS to be submitted that demonstrates that any future expansion will not pose any negative effects on the natural environment area and its features
- Scope of site to be determined once the concept plan has been finalized

-

<u>Engineering</u>

- Water connection is available on Corkstown Road
    - FUS calculations, hydrants
- Storm to be directed to ditches on Corkstown Road
    - To be controlled pre-development to post-development
- Discussion regarding sanitary onsite and whether or not it exists
    - Applicant to confirm with NCC
    - Connecting to the Tri-Township Trunk is not an option to connect into
    - Private servicing is an option (refer to sections 2.3.2 and 4.4 in the Official Plan) as there is no public service in the area for sanitary
- If more than if 10,000 Litres/day, an ECA will be required as well as a reasonable use study

Please contact Infrastructure Project Manager, Eric Surprenant for follow-up questions.

<u>Transportation</u>

- Follow Traffic Impact Assessment Guidelines
    - Traffic Impact Assessment will be required
    - Start this process as soon as possible
    - Applicant advised that their application will not be deemed complete until the submission of the draft step 1-4, including the functional draft RMA package (if applicable) and/or monitoring report (if applicable)
- ROW protection on Corkstown between March and Moodie is G - signifies Greenbelt for which unique rights-of-way protection policy apply as follows: For arterial road segments located entirely within the Greenbelt, the right-of-way requirements vary depending on: the number and width of travel lanes; the treatment of curbs, medians, and road drainage; and other amenities to be provided in the corridor
    - On this basis, the right-of-way to be acquired by the City and the means to acquire the land will be determined with involvement of the National Capital Commission on a case-by-case basis a road modifications are being planned
    - In the event that a portion of Greenbelt land is conveyed to another owner, a minimum road-widening requirement of 42.5 m shall apply for an arterial road segment adjacent to that land.
- For segments adjacent to the Greenbelt along only one side, the ROW dimension for the urban area

side should be protected, with an additional 5.0 m widening requested along the Greenbelt side (to construct the wider rural cross-section)
    - As always, the widening requirements are to be measured from the existing road centerline
- Noise Impact Studies required for the following:
    - Road
- On site plan:
    - Turning templates will be required for all accesses showing the largest vehicle to access the site; required for internal movements and at all access (entering and exiting and going in both directions).
    - Show all curb radii measurements; ensure that all curb radii are reduced as much as possible
    - Show lane/aisle widths

Please contact Transportation Project Manager, Rosanna Baggs for follow-up questions.

Environmental

- An Environmental Impact Statement will be required in order to lift the hold
    - The EIS must discuss significant woodlands, wildlife habitat, species at risk, natural landscape linkages, wetlands associated with the woodlands
    - Scope of the EIS to be agreed upon once location of the building is determined
- Will be in contact with the NCC regarding the EIS

Please contact Environmental Planner, Sami Rehamn for follow-up questions.

Forestry

- A permit is not required because the land is federally owned
- A Tree Conservation Report (TCR) must be supplied for review along with the various other plans/reports required by the City; an approved TCR is a requirement for Site Plan approval
- The removal of City-owned trees will require the permission of Forestry Services who will also review the submitted TCR
- In this case, the TCR may be combined with the EIS
- The TCR must list all trees on site by species, diameter and health condition; similar groupings (stands) of trees can combined using averages by species, diameter class
- The TCR must address all trees with a critical root zone that extends into the developable area – all trees that could be impacted by the construction that are outside the developable area need to be addressed.
- Trees with a trunk that crosses/touches a property line are considered co-owned by both property owners; permission from the adjoining property owner must be obtained prior to the removal of co-owned trees
- If trees are to be removed, the TCR must clearly show where they are, and document the reason they can not be retained – please provide a plan showing retained and removed treed areas
- All retained trees must be shown and all retained trees within the area impacted by the development process must be protected as per City guidelines listed on Ottawa.ca
- Please ensure newly planted trees have an adequate soil volume for their size at maturity. The following is a table of recommended minimum soil volumes:

Tree Type/Size	Single Tree Soil Volume (m3)	Multiple Tree Soil Volume (m3/tree)

Ornamental	15	9
Columnar	15	9
Small	20	12
Medium	25	15
Large	30	18
Conifer	25	15

- The City requests that all efforts are made to retain trees – trees should be healthy, and of a size and species that can grow into the site and contribute to Ottawa's urban forest canopy

For more information on the TCR process or help with tree retention options, contact Mark Richardson

Other

- You are encouraged to contact the Ward Councillor, Councillor xx, at [email] about the proposal. You may also consider contacting the [xx] Community Association at [email].

Please refer to the links to "Guide to preparing studies and plans" and fees for general information. Additional information is available related to building permits, development charges, and the Accessibility Design Standards. Be aware that other fees and permits may be required, outside of the development review process. You may obtain background drawings by contacting informationcentre@ottawa.ca.

These pre-consultation comments are valid for one year. If you submit a development application(s) after this time, you may be required to meet for another pre-consultation meeting and/or the submission requirements may change. You are as well encouraged to contact us for a follow-up meeting if the plan/concept will be further refined.

Please do not hesitate to contact me if you have any questions.

Regards,
Laurel

Laurel McCreight MCIP, RPP

Planner
Development Review West
Urbaniste
Examen des demandes d'aménagement ouest

City of Ottawa | Ville d'Ottawa
613.580.2424 ext./poste 16587
ottawa.ca/planning / ottawa.ca/urbanisme

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From: Hoyt, Christopher <christopher.hoyt@ncc-ccn.ca>
Sent: Tuesday, June 11, 2019 5:41 PM
To: Robert Tran
Cc: Moroz, Marek; Chakraburtty, Bina; Hetherington, Christopher; Katic, Eva; Lalonde, Sylvie
Subject: Wesley Clover - Forest School Building and Parking Proposal

Dear Robert,

Thanks for initiating federal approval for this concept. As requested at our recent approval kick off meeting, NCC staff have done an initial very quick high level review of the information provided and the below represents combined comments on this proposal:

The Greenbelt is identified in the NCC's 2013 Canada's Capital Greenbelt Master Plan as being a " … magnificent, publicly-owned landscape [that] exists thanks to past efforts to shape the future of the Capital. Without the vision and courage of those who planned and conserved the Greenbelt, many treasured landscapes would have been lost to the urban sprawl characteristic of many North American cities. Research and analysis of the Greenbelt's current condition reveal that these 20,600 hectares of forests, wetlands, farms and streams represent a rich and predominantly natural environment that hosts over 3.5 million visits per year for various recreational activities. Canada's Capital Greenbelt is unique in being the largest publicly-owned Greenbelt in the world and the most ecologically diverse landscape within an urban area".

Alignment with NCC Plans for the Greenbelt

- Existing plans don't anticipate buildings, with the exception of the 2012 amendment which shows a small building on stilts
- Daycare use not referenced
- New parking not referenced

Alignment with Lease Agreement

- Lease has been recently amended and allows for the proposed use

Alignment with Municipal Zoning and Bylaw

- Need to better understand City's proposed application of Environmental Protection zoning
- City planning report indicates; "At the current time, there is no immediate need for a structure or building as the Forest and Nature School currently utilizes existing indoor space within the campground during inclement weather. "

Alignment with Previous Approvals

- 1996 Master Plan amended in 2012
    - allowed Soccer Fields

    - showed a very small building (the size of a duck blind?) on stilts for the future forest school
- 2018 Approval
    - Demonstration plan, included equestrian uses
    - Forest School use identified without specifics around size of building or specific location

Environmental and Environmental Assessment Comments

- Need to demonstrate no damage to habitat connectivity
- Need to demonstrate no impact on species at risk – western chorus frog and butternut trees
- Need to see building footprint located on specific site

Site Servicing

- It is currently unknown whether existing connections to municipal services will be adequate for the proposed use

Building Proposed

- Unclear why environmental certification (LEED or other) would not be pursued given this proposed use
- Need to see building in a proposed location - difficult to evaluate without a 'site'.
- Footprint is significantly larger than was anticipated by 2012 Master Plan amendment
- Design should reflect the use - Forest School is quite a unique use - find an architectural vocabulary more specific to the proposal

Land Uses

- Forest School use is understood to be environmentally oriented, educational, and an excellent education vehicle for students that attend
- A more ambitious proposal from an environmental and design point of view with a ‘lighter’ presence in nature could be more easily supported
- Large additional paved areas are difficult to support for the proposed site

Analysis

- Concurrence with appropriateness of this proposal is not currently high among staff surveyed
- With the exception of the NCC’s lease with the proponent, policies do not seem to support his proposal as it is currently understood

- Proposals for new buildings and structures in the Greenbelt are hard to support; but should be positioned as being innovative from both an environmental and design excellence point of view
- Proponent is encouraged to return with a proposal that is better aligned with the existing NCC and municipal approved plans and policies
- The 'Forest School' concept is understood to be a largely outdoor endeavor - daycare use requirement is not currently supported for this location
- Other neighboring sites might be more suitable but further study is required

We're happy to meet with you to discuss further, but we recommend that further study is needed to demonstrate alignment.

Best Regards,

Chris

Christopher Hoyt, AIA, OAA, MRAIC
Senior Architect Design and Land Use
Architect principale Design et utilisation des sols
christopher.hoyt@ncc-ccn.ca
613-239-5678, ext. / poste 5769

National Capital Commission
Commission de la capitale nationale
Canada

Appendix B

SITE PLAN GENERAL NOTES:

1. ALL GENERAL SITE INFORMATION AND CONDITIONS COMPILED FROM EXISTING PLANS AND SURVEYS
2. DO NOT SCALE THIS DRAWING
3. REPORT ANY DISCREPANCIES PRIOR TO COMMENCING WORK. NO RESPONSIBILITY IS BORN BY THE CONSULTANT FOR UNKNOWN SUBSURFACE CONDITIONS
4. CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE AND REPORT ANY ERRORS AND/OR OMISSIONS TO THE CONSULTANT
5. REINSTATE ALL AREAS AND ITEMS DAMAGED AS A RESULT OF CONSTRUCTION ACTIVITIES TO THE SATISFACTION OF THE CONSULTANT
6. CONTRACTOR TO LAYOUT PLANTING BEDS, PATHWAYS ETC. TO APPROVAL OF CONSULTANT PRIOR TO ANY JOB EXCAVATION
7. THE ACCURACY OF THE POSITION OF UTILITIES IS NOT GUARANTEED - CONTRACTOR TO VERIFY PRIOR TO EXCAVATION
8. INDIVIDUAL UTILITY COMPANY MUST BE CONTACTED FOR CONFIRMATION OF UTILITY EXISTENCE AND LOCATION PRIOR TO DIGGING
9. ALL DISTURBED AREAS TO BE RESTORED TO ORIGINAL CONDITION OR BETTER UNLESS OTHERWISE NOTED

SITE PLAN KEYNOTES:

1 GARBAGE AREA
2 HIGH BUND WITH VEGETATED FLOW SPREADER ALONG EDGE OF PATH
3 STONEDUST FOOTPATH
4 GRAVEL ACCESS ROAD
5 TIERED DECK WITH PLANTING
6 BARRIER FREE PARKING SIGN
7 ROOF ABOVE
8 BICYCLE PARKING (0.6m x 1.8m)
9 1525mm WIDE DECK AROUND BUILDING PERIMETER

SITE PLAN LEGEND:

- EXISTING BUILDING
- GRAVEL
- CONCRETE PAD
- ASPHALT PAVING
- STONE DUST
- EMERGENCY EXIT
- SERVICE DOORS
- BUILDING MAIN ENTRANCE
- PROPERTY LINE
- FENCE PER LANDSCAPE
- NEW DOMESTIC WATER
- NEW SANITARY
- NEW STORM
- NEW ELECTRICAL SERVICE (BELOW GRADE)
- CATCH BASIN
- EXISTING CATCH BASIN
- FIRE HYDRANT
- FIRE HYDRANT EXISTING
- MANHOLE
- MANHOLE EXISTING
- EXISTING TREE - REFER TO LANDSCAPE

LEGAL DESCRIPTION
REFER TO LEASE AGREEMENT

REFERENCE SURVEY

MUNICIPAL ADDRESS
411 Corkstown Road. Ottawa, ON

SITE AREA	123,480 m^2
BUILDING AREA (OBC)	448.34m^2
GFA (OBC)	728.2m^2
GFA (ZONING BYLAW)	396.7m^2
FOOTPRINT (ZONING BYLAW)	413.16m^2
BUILDING HEIGHT	8.1m 2 STOREYS
ZONE	EP[868r]-h
SCHEDULE 1:	AREA C
SCHEDULE 1A:	AREA C

ZONING PROVISION	REQUIRED	PROVIDED
MIN. LOT WIDTH	NO MIN.	N/A
MIN. LOT AREA	NO MIN.	N/A
MIN. FRONT YARD SETBACK	NO MIN.	N/A
MIN. CORNER YARD SETBACK	NO MIN.	N/A
MIN. REAR YARD SETBACK	NO MIN.	N/A
MIN. INTERIOR YARD SETBACK	NO MIN.	N/A
MAX. HEIGHT	11m	8.1m
MAX. LOT COVERAGE	15%	3.6%
LANDSCAPED AREA	15% OF PARKING	N/A

PARKING QUEING + LOADING	REQUIRED	PROVIDED
PARKING SPACES	8	8
ACCESSIBLE PARKING	1	1
BICYCLE PARKING	1	1
REFUSE COLLECTION	YES	YES
GARBAGE COLLECTION	--	12 m^2

CSV ARCHITECTS
sustainable design - conception écologique

613.564.8118
www.csv.ca
402-1066 Somerset St. W
Ottawa, Ontario, K1Y 4T3

STRUCTURAL ENGINEER
WSP
150 Slater St.
Ottawa, ON K1P 5M8
613 829-2800
scott.funnell@wsp.com

MECHANICAL ENGINEER
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1688 Woodward Drive
Ottawa, ON K2C 3R8
613 727-5111
eperusse@gwal.com

ELECTRICAL ENGINEER
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1688 Woodward Drive
Ottawa, ON K2C 3R8
613 727-5111
eperusse@gwal.com

CIVIL ENGINEER
Novatech
240 Michael Cowpland Drive, Suite 200
Ottawa, ON K2M 1P6
613 254-5867
g.winters@novatech-eng.com

LANDSCAPE ARCHITECT
Lashley & Associates
950 Gladstone Ave, Suite 200
Ottawa, ON K1Y 3E6
613 233-8579
rpaliga@lashleyla.com

STAMP

REV	DATE	ISSUE
1	05/01/2020	ISSUED FOR SITE PLAN CONTROL

NOTES

1. OWNERSHIP OF THE COPYRIGHT OF THE DESIGN AND THE WORKS EXECUTED FROM THE DESIGN REMAINS WITH CSV ARCHITECTS, AND MAY NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN CONSENT OF CSV ARCHITECTS.
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3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER PROJECT DRAWINGS AND SPECIFICATIONS.
4. DO NOT SCALE DRAWINGS. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY DIMENSIONS ON SITE.
5. ALL WORK SHALL BE IN ACCORDANCE WITH THE ONTARIO BUILDING CODE AND ALL SUPPLEMENTS AND APPLICABLE MUNICIPAL REGULATIONS.

CLIENT
Andrew Fleck Children's Services
OTTAWA
ONTARIO, CANADA

PROJECT
Forest and Nature School
411 Corkstown Rd, Ottawa, ON

TITLE
SITE PLAN

PROJECT NO: 181930
DRAWN: MBH
APPROVED: JS
SCALE: As indicated

REV 1
DRAWING NO. A.100

Appendix C

NOVATECH
Engineers, Planners & Landscape Architects

Forest and Nature School WATER DEMAND CALCULATIONS

JOB NO. 119045

Water Demand					
Use	School		Demands (L/s)		
	Number of Students	Number of Employees	Average Day	Max. Daily	Peak Hour
Proposed Forest and Nature School	49	26	0.12	0.18	0.32

Notes:

Avg. Day Demand (from City of Ottawa Guidelines):

- School 30 L/day/person (8-hour day assumed)
(Assumed to be the same as the average sanitary flow for day school without cafeteria of gym and showers)
- Employee 75 L/day/person (8-hour day assumed)

Max. Daily Demand:

- Institutional 1.5 x Avg. Day

Peak Hour Demand:

- Institutional 1.8 x Max. Day

Prepared By:
NOVATECH
Date: March 31, 2020

FUS - Fire Flow Calculations

As per 1999 Fire Underwriter's Survey Guidelines

Novatech — Engineers, Planners & Landscape Architects

Novatech Project #:	119045
Project Name:	Forest and Nature School
Date:	22/04/2020
Input By:	LGB
Reviewed By:	GJM

Legend: Input by User; No Information or Input Required

Building Description: 2-storey wooden building

Wood frame

Step			Input		Value Used	Total Fire Flow (L/min)
Base Fire Flow						
1	**Construction Material**			**Multiplier**		
	Coefficient related to type of construction C	Wood frame	Yes	1.5	1.5	
		Ordinary construction		1		
		Non-combustible construction		0.8		
		Modified Fire resistive construction (2 hrs)		0.6		
		Fire resistive construction (> 3 hrs)		0.6		
2	**Floor Area**					
	A	Building Footprint (m^2)	420			
		Number of Floors/Storeys	2			
		Area of structure considered (m^2)			**840**	
	F	**Base fire flow without reductions**				**10,000**
		$F = 220\,C\,(A)^{0.5}$				
Reductions or Surcharges						
3	**Occupancy hazard reduction or surcharge**			**Reduction/Surcharge**		
	(1)	Non-combustible		-25%	0%	**10,000**
		Limited combustible		-15%		
		Combustible	Yes	0%		
		Free burning		15%		
		Rapid burning		25%		
4	**Sprinkler Reduction**			**Reduction**		
	(2)	Adequately Designed System (NFPA 13)	No	-30%	-10%	**-1,000**
		Standard Water Supply	Yes	-10%		
		Fully Supervised System	No	-10%		
				Cumulative Total	**-10%**	
5	**Exposure Surcharge (cumulative %)**				**Surcharge**	
	(3)	North Side	> 45.1m		0%	**0**
		East Side	> 45.1m		0%	
		South Side	> 45.1m		0%	
		West Side	> 45.1m		0%	
				Cumulative Total	**0%**	
Results						
6	(1) + (2) + (3)	**Total Required Fire Flow, rounded to nearest 1000L/min**			**L/min**	**9,000**
		(2,000 L/min < Fire Flow < 45,000 L/min)		or	L/s	**150**
				or	USGPM	2,378
7	**Storage Volume**	Required Duration of Fire Flow (hours)			Hours	2
		Required Volume of Fire Flow (m^3)			m^3	1080

Appendix D

PROJECT #: 119045
PROJECT NAME: Forest and Nature School

THEORETICAL SANITARY FLOW DESIGN SHEET

NOVATECH
Engineers, Planners & Landscape Architects

LOCATION		INSTITUTIONAL FLOW					EXTRANEOUS FLOW		TOTAL FLOWS			PIPE						
Use	Total Area (ha)	School: Students (persons)	School: Employees (persons)	Avg Flow (l/s)	Peak Factor (-)	Inst. Peak Flow (l/s)	Infiltration Allowance: Dry Weather (I/I dry) (l/s)	Infiltration Allowance: Wet Weather (I/I wet) (l/s)	Average Dry Weather Flow (ADWF) (l/s)	Peak Dry Weather Flow (PDWF) (l/s)	Peak Wet Weather Flow (PWWF) (l/s)	Length (m)	Dia Act (mm)	Dia Nom (mm)	Slope (%)	Velocity (Full) (m/s)	Capacity (Full) (l/s)	Ratio Q/Qfull (%)
Proposed Forest and Nature School	0.160	49	26	0.12	1.5	0.18	0.01	0.04	0.13	0.19	0.23	99.0	201	200	0.50	0.74	23.6	1%
	0.160	49	26	0.12	1.5	0.18	0.01	0.04	**0.13**	**0.19**	**0.23**							

Design Parameters:

School Average Flow (8-hour day assumed)
Day school without cafeteria or Gym and showers — 30 L/person/day

Employee Average Flow (8-hour day assumed)
Various buildings and places of employment (e.g. store employees, office workers etc.) — 75 L/person/day

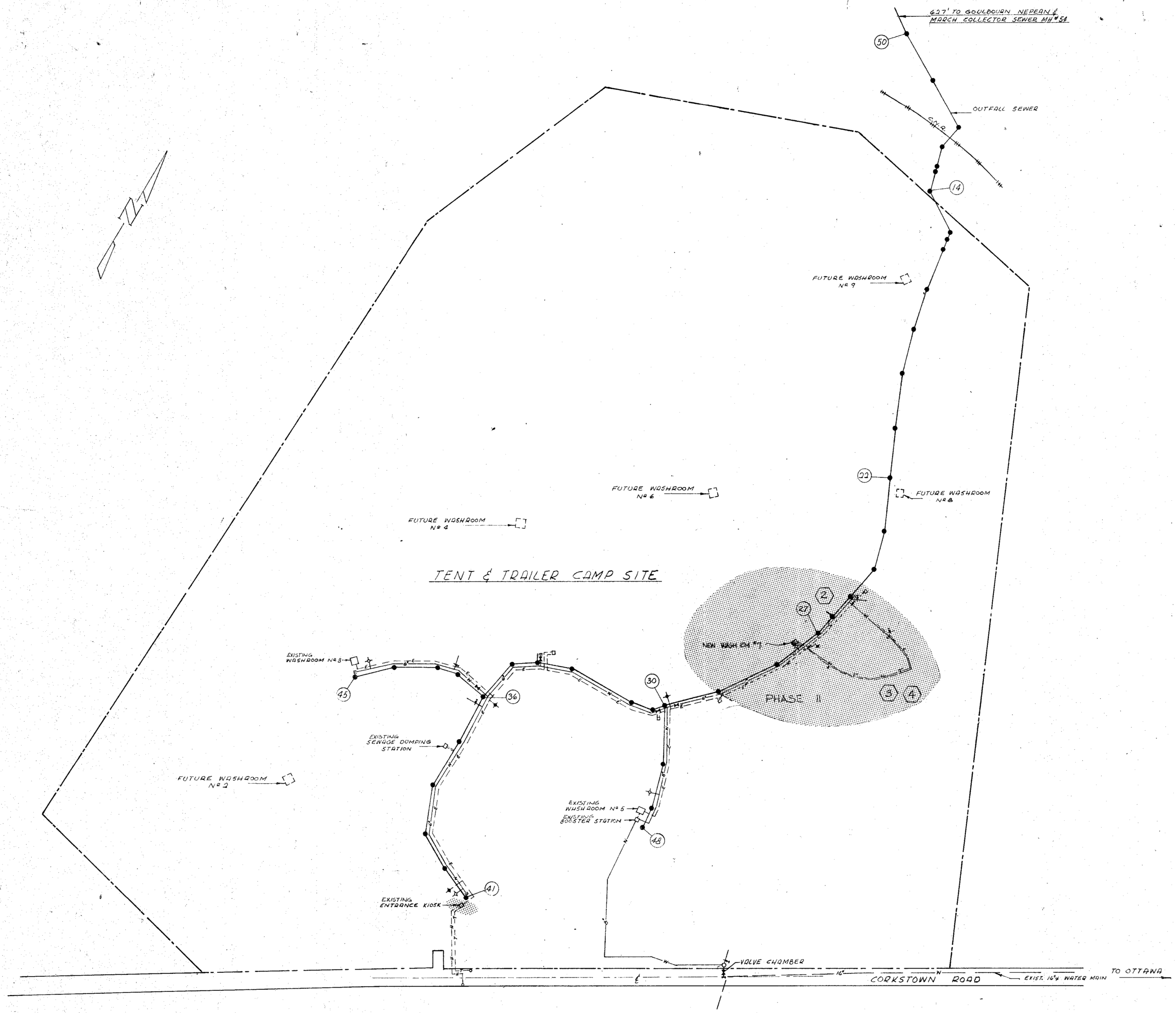
Peaking Factors
Institutional — 1.0 if institutional contribution <20%
1.5 if institutional contribution >20%

Peak Extraneous Flows

Infiltration Allowance (I/I Dry Weat	0.05	L/s/ha
Infiltration Allowance (I/I Wet Wea	0.28	L/s/ha
Infiltration Allowance (Total I/I)	0.33	L/s/ha

Designed: LGB
Checked: GJM

Date: 14/4/2020



LEGEND

- AREAS OF CONTRACT
- SEWER (EXISTING)
- WATER MAIN
- HYDRANT
- VALVE IN VALVE CHAMBER
- VALVE WITH VALVE BOX
- EXIST. GRADE
- ROAD GRADE
- ELECTRICAL CABLE
- INCOMING HYDRO CABLE
- TELEPHONE CABLE
- LUMINAIRE
- JUCTION BOX
- REFUSAL

DRAWING NUMBER (2)

Drawn | Approved

D.W. Graham and Associates Limited
Landscape Architects — Ottawa

J.L. Richards and Associates Limited
Engineers — Ottawa

Edward J. Cuhaci
Architect — Ottawa

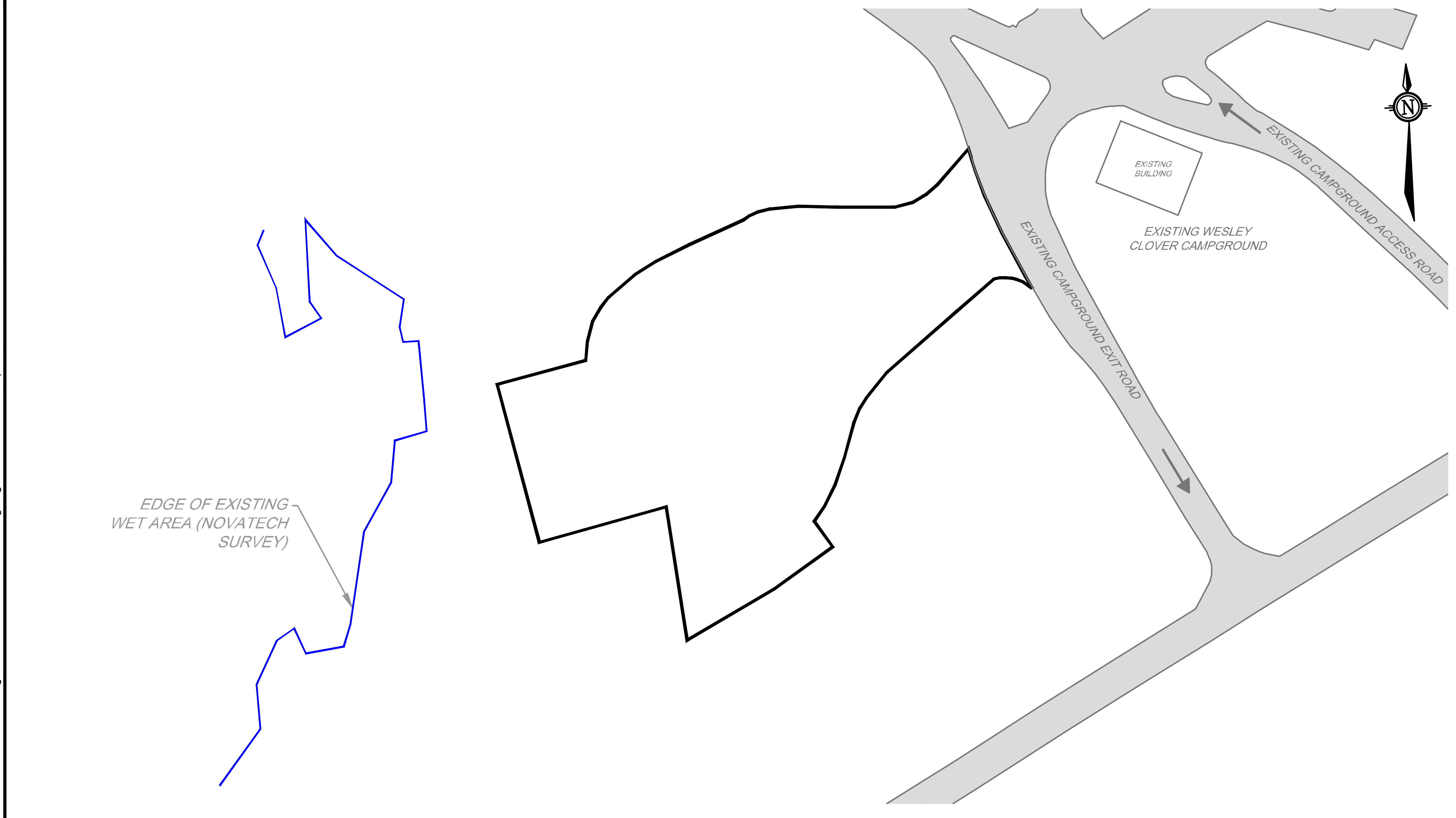
THE OTTAWA AND NEPEAN MUNICIPAL TENT AND TRAILER PARK

Twp of Nepean. Project 9301

MASTER PLAN
PHASE II

Drawn G.J.R. | Design W.H.K. | Date JAN-1969 | SCALE 1" = | PLAN Nº 1

Appendix E



NOVATECH
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Ottawa, Ontario, Canada K2M 1P6
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Website www.novatech-eng.com

LEGEND

SITE BOUNDARY

EDGE OF EXISTING WET AREA (NOVATECH SURVEY)

411 CORKSTOWN ROAD

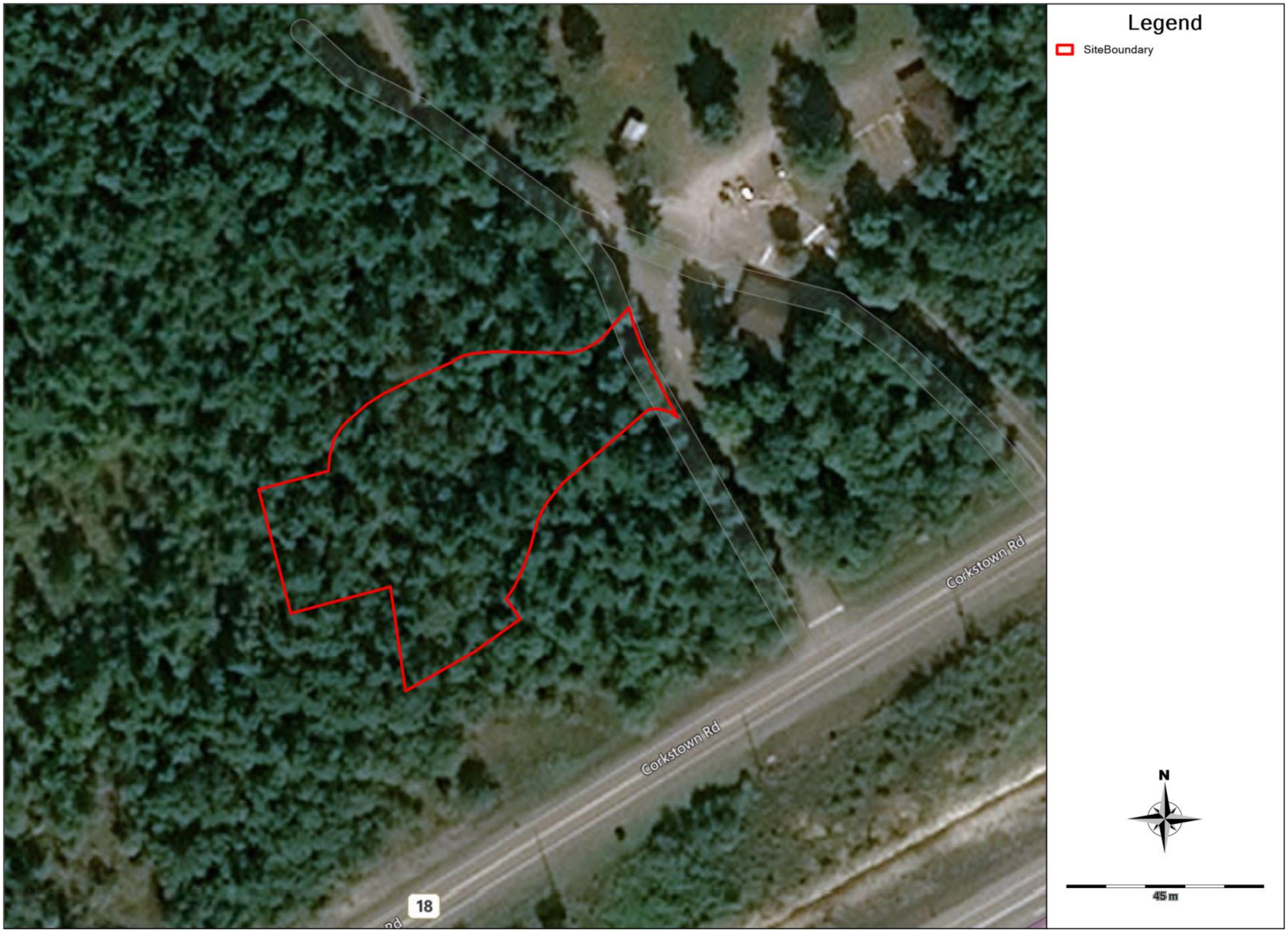
KEY PLAN

SCALE	DATE	JOB	FIGURE
1 : 500 (0, 5m, 10m, 20m)	APR 2020	119045	2

M:\2019\119045\DATA\Calculations\Sewer Calcs\SWM\Water Balance\CAD figures\119045-WaterBalance.dwg, Figure 1 - WETLAND, Apr 27, 2020 - 11:02am, mschroeder

SHT8X11.DWG - 216mmx279mm

Figure 3: Existing Conditions



Imagery source: Bing Maps, 2020

Water Balance Model Description

The Thornthwaite-Mather (1957) water balance models are conceptual models that are used to simulate steady-state climatic averages or continuous values of precipitation (rain + snow), snowpack, snowmelt, soil moisture, evapotranspiration, and water surplus (infiltration + runoff) (refer to **Figure 1)**. Input parameters consist of daily precipitation *(PRECIP),* temperature *(MAX / MIN TEMP),* potential evaportranspiration *(PET)*, and the available water content *(AWC)* that can also be referred to as the water holding capacity of the soil. All water quantities in the model are based on monthly calculations and are represented as depths (volume per unit area) of liquid water over the area being simulated. *All model units are in millimetres (mm)*.

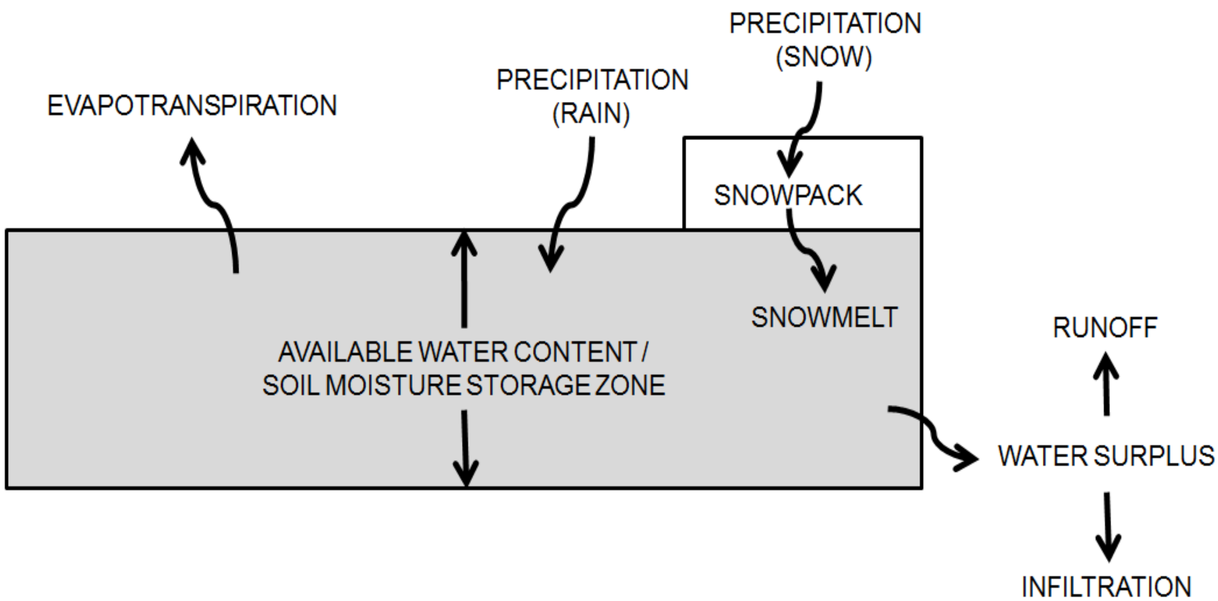


Figure 1: Conceptual Water Balance Model

Available Water Content (Water Holding Capacity)

The available water content (AWC) or water holding capacity of the soil was taken from Table 3.1 from the *Stormwater Management and Planning Manual (MOE, 2003)*, which has been reproduced in **Table 1** below. The available water content is the soil-moisture storage zone or the zone between the field capacity and vertical extent of the root zone.

Table 1: Water Holding Capacity Values (MOE, 2003)

Land Use / Soil Type	Hydrologic Soil Group	Water Holding Capacity (mm)
Urban Lawns / Shallow Rooted Crops (spinach, beans, beets, carrots)		
Fine Sand	A	50
Fine Sandy Loam	B	75
Silt Loam	C	125
Clay Loam	CD	100
Clay	D	75

Water Balance Model Description

Land Use / Soil Type	Hydrologic Soil Group	Water Holding Capacity (mm)
Moderately Rooted Crops (corn and cereal grains)		
Fine Sand	A	75
Fine Sandy Loam	B	150
Silt Loam	C	200
Clay Loam	CD	200
Clay	D	150
Pasture and Shrubs		
Fine Sand	A	100
Fine Sandy Loam	B	150
Silt Loam	C	250
Clay Loam	CD	250
Clay	D	200
Mature Forests		
Fine Sand	A	250
Fine Sandy Loam	B	300
Silt Loam	C	400
Clay Loam	CD	400
Clay	D	350

Precipitation

Daily precipitation *(PRECIP)* values consist of the total daily rainfall and water equivalent of snowmelt that fell on that day. Based on the mean daily temperature *(MEAN TEMP)* precipitation falls either as rainfall *(RAIN)* or the water equivalent of snowfall *(SNOW)*:

- *RAIN: If (MEAN TEMP >= 0, RAIN, SNOW)*
- *SNOW: If (MEAN TEMP < 0, SNOW, RAIN)*

Snowmelt / Snowpack / Water Input

Snowmelt *(MELT)* occurs if there is available snow (water equivalent) in the snowpack *(SNOWPACK)* and the maximum daily temperature *(MAX TEMP)* is greater than 0. The available snowmelt is limited to the available water in the snowpack.

Snowmelt is computed by a degree-day equation (Haith, 1985):

SNOWMELT (cm/d) = MELT COEFICIENT x [AIR TEMP (^{O}C) – MELT TEMP(^{O}C)]

The melt coefficient is typically 0.45 for northern climates (Haith, 1985). The melt temperature is assumed to be 0^{O}C. The air temperature is assumed to be the max temperature multiplied by a ratio of the max to min temperatures:

AIR TEMP = *MAX TEMP / (MAX TEMP – MIN TEMP)*

Therefore the snowmelt equation is:

- *MELT: If (MAX TEMP > 0, IF(SNOWPACK > 0, MIN((MAX TEMP*0.45*MAX TEMP/(MAX TEMP – MIN TEMP)*10mm/cm), SNOWPACK), 0), 0)*

Snow accumulates in the snowpack from the previous day if precipitation falls as snow and there is no snowmelt or the amount of snow that falls in a day exceeds the daily snowmelt:

$SNOWPACK_N = SNOWPACK_{N-1} + SNOW - MELT$

The initial snowmelt on day 1 (i.e. January 1) is assumed to be 0. The initial snowpack on day 1 is assumed to be the snowpack on the last day of simulation (i.e. December 31).

The total water input (W) is rain + snowmelt. This is the available water that fills the soil moisture storage zone each day.

Evaporation

Measured potential evaporation (PE) data (i.e. lake evaporation) is provided with the Environment Canada Climate Normals (see example below). The data represents daily averages for each month over a 20+ year period.

▼ Evaporation

Evaporation														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Lake Evaporation (mm)	0	0	0	0	3.6	4.3	4.5	3.7	2.4	1.4	0	0	0	C

The daily evaporation data was assumed to represent the middle or 15th of each month and 'smoothed' to represent the transition from month to month (see **Figure 2** below). As shown in **Figure 2** this produces a more realistic curve of potential evapotranspiration.

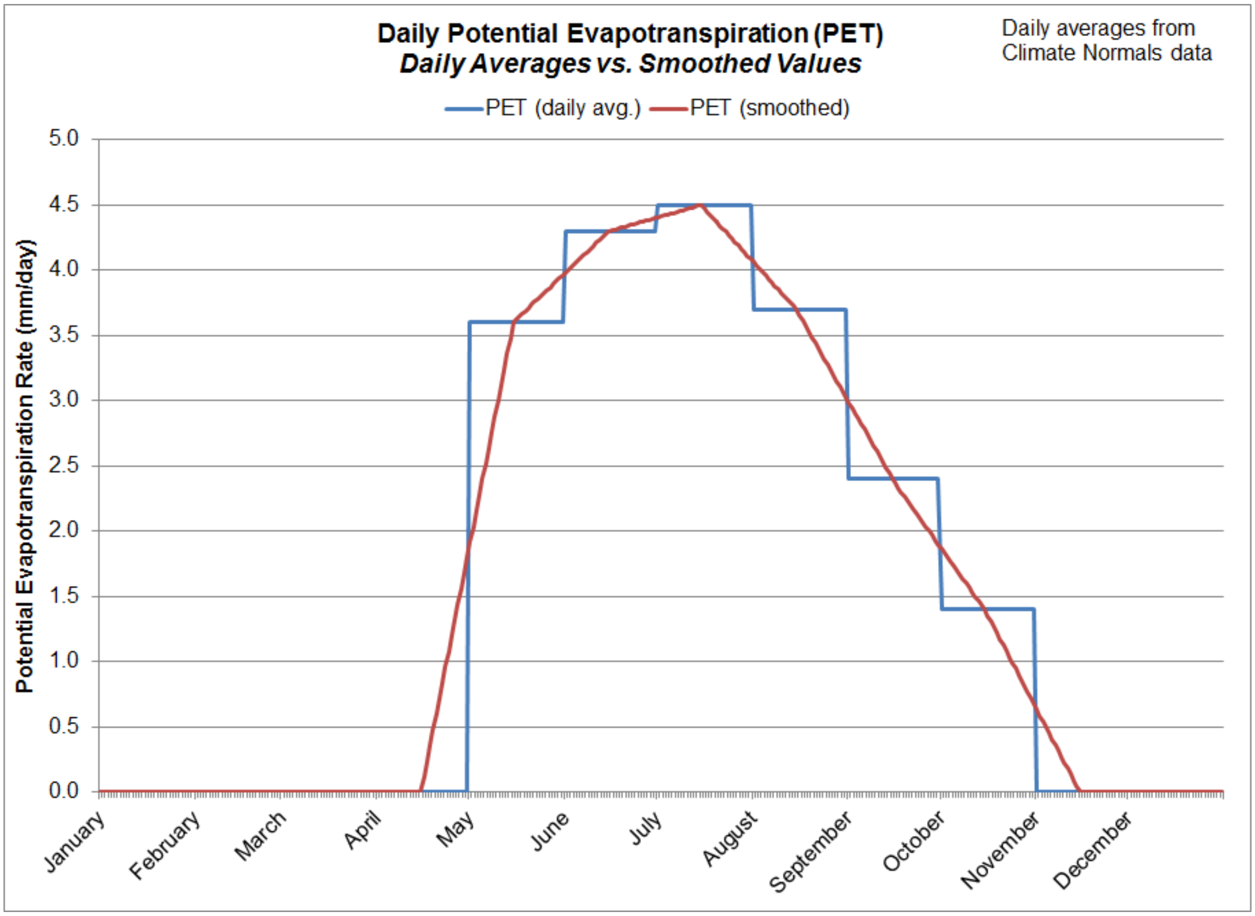


Figure 2: Daily Potential Evapotranspiration Rates (Daily Averages vs. Smoothed Values)

Potential Evapotranspiration

To convert potential evaporation data to potential crop evapotranspiration (PET) data a cover coefficient is applied based on land use and growing / dormant seasons:

PET = PE x Crop Cover Coefficient

Crop cover coefficients are based on the crop growth stages for different crop types (see **Figure 3**). A typical crop coefficient curve is shown in **Figure 4**, which depicts a crop that provides transpiration above the potential evaporation rates during the growing season.

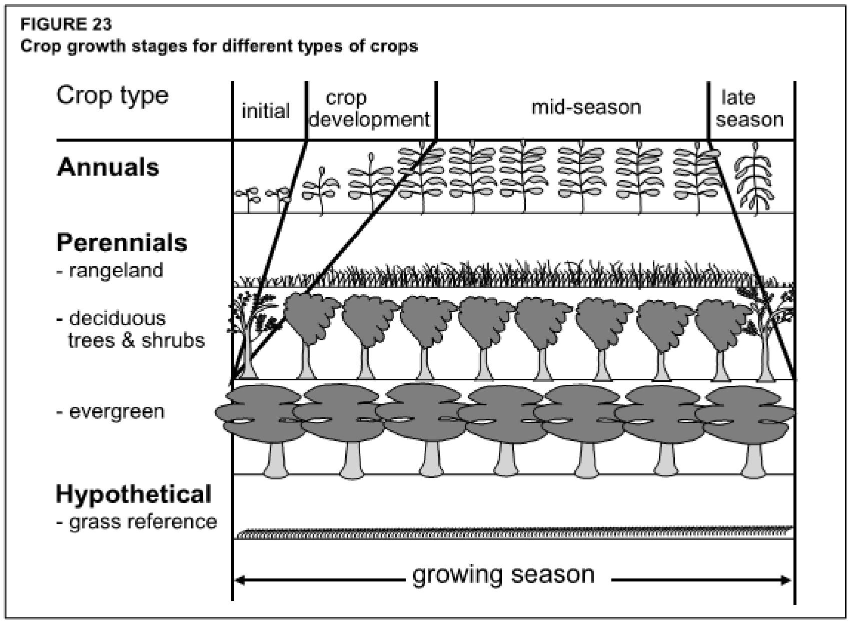


Figure 3: Crop Growth Stages for Different Types of Crops

Source: Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements. FAO Irrigation and Drainage paper 56.

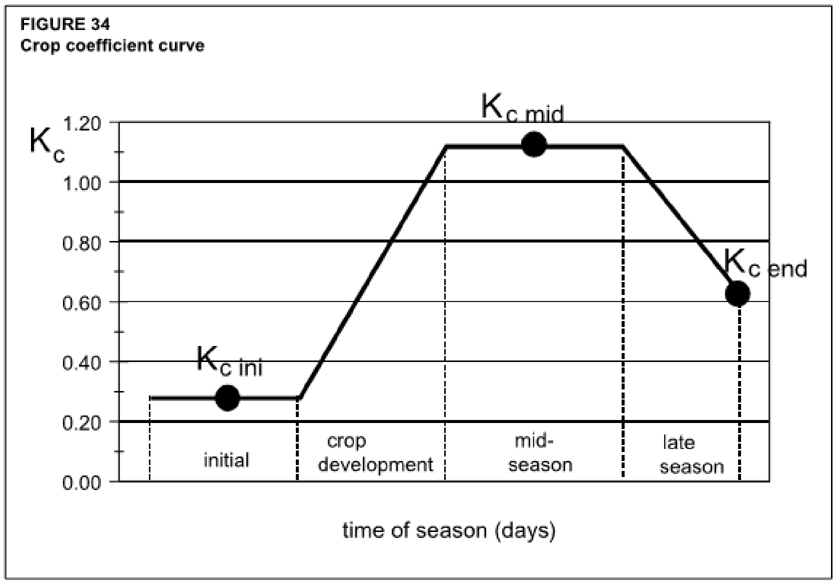


Figure 4: Crop Coefficient Curve

Source: Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements. FAO Irrigation and Drainage paper 56.

Water Balance Model Description

The crop cover coefficients used in the water budget model for the various land use types is shown in **Table 2**. The growing / dormant seasons are shown in **Table 3**. The crop cover coefficients for the initial growing season are based on the average value of the dormant and middle of the growing season.

Table 2: Crop Cover Coefficients

Land Use	Dormant Season	Initial Growing Season	Middle of Growing Season	End of Growing Season
Urban Lawns / Shallow Rooted Crops	0.40	0.78	1.15	0.55
Moderately Rooted Crops	0.30	0.73	1.15	0.40
Pasture and Shrubs	0.40	0.68	0.95	0.90
Mature Forest	0.3	0.75	1.20	0.30
Impervious Areas	1.00	1.00	1.00	1.00

Reference: Data is based on Table 12 from the Food and Agriculture Organization of the United Nations (FAO), 1998, Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements. FAO Irrigation and Drainage paper 56.

Table 3: Crop Growing Season

Month(s)	Crop Growing Season
January – April	Dormant Season
May	Initial Growing Season
June - August	Middle of Growing Season
September	End of Growing Season
October - December	Dormant Season (harvest in October)

Reference: Food and Agriculture Organization of the United Nations (FAO), 1977, Crop Water Requirements. FAO Irrigation and Drainage paper 24.

Actual Evapotranspiration

Following Alley (1984), if the monthly water input (i.e. rain + snowmelt) is greater than the potential evapotranspiration (PET) rate, the actual evapotranspiration (AET) rate takes place at the potential evapotranspiration rate:

IF W > PET, then AET = PET

If the monthly water input is less than the potential evapotranspiration rate (i.e. W < PET) then the actual evapotranspiration rate is the sum of the water input and an increment removed from the available water in the soil moisture storage zone (SOIL WATER):

IF W < PET, then AET = W + ΔSOIL WATER

Water Balance Model Description

WHERE: $\Delta SOIL\ WATER = SOIL\ WATER_{N-1} - SOIL\ WATER_{N}$

Figure 5 shows a comparison of the average monthly potential evapotranspiration and actual evapotranspiration rates.

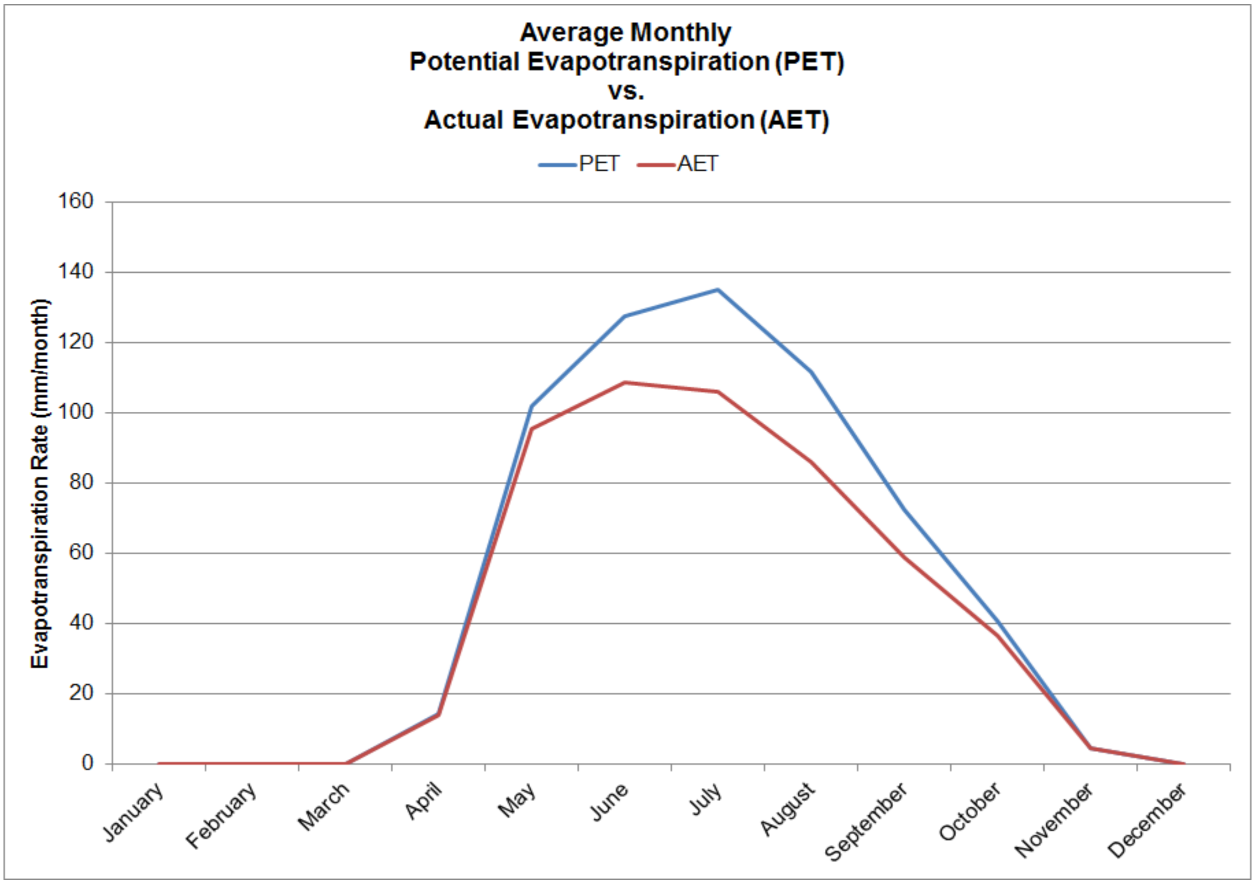


Figure 5: Average Monthly Potential Evapotranspiration vs. Actual Evapotranspiration

Soil Moisture

The soil moisture storage zone (SOIL WATER) is the amount of water available for actual evapotranspiration, but actual evapotranspiration is limited by the potential evapotranspiration rate.

The decrease / change in the soil moisture storage zone (ΔSOIL WATER) is based on the following relationship (Thornthwaite,1948), where AWC represents the available water content:

$$\Delta SOIL\ WATER = SOIL\ WATER_{N-1} \times [1-\exp(-((PET - W) / AWC))]$$

The soil moisture storage zone is replenished with rainwater and snowmelt (i.e. the water input) to the maximum value of the available water content (AWC):

$$SOIL\ WATER_{N} = \min[(W - PET) + SOIL\ WATER_{N-1}),\ AWC]$$

Water Balance Model Description

Water Surplus

The water surplus (SURPLUS) is defined as the excess water that is greater than the available water content (AWC).

SURPLUS = W – AET - ΔSOIL WATER

The water surplus represents the difference between precipitation and evapotranspiration. It is an estimate of the water that is available to contribute to infiltration and runoff (i.e. streamflow).

Infiltration / Runoff

The amount of water surplus that is infiltration was determined by summing the infiltration factors (IF) based on topography, soils and land cover. Since the water surplus represents infiltration and runoff; direct runoff is the amount of water surplus remaining after taking into account infiltration: (1.0 – infiltration factor = runoff factor). The infiltration and runoff factors were applied to the average monthly water surplus values:

INFILTRATION = IF x SURPLUS

RUNOFF = (1.0 – IF) x SURPLUS

The infiltration factors are shown in **Table 4**, which was reproduced from Table 3.1 in the *Stormwater Management and Planning Manual (MOE, 2003)*. These infiltration factors were initially presented in the document *"Hydrogeological Technical Information Requirements for Land Development Applications" (MOE, 1995)*.

Table 4: Infiltration Factors (MOE, 2003)

Description	Value of Infiltration Factor
Topography	
Flat Land, average slope < 0.6 m/km	0.3
Rolling Land, average slope 2.8 m/km to 3.8 m/km	0.2
Hilly Land, average slope 28 m/km to 47 m/km	0.1
Surficial Soils	
Tight impervious clay	0.1
Medium combination of clay and loam	0.2
Open sandy loam	0.4
Land Cover	
Cultivated Land	0.1
Woodland	0.2

Water Balance Model Description

Each soil type been assigned a corresponding infiltration factor as per Table 3.1 in the *Stormwater Management and Planning Manual (MOE, 2003),* as shown in **Table 5** below.

Table 5: Soils Infiltration Factors

Soil Type	Hydrologic Soil Group	Infiltration Factor
Coarse Sand	A	0.40
Fine Sand	AB	0.40
Fine Sandy Loam	B	0.30
Loam	BC	0.30
Silt Loam	C	0.20
Clay Loam	CD	0.15
Clay	D	0.10

The land use was combined into five (5) main categories (mature forest, row crops, pasture / meadow, urban lawns, and impervious areas) to be consistent with Table 3.1 in the *Stormwater Management and Planning Manual (MOE, 2003)*. The land use infiltration factors are shown in **Table 6** below.

Table 6: Land Use Infiltration Factor

Land Use	Infiltration Factor
Urban Lawns	0.10
Row Crops	0.10
Pasture / Meadow	0.10
Mature Forest	0.20
Impervious Areas	0.00

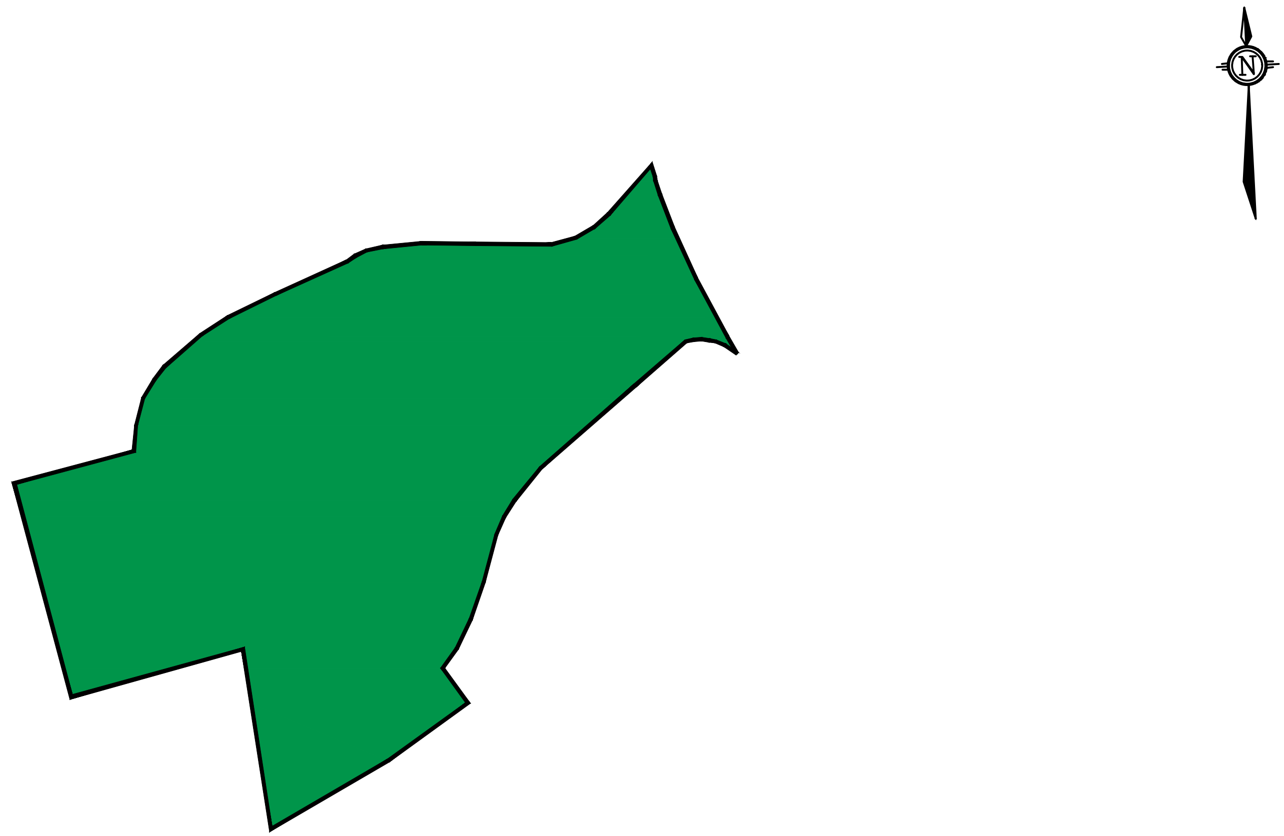
Land Use / Soils / Topography

The available water content (AWC) and infiltration factors (IF), and crop cover coefficients (CROP COEF) are determined based on the combination of land use, soils and topography, as shown in **Table 7**.

Table 7: Model Parameters based on Land Use / Soils (existing areas)

Land Use	Soils (HSG)	AWC (mm)	IF (Land Use)	IF (Soils)	Crop Cover Coefficient			
					Dormant Season	Initial Growing Season	Middle of Growing Season	End of Growing Season
Urban Lawns	A	50	0.10	0.40	0.40	0.78	1.15	0.55
	AB	62.5		0.40				
	B	75		0.30				
	BC	100		0.30				
	C	125		0.20				
	CD	100		0.15				
	D	75		0.10				
Row Crops	A	75	0.10	0.40	0.30	0.73	1.15	0.40
	AB	112.5		0.40				
	B	150		0.30				
	BC	175		0.30				
	C	200		0.20				
	CD	200		0.15				
	D	150		0.10				
Pasture / Meadow	A	100	0.10	0.40	0.40	0.68	0.95	0.90
	AB	125		0.40				
	B	150		0.30				
	BC	200		0.30				
	C	250		0.20				
	CD	250		0.15				
	D	200		0.10				
Mature Forest	A	250	0.20	0.40	0.30	0.75	1.20	0.30
	AB	275		0.40				
	B	300		0.30				
	BC	350		0.30				
	C	400		0.20				
	CD	400		0.15				
	D	350		0.10				
Impervious Areas *(see Table 9)*	A	1.57	0.00	0.00	1.00	1.00	1.00	1.00
	AB	1.57						
	B	1.57						
	BC	1.57						
	C	1.57						
	CD	1.57						
	D	1.57						

*For impervious areas, potential evapotranspiration is equal to potential evaporation (i.e. crop cover coefficient = 1.00).



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LEGEND

SITE BOUNDARY

FOREST

411 CORKSTOWN ROAD

EXISTING LAND USE

SCALE		
1 : 500 (0, 5m, 10m, 20m)		
DATE APR 2020	JOB 119045	FIGURE 4

SHT8X11.DWG - 216mmx279mm

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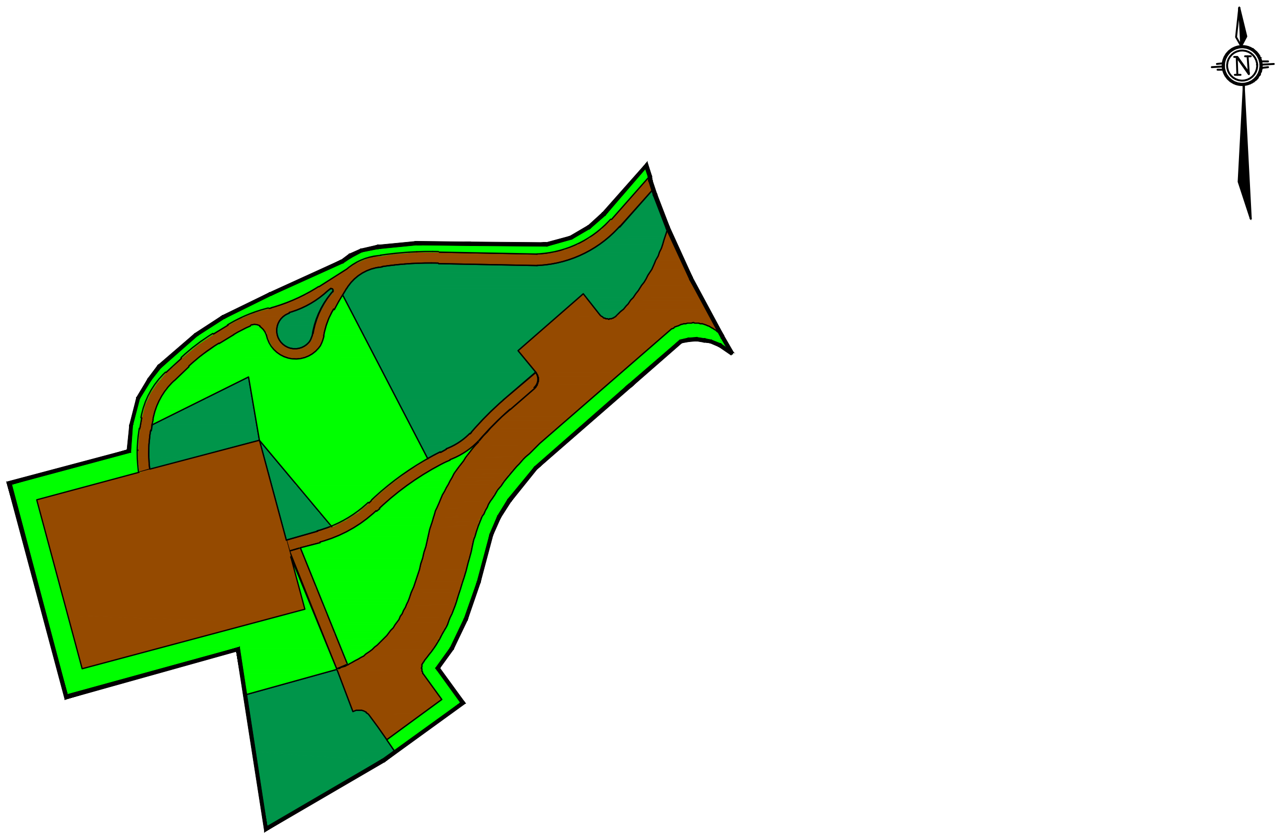

LEGEND

- SITE BOUNDARY
- FOREST
- OPEN SPACE / "PASTURE"
- IMPERVIOUS AREAS

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411 CORKSTOWN ROAD

PROPOSED LAND USE

SCALE 1 : 500 (0, 5m, 10m, 20m)		
DATE APR 2020	JOB 119045	FIGURE 5

SHT8X11.DWG - 216mmx279mm

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Water Balance Calculations: 411 CORKSTOWN ROAD

NOVATECH
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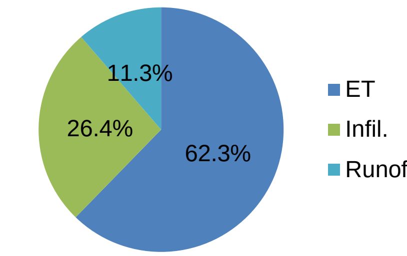
Pre-Development

Drainage Area 0.38 ha

Landuse	% of Watershed	Watershed Area	% of Pervious Area within Watershed	Water Holding Capacity	Infiltration Factor	Factor	Condition	Infiltration Factor
Mature Forest	100.0%	0.380	100.0%	250 mm	0.20	**Topography**	Hilly Land	0.10
Pasture/Meadow	0.0%	0.000	0.0%	100 mm	0.10	**Soils**	Gravely Sandy	0.40
Urban Lawns	0.0%	0.000	0.0%	50 mm	0.10		**Pervious Infiltration Factor**	**0.70**
Imp. Areas	0.0%	0.000	0.0%	0 mm	0.00		**Weighted Infiltration Factor**	**0.70**
Average				**250 mm**	**0.20**		**Runoff Factor**	**0.30**

*table 3.1 MOE

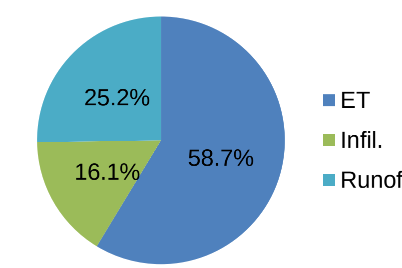


		Ottawa (6105976) 1981-2010												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Total Precipitation (mm)	**P**	63	50	58	71	87	93	84	84	93	86	83	70	**920**
Potential Evapotranspiration (mm)	**PE**	0	0	0	0	112	129	136	115	72	43	0	0	**607**
Total Precip. - Potential ET (mm)	P-PE	63	50	58	71	-25	-36	-52	-31	21	43	83	70	
Soil Moisture Storage (mm)	ST	250	250	250	250	226	196	159	140	161	203	250	250	
Change in Soil Moisture Storage (mm)	ΔST	0	0	0	0	-24	-31	-37	-18	21	43	47	0	
Deficit (mm)	D	0	0	0	0	1	6	15	12	0	0	0	0	**34**
Actual Evapotranspiration (mm)	**AE**	0	0	0	0	110	123	121	102	72	43	0	0	**573**
Water Surplus (mm)	**S**	63	50	58	71	0	0	0	0	0	0	36	70	**347**
Annual Infiltration (mm)	**I**													**243**
Annual Runoff (mm)	**R**													**104**

Post-Development

Drainage Area 0.38 ha

Landuse	% of Watershed	Watershed Area	% of Pervious Area within Watershed	Water Holding Capacity	Infiltration Factor	Factor	Condition	Infiltration Factor
Mature Forest	26.3%	0.100	43.5%	250 mm	0.20	**Topography**	Hilly Land	0.10
Pasture/Meadow	34.2%	0.130	56.5%	100 mm	0.10	**Soils**	Gravely Sandy	0.40
Urban Lawns	0.0%	0.000	0.0%	50 mm	0.10		**Pervious Infiltration Factor**	**0.64**
Imp. Areas	39.5%	0.150	-	0 mm	0.00		**Weighted Infiltration Factor**	**0.39**
Average				**100 mm**	**0.14**		**Runoff Factor**	**0.61**



		Ottawa (6105976) 1981-2010												
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Total Precipitation (mm)	**P**	63	50	58	71	87	93	84	84	93	86	83	70	**920**
Potential Evapotranspiration (mm)	**PE**	0	0	0	0	112	129	136	115	72	43	0	0	**607**
Total Precip. - Potential Evap. (mm)	P-PE	63	50	58	71	-25	-36	-52	-31	21	43	83	70	
Soil Moisture Storage (mm)	ST	100	100	100	100	78	54	32	23	44	87	100	100	
Change in Soil Moisture Storage (mm)	ΔST	0	0	0	0	-22	-24	-22	-9	21	43	13	0	
Deficit (mm)	D	0	0	0	0	3	13	30	22	0	0	0	0	**68**
Actual Evapotranspiration (mm)	**AE**	0	0	0	0	109	116	106	92	72	43	0	0	**539**
Water Surplus (mm)	**S**	63	50	58	71	0	0	0	0	0	0	69	70	**380**
Annual Infiltration (mm)	**I**													**148**
Annual Runoff (mm)	**R**													**232**

Notes:
1) Uses measured average monthly total precipitation and potential evaporation data (converted to evapotranspiration based on a cover coefficient of 1.0).
2) Actual evapotranspiration and water surplus calculated using the Thornthwaite & Mather (1957) methodology.
3) Runoff and infiltration calculated as per the MOE SWM Planning and Design Manual (2003) methodology.
4) Impervious areas consist of rooftops, roads, and driveways.

Summary

Sceneario	**ET**	**Surplus**	**Infil.**	**Runoff**
Pre-Development	62.3%	37.7%	26.4%	11.3%
Post-Development	58.7%	41.3%	16.1%	25.2%

Prepared by Novatech Engineering Consultants Ltd.
Date: 4/23/2020

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411 Corkstown Road
Forest and Nature School
Infiltration Calculations

Percolation Rate (mm/hr)	Area	Storage Volume (m3)			Bottom Area of Trench (m2)	Infiltration Rate (L/s)	Retention Time (hours)	Retention Time (days)
		Subdrain	Clearstone	Total				
70	South	-	-	14.7	90.0	1.75	2.3	0.1
70	North	-	-	14.7	90.0	1.75	2.3	0.1

Vegetated Swale Volume Calculations

South Vegetated Swale		North Vegetated Swale	
Swale Depth (H)	0.12 m	Swale Depth (H)	0.12 m
Bottom Width (W)	1.00 m	Bottom Width (W)	1.00 m
Side Slopes	3.00 H:1V	Side Slopes	3.00 H:1V
X-Sect Total Area	0.163 m^2	X-Sect Total Area	0.163 m^2
Length	90 m	Length	90 m
Volume	14.69 m^3	Volume	14.69 m^3

411 Corkstown Road
Forest and Nature School
Infiltration Calculations

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Roof Only

Post Development Runoff Coefficient "C"

Area	Surface	Ha	5 Year Event "C"	5 Year Event C_{avg}	100 Year Event "C" + 25%	100 Year Event *C_{avg}
Total	Gravel	0.057	0.70	0.47	0.88	0.56
	Stone dust	0.024	0.60		0.75	
0.375	Roof	0.071	0.90		1.00	
	Soft	0.223	0.25		0.31	

Runoff Coefficient Equation

$C_5 = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{Tot}$

$C_{100} = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{Tot}$

* Runoff Coefficient increases by 25% up to a maximum value of 1.00 for the 100-Year event

QUANTITY STORAGE REQUIREMENT - 5 YEAR

0.071 =Area (ha)
0.90 = C

Max (m^3) **10.98**

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Available Infiltration (L/s)	Net Flow to be Stored (L/s)	Storage Req'd (m^3)
5 YEAR	5	141.18	25.08	3.50	21.58	6.47
	10	104.19	18.51	3.50	15.01	9.01
	15	**83.56**	**14.84**	**3.50**	**11.34**	**10.21**
	20	70.25	12.48	3.50	8.98	10.78
	25	60.90	10.82	3.50	7.32	10.98

QUANTITY STORAGE REQUIREMENT - 100 YEAR

0.071 =Area (ha)
1.00 = C

Max (m^3) **27.35**

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Available Infiltration (L/s)	Net Flow to be Stored (L/s)	Storage Req'd (m^3)
100 YEAR	25	103.85	20.50	3.50	17.00	25.50
	30	91.87	18.13	3.50	14.63	26.34
	35	**82.58**	**16.30**	**3.50**	**12.80**	**26.88**
	40	75.15	14.83	3.50	11.33	27.20
	45	69.05	13.63	3.50	10.13	27.35

Equations:
Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the rainfall intensity, City of Ottawa IDF
A is the total drainage area

Stormwater Design
Proposed Development
Forest and Nature School
Project No: 119045

Pre - Development: Overall Flows										
Description	***A (ha)***	***A imp (ha) C= 0.90***	***A path (ha) C= 0.60***	***A grav (ha) C= 0.70***	***A perv (ha) C= 0.25***	**C_2 / C_5**	**C_{100} (25% increase)**	**Q-pre (L/s) 2 year**	**5 year**	**100 year**
Total Site Area	0.375	0.000	0.000	0.000	0.375	0.25	0.31	20.0	27.2	58.2
Total =	0.375	0.000	0.000	0.000	0.375	0.25	0.31	**20.0**	**27.2**	**58.2**
								t_c=10mins	t_c=10mins	t_c=10mins

Allowable Building Flows											
Description		***A (ha)***	***A imp (ha) C= 0.90***	***A path (ha) C= 0.60***	***A grav (ha) C= 0.70***	***A perv (ha) C= 0.25***	**C_2 / C_5**	**C_{100} (25% increase)**	**Q-allow (L/s) 2 year**	**5 year**	**100 year**
A-1	Building Area	0.071	0.000	0.000	0.000	0.071	0.25	0.31	3.8	5.1	11.0
	Total =	0.071	0.000	0.000	0.000	0.071	0.25	0.31	**3.8**	**5.1**	**11.0**
									t_c=10mins	t_c=10mins	t_c=10mins

Post - Development: Total Flows for Uncontrolled Sub Catchments											
Area ID	**Description**	***A (ha)***	***A imp (ha) C= 0.9***	***A path (ha) C= 0.6***	***A gravel (ha) C= 0.7***	***A perv (ha) C= 0.25***	**C_2 / C_5**	**C_{100} (25% increase)**	**Q-post uncontrolled (L/s) 2 year**	**5 year**	**100 year**
A-1	Building Area	0.071	0.071	0.000	0.000	0.000	0.90	1.00	13.6	18.5	35.3
A-2	Remaining Site Area	0.304	0.000	0.024	0.057	0.223	0.36	0.45	23.5	31.9	68.3
	Total =	0.375	0.071	0.024	0.06	0.22	0.46	0.56	**37.1**	**50.4**	**103.6**
			19%	6%	15%	59%			t_c=10mins	t_c=10mins	t_c=10mins

Post - Development : Total Flows for Controlled Site								
Area	**Description**	**Q-post controlled (L/s) 2 year**	**5 year**	**100 year**	**Storage Required (m^3) 2 year**	**5 year**	**100 year**	**Provided (m^3)**
A-1	Building Area	0.0	0.0	0.0	6.9	11.0	27.4	27.4
A-2	Remaining Site Area	23.5	31.9	68.3	N/A	N/A	N/A	0.0
	Total =	**23.5**	**31.9**	**68.3**	**6.9**	**11.0**	**27.4**	**27.4**

* Flows from building are infiltrated via swales at rate of 3.5 L/s (=0 L/s runoff)

Forest and Nature School
Project No: 119045
REQUIRED STORAGE - 1:2 YEAR EVENT
AREA A-1 Proposed Building

OTTAWA IDF CURVE

Area = 0.071 ha   Qallow = 3.5 L/s
C = 0.90   Vol(max) = 6.9 m3

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	103.57	18.40	14.90	4.47
10	76.81	13.64	10.14	6.09
15	61.77	10.97	7.47	6.73
20	52.03	9.24	5.74	6.89
25	45.17	8.02	4.52	6.79
30	40.04	7.11	3.61	6.50
35	36.06	6.41	2.91	6.10
40	32.86	5.84	2.34	5.61
45	30.24	5.37	1.87	5.05
50	28.04	4.98	1.48	4.44
55	26.17	4.65	1.15	3.79
60	24.56	4.36	0.86	3.10
65	23.15	4.11	0.61	2.39
70	21.91	3.89	0.39	1.65
75	20.81	3.70	0.20	0.89
90	18.14	3.22	-0.28	-1.50
105	16.13	2.87	-0.63	-3.99
120	14.56	2.59	-0.91	-6.57
135	13.30	2.36	-1.14	-9.22
150	12.25	2.18	-1.32	-11.91

Forest and Nature School
Project No: 119045
REQUIRED STORAGE - 1:5 YEAR EVENT
AREA A-1 Proposed Building

OTTAWA IDF CURVE

Area = 0.071 ha   Qallow = 3.5 L/s
C = 0.90   Vol(max) = 11.0 m3

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	141.18	25.08	21.58	6.47
10	104.19	18.51	15.01	9.01
15	83.56	14.84	11.34	10.21
20	70.25	12.48	8.98	10.78
25	60.90	10.82	7.32	10.98
30	53.93	9.58	6.08	10.94
35	48.52	8.62	5.12	10.75
40	44.18	7.85	4.35	10.44
45	40.63	7.22	3.72	10.04
50	37.65	6.69	3.19	9.57
55	35.12	6.24	2.74	9.04
60	32.94	5.85	2.35	8.47
65	31.04	5.51	2.01	7.86
70	29.37	5.22	1.72	7.21
75	27.89	4.95	1.45	6.54
90	24.29	4.31	0.81	4.40
105	21.58	3.83	0.33	2.10
120	19.47	3.46	-0.04	-0.30
135	17.76	3.16	-0.34	-2.79
150	16.36	2.91	-0.59	-5.34

Forest and Nature School
Project No: 119045
REQUIRED STORAGE - 1:100 YEAR EVENT
AREA A-1 Proposed Building

OTTAWA IDF CURVE

Area = 0.071 ha   Qallow = 3.5 L/s
C = 1.00   Vol(max) = 27.4 m3

Time (min)	Intensity (mm/hr)	Q (L/s)	Qnet (L/s)	Vol (m3)
5	242.70	47.90	44.40	13.32
10	178.56	35.24	31.74	19.05
15	142.89	28.20	24.70	22.23
20	119.95	23.68	20.18	24.21
25	103.85	20.50	17.00	25.50
30	91.87	18.13	14.63	26.34
35	82.58	16.30	12.80	26.88
40	75.15	14.83	11.33	27.20
45	69.05	13.63	10.13	27.35
50	63.95	12.62	9.12	27.37
55	59.62	11.77	8.27	27.29
60	55.89	11.03	7.53	27.12
65	52.65	10.39	6.89	26.88
70	49.79	9.83	6.33	26.58
75	47.26	9.33	5.83	26.22
90	41.11	8.11	4.61	24.92
105	36.50	7.20	3.70	23.33
120	32.89	6.49	2.99	21.55
135	30.00	5.92	2.42	19.61
150	27.61	5.45	1.95	17.55

Following the borehole drilling work, the soil and bedrock samples were returned to our laboratory for examination by a geotechnical engineer. Descriptions of the subsurface conditions logged in the boreholes advanced at the site are provided on the Record of Borehole sheets in Appendix A.

The field work was supervised throughout by a member of our engineering staff.

The borehole locations were selected by GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) personnel. The location of the boreholes were determined using a Trimble R10 global positioning system.

4.0 SUBSURFACE CONDITIONS

4.1 General

The soil and groundwater conditions logged in the boreholes are provided on the Record of Borehole sheets in Appendix A. The borehole logs indicate the subsurface conditions at the specific test locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. Subsurface conditions at other than the borehole locations may vary from the conditions encountered in the boreholes. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site.

The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification and identification of soil involves judgement and GEMTEC does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The following presents an overview of the subsurface conditions encountered in the boreholes advanced during this investigation.

4.2 Topsoil

Dark brown organic topsoil, having a thickness of about 0.1 metres, was encountered at ground surface at all borehole locations.

4.3 Sand and Gravel

Sand and gravel, having a thickness of between about 0.1 and 0.5 metres, was encountered below the topsoil in all boreholes at depths of about 0.1 metres. The composition of the sand and gravel can generally be described as ranging from gravel and sand to gravelly sand with trace silt.

The moisture content of the sand and gravel encountered in boreholes 20-1 and 20-4 was found to be 14 and 4 percent, respectively. The results of grain size distribution tests carried out on samples of the sand and gravel are provided in Appendix B.

4.4 Bedrock

Bedrock was encountered in boreholes 20-2 at a depth of 0.2 metres below ground surface and cored to a depth of 3.9 metres below ground surface. Auger refusal on inferred bedrock occurred at depths ranging from 0.1 to 0.5 metres below ground surface at boreholes 20-1, 20-3, 20-4, and 20-5.

The bedrock recovered from the borehole 20-2 showed a total core recovery (TCR) of 71 to 100 percent, solid core recovery (SCR) of 56 to 95 percent, and rock quality designation (RQD) values of 0 to 55 percent. The bedrock can generally be described as grey brown slightly weathered, sandstone bedrock. The RQD values indicate that the recovered bedrock core is of very poor to fair quality. A photograph of the bedrock core recovered from boreholes 20-2 is provided on Figure C1 in Appendix C.

The results of unconfined compressive strength tests on four samples of the recovered bedrock core are provided in Appendix C and indicate compressive strengths ranging from 54 to 253 Megapascals. Based on these results the bedrock can be classified as strong to very strong.

4.5 Groundwater Levels

The groundwater level measured in the well screen at borehole 20-2 on April 7, 2020 was 0.8 metres below ground surface.

The groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation.

4.6 Groundwater Chemistry Relating to Corrosion

The results of chemical testing on a groundwater sample recovered from borehole 20-2 are provided in Appendix D and summarized in Table 4.1.

Table 4.1 – Summary of Groundwater Corrosion Testing

Parameter	Borehole 20-2
Chloride Content (mg/L)	14
Resistivity (Ohm.m)	26.0
pH	7.3
Sulphate Content (mg/L)	33

wave velocity testing would be required to improve the classification to above Site Class C. Based on our experience, depending on the design of the structure, significant savings in construction costs could be realized by improving to Seismic Site Class A or B; therefore, we recommend consulting with the designers and structural engineer to determine the potential savings related to improving the seismic site classification.

5.2.6 Grade Raise Restriction and Site Grading

The proposed buildings will be founded on or within near surface bedrock, therefore, there are no grade raise restrictions for this site from a geotechnical perspective. As part of the overall site grading for the proposed building and access roads/parking areas, grades should be proposed to promote drainage away from all structures and hard surface areas to ditches and/or catch basins.

5.2.7 Slab on Grade Support

To provide predictable settlement performance of the floor slab, topsoil and any fill or disturbed soil and debris should be removed from the slab area. The base for the floor slab should consist of at least 300 millimetres of OPSS Granular A. OPSS documents allow recycled asphaltic concrete and concrete to be used in Granular A material. Since the source of recycled material cannot be determined or controlled, it is suggested that any imported Granular A materials be composed of 100 percent crushed rock only, for environmental reasons.

All imported granular materials placed below the proposed floor slab should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density value.

Underfloor drainage is not considered necessary provided that the floor slab level is above the finished exterior grade.

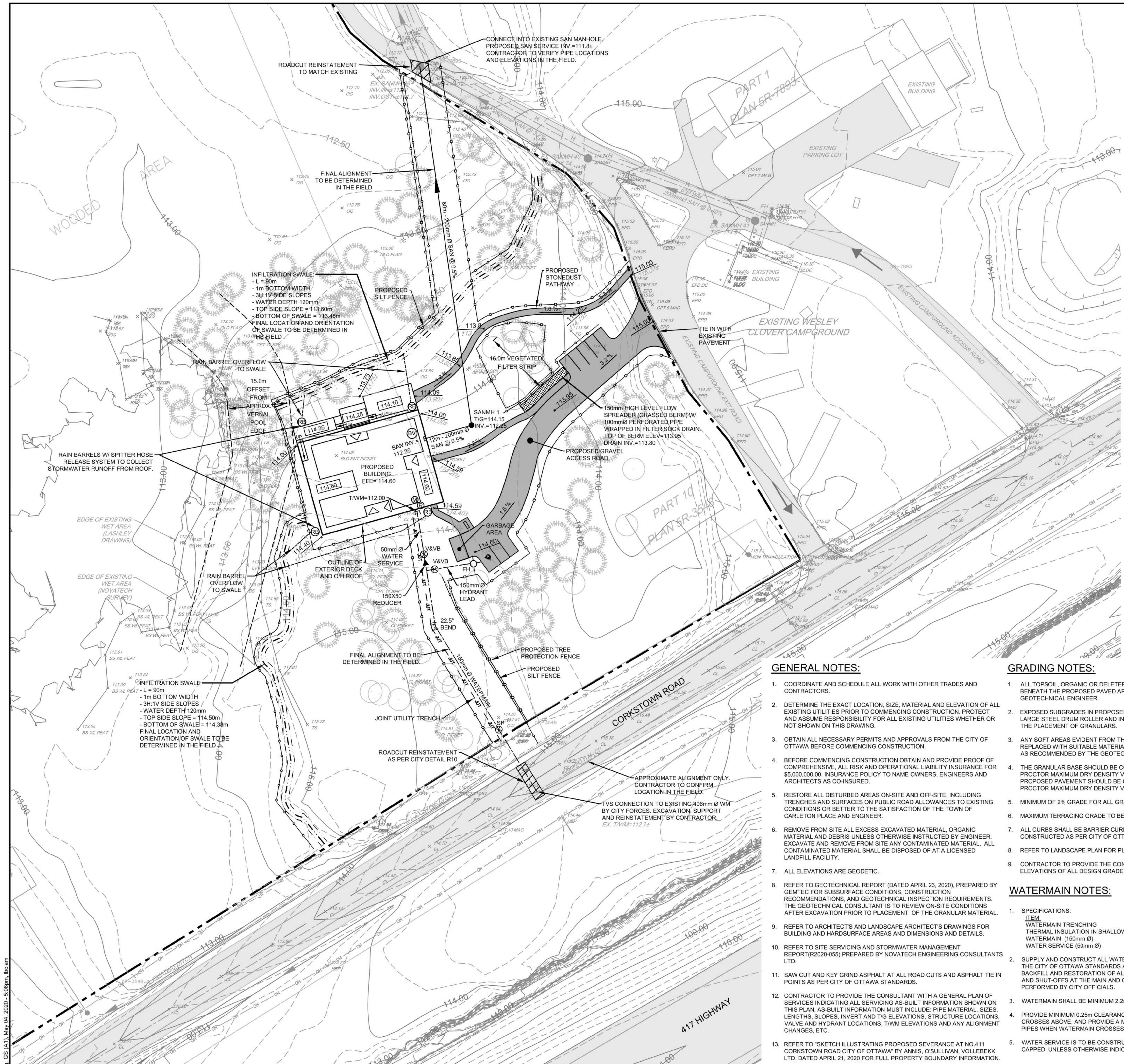
The floor slab should be wet cured to minimize shrinkage cracking and slab curling. The slab should be saw cut to about 1/3 the thickness of the slab as soon as curing of the concrete permits, in order to minimized shrinkage cracks.

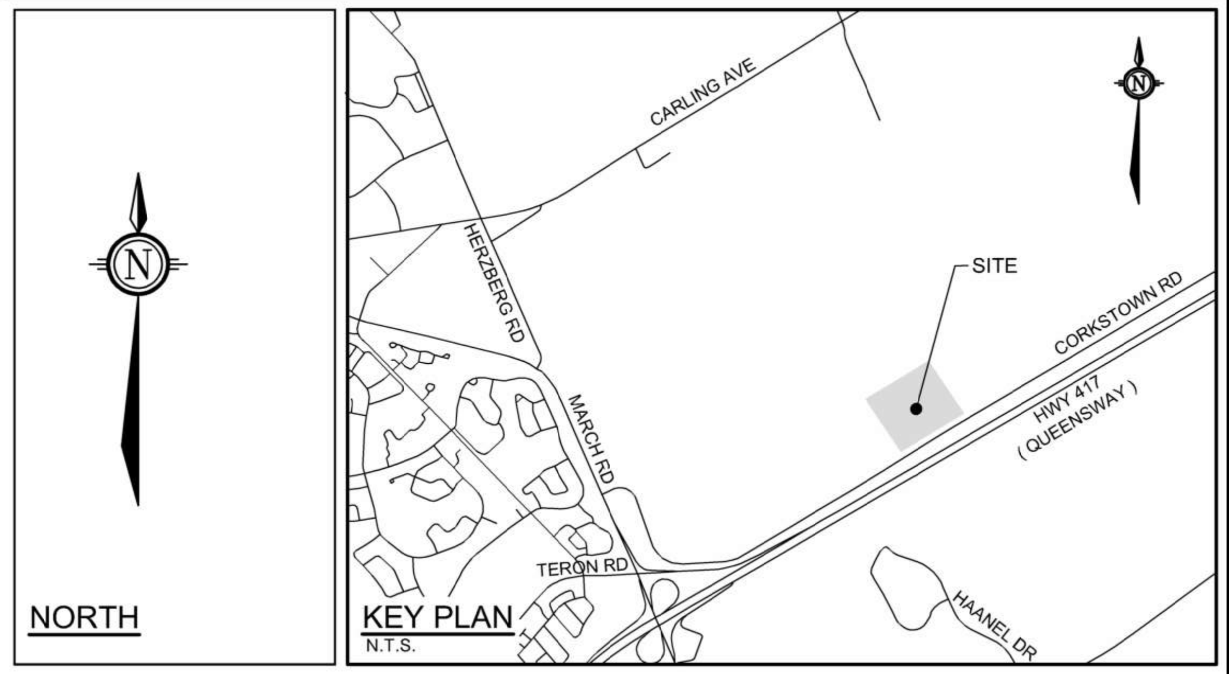
Proper moisture protection with a vapour retarder should be used for any slab on grade where the floor will be covered by moisture sensitive flooring material or where moisture sensitive equipment, products or environments will exist. The “Guide for Concrete Floor and Slab Construction”, ACI 302.1R-04 should be considered for the design and construction of vapour retarders below the floor slab.

5.3 Infiltration Characteristics of Native Soil

The results of our grain size testing indicates a permeability (K) of 1×10^{-4} metres per second for the overburden soil below the topsoil. This corresponds to an infiltration rate of about 160 millimetres per hour. We recommend allowing for unfactored infiltration rates ranging from 140 to 210 millimetres per hour.

Attached Plans





LEGEND

- 114.00 — MAJOR CONTOUR (1.0m INTERVAL) (FROM CITY 1:1000 TOPO MAPPING)
- MINOR CONTOUR LINE (0.25m INTERVAL) (FROM CITY 1:1000 TOPO MAPPING)
- EXISTING FENCE
- EXISTING DITCH
- PROPERTY LINE
- x 114.15 — EXISTING ELEVATION (FROM NOVATECH SURVEY - JUNE 2019)
- 112.00 — PROPOSED ELEVATION
- 94.00(S) — PROPOSED SWALE ELEVATION
- FFE= — FINISHED FLOOR ELEVATION
- 2.0% — PROPOSED GRADE AND DIRECTION
- PROPOSED TERRACE GRADING (3:1 MAX)
- DIRECTION OF EXISTING OVERLAND FLOW
- PROPOSED GRAVEL ROADWAY / STONEDUST PATHWAY
- PROPOSED ROAD CUT REINSTATEMENT (PER CITY DETAIL R10)
- PROPOSED TREE PROTECTION FENCE
- PROPOSED SILT FENCE
- 150mmØ WM — PROPOSED WATER SERVICE
- SAN MH 1 — PROPOSED SANITARY SEWER AND MANHOLE
- PROPOSED VEGETATED SWALE
- 250mmØ SAN, SANMH — EXISTING SANITARY SEWER AND MANHOLE
- 150mmØ WM — EXISTING WATERMAIN
- FH — EXISTING FIRE HYDRANT
- VC — EXISTING VALVE CHAMBER
- (M) — PROPOSED WATER METER
- (BV) — PROPOSED SANITARY BACKWATER VALVE
- (R) — PROPOSED REMOTE WATER METER
- ⊗ SP — PROPOSED STANDPOST (AS PER CITY DETAIL W3.3)
- PROPOSED BEND
- FH — PROPOSED FIRE HYDRANT (PER CITY DETAIL W19)
- RB — PROPOSED RAIN BARREL W/ SPITTER HOSE CONTROLLED RELEASE SYSTEM
- ⊗ V&VB — PROPOSED VALVE & VALVE BOX
- JUT — PROPOSED JOINT UTILITY TRENCH
- OH — EXISTING OVERHEAD UTILITIES
- UP — EXISTING UTILITY POLE

PAVEMENT STRUCTURE: GRAVEL ROAD

200mm OPSS GRAN "A"
300mm OPSS GRAN "B" TYPE II
(REFER TO GEOTECHNICAL REPORT)

STONEDUST PATH

150mm STONE DUST
(REFER TO GEOTECHNICAL REPORT)

GENERAL NOTES:

1. COORDINATE AND SCHEDULE ALL WORK WITH OTHER TRADES AND CONTRACTORS.
2. DETERMINE THE EXACT LOCATION, SIZE, MATERIAL AND ELEVATION OF ALL EXISTING UTILITIES PRIOR TO COMMENCING CONSTRUCTION. PROTECT AND ASSUME RESPONSIBILITY FOR ALL EXISTING UTILITIES WHETHER OR NOT SHOWN ON THIS DRAWING.
3. OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF OTTAWA BEFORE COMMENCING CONSTRUCTION.
4. BEFORE COMMENCING CONSTRUCTION OBTAIN AND PROVIDE PROOF OF COMPREHENSIVE, ALL RISK AND OPERATIONAL LIABILITY INSURANCE FOR $5,000,000.00. INSURANCE POLICY TO NAME OWNERS, ENGINEERS AND ARCHITECTS AS CO-INSURED.
5. RESTORE ALL DISTURBED AREAS ON-SITE AND OFF-SITE, INCLUDING TRENCHES AND SURFACES ON PUBLIC ROAD ALLOWANCES TO EXISTING CONDITIONS OR BETTER TO THE SATISFACTION OF THE TOWN OF CARLETON PLACE AND ENGINEER.
6. REMOVE FROM SITE ALL EXCESS EXCAVATED MATERIAL, ORGANIC MATERIAL AND DEBRIS UNLESS OTHERWISE INSTRUCTED BY ENGINEER. EXCAVATE AND REMOVE FROM SITE ANY CONTAMINATED MATERIAL. ALL CONTAMINATED MATERIAL SHALL BE DISPOSED OF AT A LICENSED LANDFILL FACILITY.
7. ALL ELEVATIONS ARE GEODETIC.
8. REFER TO GEOTECHNICAL REPORT (DATED APRIL 23, 2020), PREPARED BY GEMTEC FOR SUBSURFACE CONDITIONS, CONSTRUCTION RECOMMENDATIONS, AND GEOTECHNICAL INSPECTION REQUIREMENTS. THE GEOTECHNICAL CONSULTANT IS TO REVIEW ON-SITE CONDITIONS AFTER EXCAVATION PRIOR TO PLACEMENT OF THE GRANULAR MATERIAL.
9. REFER TO ARCHITECT'S AND LANDSCAPE ARCHITECT'S DRAWINGS FOR BUILDING AND HARDSURFACE AREAS AND DIMENSIONS AND DETAILS.
10. REFER TO SITE SERVICING AND STORMWATER MANAGEMENT REPORT(R2020-055) PREPARED BY NOVATECH ENGINEERING CONSULTANTS LTD.
11. SAW CUT AND KEY GRIND ASPHALT AT ALL ROAD CUTS AND ASPHALT TIE IN POINTS AS PER CITY OF OTTAWA STANDARDS.
12. CONTRACTOR TO PROVIDE THE CONSULTANT WITH A GENERAL PLAN OF SERVICES INDICATING ALL SERVICING AS-BUILT INFORMATION SHOWN ON THIS PLAN. AS-BUILT INFORMATION MUST INCLUDE: PIPE MATERIAL, SIZES, LENGTHS, SLOPES, INVERT AND T/G ELEVATIONS, STRUCTURE LOCATIONS, VALVE AND HYDRANT LOCATIONS, T/WM ELEVATIONS AND ANY ALIGNMENT CHANGES, ETC.
13. REFER TO "SKETCH ILLUSTRATING PROPOSED SEVERANCE AT NO.411 CORKSTOWN ROAD CITY OF OTTAWA" BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. DATED APRIL 21, 2020 FOR FULL PROPERTY BOUNDARY INFORMATION.

GRADING NOTES:

1. ALL TOPSOIL, ORGANIC OR DELETERIOUS MATERIAL MUST BE ENTIRELY REMOVED FROM BENEATH THE PROPOSED PAVED AREAS AS DIRECTED BY THE SITE ENGINEER OR GEOTECHNICAL ENGINEER.
2. EXPOSED SUBGRADES IN PROPOSED PAVED AREAS SHOULD BE PROOF ROLLED WITH A LARGE STEEL DRUM ROLLER AND INSPECTED BY THE GEOTECHNICAL ENGINEER PRIOR TO THE PLACEMENT OF GRANULARS.
3. ANY SOFT AREAS EVIDENT FROM THE PROOF ROLLING SHOULD BE SUB-EXCAVATED AND REPLACED WITH SUITABLE MATERIAL THAT IS FROST COMPATIBLE WITH THE EXISTING SOILS AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.
4. THE GRANULAR BASE SHOULD BE COMPACTED TO AT LEAST 100% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY VALUE. ANY ADDITIONAL GRANULAR FILL USED BELOW THE PROPOSED PAVEMENT SHOULD BE COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY VALUE.
5. MINIMUM OF 2% GRADE FOR ALL GRASS AREAS UNLESS OTHERWISE NOTED.
6. MAXIMUM TERRACING GRADE TO BE 3:1 UNLESS OTHERWISE NOTED.
7. ALL CURBS SHALL BE BARRIER CURB (150mm) UNLESS OTHERWISE NOTED AND CONSTRUCTED AS PER CITY OF OTTAWA STANDARDS.
8. REFER TO LANDSCAPE PLAN FOR PLANTING AND OTHER LANDSCAPE FEATURE DETAILS.
9. CONTRACTOR TO PROVIDE THE CONSULTANT WITH A GRADING PLAN INDICATING AS-BUILT ELEVATIONS OF ALL DESIGN GRADES SHOWN ON THIS PLAN.

WATERMAIN NOTES:

1. SPECIFICATIONS:

ITEM	SPEC. No.	REFERENCE
WATERMAIN TRENCHING	W17	CITY OF OTTAWA
THERMAL INSULATION IN SHALLOW TRENCHES	W22	CITY OF OTTAWA
WATERMAIN (150mm Ø)	PVC DR 18	
WATER SERVICE (50mm Ø)	COPPER "TYPE K"	

2. SUPPLY AND CONSTRUCT ALL WATERMAINS AND APPURTENANCES IN ACCORDANCE WITH THE CITY OF OTTAWA STANDARDS AND SPECIFICATIONS. EXCAVATION, INSTALLATION, BACKFILL AND RESTORATION OF ALL WATERMAINS BY THE CONTRACTOR. CONNECTIONS AND SHUT-OFFS AT THE MAIN AND CHLORINATION OF THE WATER SYSTEM SHALL BE PERFORMED BY CITY OFFICIALS.
3. WATERMAIN SHALL BE MINIMUM 2.2m DEPTH BELOW GRADE UNLESS OTHERWISE INDICATED.
4. PROVIDE MINIMUM 0.25m CLEARANCE BETWEEN OUTSIDE OF PIPES WHEN WATERMAIN CROSSES ABOVE, AND PROVIDE A MINIMUM OF 0.5m CLEARANCE BETWEEN OUTSIDE OF PIPES WHEN WATERMAIN CROSSES BELOW.
5. WATER SERVICE IS TO BE CONSTRUCTED TO WITHIN 1.0m OF FOUNDATION WALL AND CAPPED, UNLESS OTHERWISE INDICATED.

SEWER NOTES:

1. SPECIFICATIONS:

ITEM	SPEC. No.	REFERENCE
SANITARY MANHOLE (1200Ø)	701.010	OPSD
SANITARY MH FRAME & COVER	401.010	OPSD
SANITARY SEWER	PVC DR 35	
SEWER TRENCH - BEDDING (GRANULAR A)		
COVER (GRANULAR A OR GRANULAR B TYPE I, WITH MAXIMUM PARTICLE SIZE=25mm)		

2. INSULATE ALL PIPES (SAN/) THAT HAVE LESS THAN 1.5m COVER WITH 50mmX1200mm HI-40 INSULATION. PROVIDE 150mm CLEARANCE BETWEEN PIPE AND INSULATION.
3. SERVICES ARE TO BE CONSTRUCTED TO 1.0m FROM FACE OF BUILDING AT A MINIMUM SLOPE OF 1.0%.
4. PIPE BEDDING, COVER AND BACKFILL ARE TO BE COMPACTED TO AT LEAST 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY. THE USE OF CLEAR CRUSHED STONE AS A BEDDING LAYER SHALL NOT BE PERMITTED.
5. FLEXIBLE CONNECTIONS ARE REQUIRED FOR CONNECTING PIPES TO MANHOLES (FOR EXAMPLE KOR-N-SEAL, PSX: POSITIVE SEAL AND DURASEAL). THE CONCRETE CRADLE FOR THE PIPE CAN BE ELIMINATED.
6. THE OWNER SHALL REQUIRE THAT THE SITE SERVICING CONTRACTOR PERFORM FIELD TESTS FOR QUALITY CONTROL OF ALL SANITARY SEWERS. LEAKAGE TESTING SHALL BE COMPLETED IN ACCORDANCE WITH OPSS 410.07.16, 410.07.16.04 AND 407.07.24. DYE TESTING IS TO BE COMPLETED ON ALL SANITARY SERVICES TO CONFIRM PROPER CONNECTION TO THE SANITARY SEWER MAIN. THE FIELD TESTS SHALL BE PERFORMED IN THE PRESENCE OF A CERTIFIED PROFESSIONAL ENGINEER WHO SHALL SUBMIT A CERTIFIED COPY OF THE TEST RESULTS.
7. CONTRACTOR TO TELEVISE (CCTV) ALL PROPOSED SEWERS, 200mmØ OR GREATER. UPON COMPLETION OF CONTRACT, THE CONTRACTOR IS RESPONSIBLE TO FLUSH AND CLEAN ALL SEWERS & APPURTENANCES.

EROSION AND SEDIMENT CONTROL NOTES:

1. THE OWNER AGREES TO PREPARE AND IMPLEMENT AN EROSION AND SEDIMENT CONTROL PLAN TO THE SATISFACTION OF THE CITY OF OTTAWA, APPROPRIATE TO THE SITE CONDITIONS, PRIOR TO UNDERTAKING ANY SITE ALTERATIONS (FILLING, GRADING, REMOVAL OF VEGETATION, ETC.) AND DURING ALL PHASES OF SITE PREPARATION AND CONSTRUCTION IN ACCORDANCE WITH THE CURRENT BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL SUCH AS BUT NOT LIMITED TO INSTALLING FILTER CLOTHS ACROSS MANHOLE/CATCHBASIN LIDS TO PREVENT SEDIMENTS FROM ENTERING STRUCTURES AND INSTALL AND MAINTAIN A LIGHT DUTY SILT FENCE BARRIER AS REQUIRED.
2. THE CONTRACTOR SHALL PLACE FILTER CLOTH UNDER THE MANHOLE GRATES FOR THE DURATION OF CONSTRUCTION AND WILL REMAIN IN PLACE DURING ALL PHASES OF CONSTRUCTION.
3. SILT FENCING FOR ENTIRE PERIMETER OF SITE, SHALL BE UTILIZED TO CONTROL EROSION FROM THE SITE DURING CONSTRUCTION.
4. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

NOTE:
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

No.	REVISION	DATE	BY
3	ISSUED FOR SITE PLAN APPROVAL	05 MAY 2020	GJM
2	ISSUED FOR NCC REVIEW	15 APR 2020	GJM
1	ISSUED FOR CO-ORDINATION	03 APR 2020	GJM

SCALE 1:500
1:500 — 0 5 10 15 20

DESIGN LGB/MS
CHECKED GJM
DRAWN RJG
CHECKED LGB
APPROVED GJM

FOR REVIEW ONLY

LICENSED PROFESSIONAL ENGINEER — L. G. BOLAM — 100523457 — May 4, 2020 — PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER — G.J. MacDONALD — May 4, 2020 — PROVINCE OF ONTARIO

NOVATECH
Engineers, Planners & Landscape Architects
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Ottawa, Ontario, Canada K2M 1P6
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Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
CITY OF OTTAWA
411 CORKSTOWN ROAD

DRAWING NAME
GRADING AND SERVICING PLAN

PROJECT No. 119045-00
REV REV # 3
DRAWING No. 119045-GS

PLANA1.DWG - 841mmx594mm
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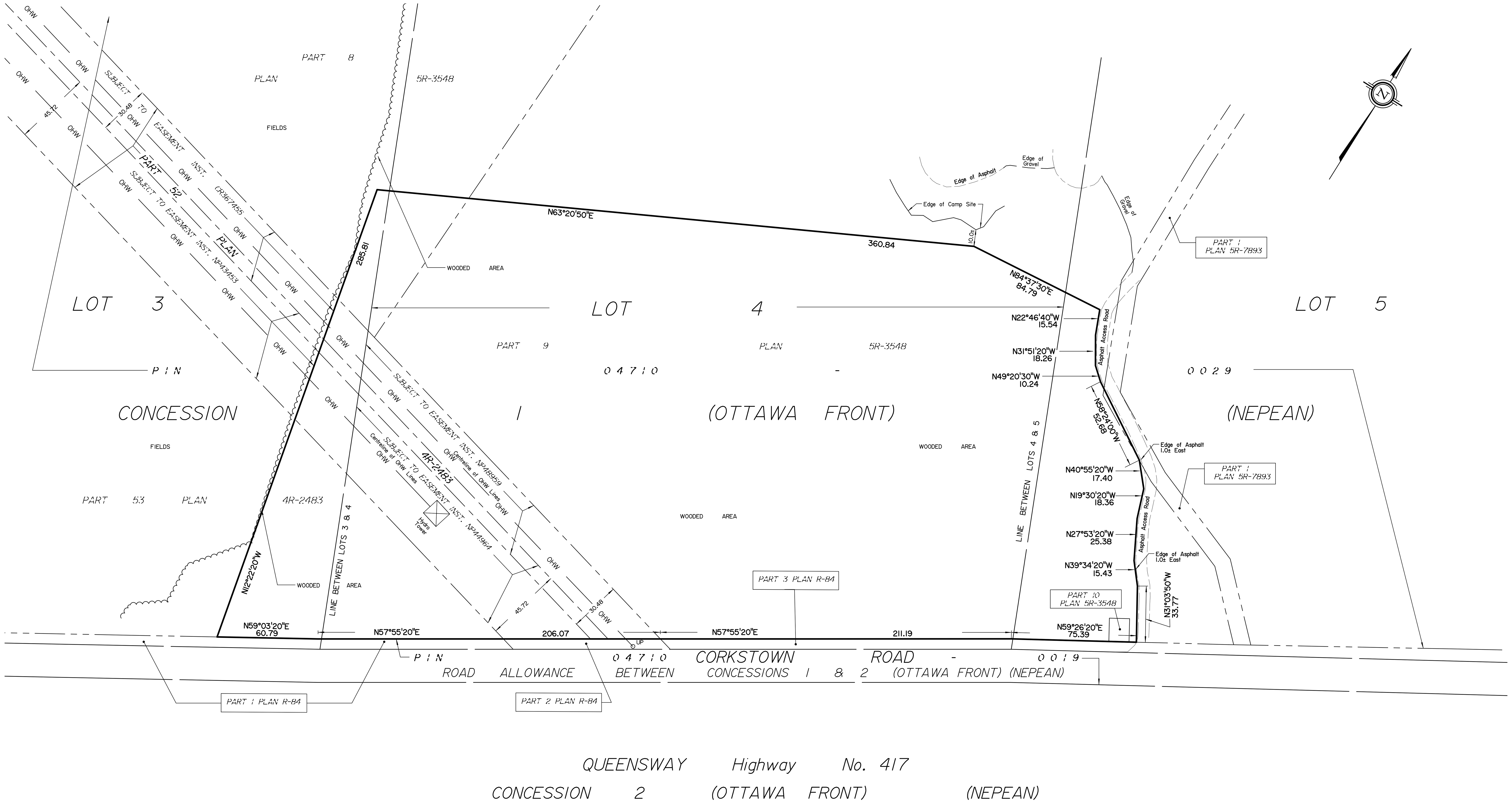

SKETCH ILLUSTRATING PROPOSED SEVERANCE AT

No. 411 Corkstown Road
CITY OF OTTAWA

Prepared by Annis, O'Sullivan, Vollebekk Ltd.
April 21, 2020

Scale 1 : 1500

60 45 30 15 0 30 60 Metres

Metric

DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

CAUTION

This is NOT a Plan of Survey and shall not be used except for the purpose indicated in the title block.

Bearings are grid, derived from the northerly limit of Corkstown Road shown to be N59°26'20"E on Plan 5R-3548 and are referred to the Central Meridian of MTM Zone 9 (76°30' West Longitude) NAD-83 (original).

SITE AREA = 12.348 Hectares

BOUNDARY INFORMATION COMPILED FROM SURVEY RECORDS.

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Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com
Ontario Land Surveyors

Job No. 20551-20 CSV PtLts 3 4 CI OF NP Sketch DI | ig