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Highland Park Cemetery Visitation Centre

Servicing & Stormwater Management Report

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Highland Park Cemetery Visitation Centre

Servicing and Stormwater Management Report

Prepared By:

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Ottawa, Ontario
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June 3, 2019

Novatech File: 101063
Ref: R-2019-086

June 3, 2019

BY COURIER

City of Ottawa
Planning & Growth Management Department
110 Laurier Avenue West
4th Floor Infrastructure Approvals Division
Ottawa, ON K1P 1J1

Attention: Mark Young, Planner

Dear Sir:

Reference: Highland Park Cemetery – Visitation Centre
Servicing and Stormwater Management Report
Our File No.: 101063

Please find enclosed the Servicing and Stormwater Management Report for the proposed construction of a Visitation Centre at the Highland Park Cemetery. The report outlines the detailed servicing and stormwater management design to meet the requirements of the City of Ottawa and Mississippi Valley Conservation Authority (MVCA) in support of an application for Site Plan approval.

A copy of this report has been forwarded directly to the Mississippi Valley Conservation Authority.

If you have any questions, please call the undersigned.

Yours truly,

NOVATECH

Alex McAuley, P.Eng.
Project Manager | Land Development Engineering

Enclosed.

cc: Niall Oddie – Mississippi Valley Conservation Authority

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1.0 INTRODUCTION

Novatech has been retained to provide design services for the proposed addition of a visitation centre to the existing Highland Park Cemetery. This report provides the detailed design for site servicing, storm drainage and stormwater management for the proposed visitation centre.

The Highland Park Cemetery is located at 2037 McGee Side Road, in Carp (Ottawa), Ontario. Refer to **Figure 1** – Key Plan. The specific area of the property being developed is shown on the **Figure 2** – Location Plan.

1.1 Background Reports

This report references the following background documents:

- Pre-Consultation Minutes, City of Ottawa (April 19, 2018)
- “Hydrogeological Assessment” letter prepared by Gemtec (Jan 25, 2019);
- “Geotechnical Investigation” prepared by Gemtec (Jan 25, 2019);
- Carp River Subwatershed Study
- City of Ottawa Sewer Design Guidelines

1.2 Existing Conditions

Highland Park Cemetery has been in operation for over 30 years. The cemetery property consists of approximately 49 ha and is mostly vegetated with a mix of agricultural fields, maintained grass and laneways. There is an existing office/maintenance building complete with well and septic system. The neighbouring land uses are primarily agricultural fields. An existing ditch acts as the drainage outlet for the cemetery. Given the rural location, there are no municipal services available on McGee Side Road. Refer to **Figure 3** – Existing Conditions Plan.

Soils

The soils on this site are primarily topsoil underlain by silty clay over glacial till. Boreholes and test pits were advanced by Gemtec. Refer to the “Geotechnical Investigation” prepared by Gemtec (Jan 25, 2019) for more information.

Topography / Storm Outlet

Under existing conditions, the site is gradually sloped towards the north east and drains towards the Carp River. The existing cemetery is serviced by localized swales and culverts.

The pre-development drainage areas are shown on the Pre-Development Storm Drainage Area Plan (101063-PRE). Under pre-development conditions the site generally drains in two directions, to the existing ditch at the north property line, and to the east towards Oak Creek Side Road through the existing agricultural fields.

1.3 Proposed Building

The proposed visitation centre consists of a new building, parking lot / laneways and associated infrastructure. Refer to Site Plan (1513-A1.02 prepared by Hobin Architects).

1.4 Scope

The scope of Novatech's design is limited to the grading and servicing of the proposed visitation centre. This work includes the immediately adjacent parking lot / laneways, the septic system, the two roadside water quality ditches, and the stormwater management facility. Analysis of the existing infrastructure onsite is beyond the scope of this report.

1.5 Approvals

The proposed stormwater conveyance and stormwater management design will require approval from the City of Ottawa, the Mississippi Valley Conservation Authority (MVCA) and the Ottawa Septic System Office (OSSO).

2.0 SERVICING

Since municipal services are not available on McGee Side Road, it is proposed to service the proposed visitation centre with drilled well and septic system.

The stormwater runoff will be conveyed overland via proposed swales, which will complement the existing swales and culverts.

2.1 Grading

Based on the architectural design, the proposed building will be elevated above the surrounding land and existing driveways. The elevated design allows for grading away from the proposed building, and towards proposed grassed swales. The architectural plans call for a depressed loading zone with direct basement access. It is proposed to construct an exterior heated concrete ramp to access the basement level. Drainage of the depressed loading zone will be discussed in **Section 3.3** of this report.

2.2 Water Supply

The building will be serviced by a new drilled well that was drilled and tested as part of the "Hydrogeological Assessment" report (Gemtec, July 2010) and subsequent "Hydrogeological Assessment – Comments/Update" letter (Gemtec, Jan 25, 2019). The test well may be used for domestic water supply per the recommendations by Gemtec. The approximate location of the well is shown on the Grading and Servicing Plan (Drawing 101063-GR).

2.3 Wastewater Disposal

The building will be serviced by an individual sewage disposal system in accordance with the recommendations of the "Hydrogeological Assessment" report (Gemtec, July 2010) and subsequent "Hydrogeological Assessment – Comments/Update" letter (Gemtec, Jan 25, 2019). The sewage disposal system shown on the Grading and Servicing Plan (Drawing 101063-GR) is a fully raised conventional (Class IV) tile fields based on a design flow of 6,000 L/day.

A Sewage System Permit application will be required from the Ottawa Septic System Office.

Refer to **Appendix B** for details on the proposed septic system design.

2.4 Pavement Design

The typical pavement cross-section is shown on the Grading and Servicing Plan (Drawing 101063-GR).

The pavement structure being proposed is as follows:

Table 1: Pavement Structure

Pavement Material Description	Layer Thickness (mm)	
	Heavy Duty	Light Duty
Asphalt Wear Course (Superpave 12.5)	40	50
Asphalt Base Course (Superpave 19.0)	50	-
OPSS Granular A	150	150
OPSS Granular B Type II	450	300
TOTAL	**540**	**500**

The proposed pavement structure meets the recommendations provided in the Geotechnical Investigation report prepared by Gemtec.

3.0 STORM DRAINAGE AND STORMWATER MANAGEMENT

The stormwater management criteria and storm drainage design are based on a pre-consultation meeting with City of Ottawa staff. Correspondence is provided in **Appendix A**.

3.1 Stormwater Management Criteria

The following criteria have been applied to the stormwater management design:

Water Quantity

- Provide storage to attenuate post-development peak flows to pre-development conditions for all storms up-to and including the 100-year storm event.
- Design a storm drainage system to safely convey post-development flows for all storms up-to and including the 100-year storm event.
- Provide 100-year level of service for the depressed basement loading zone.

Water Quality

- Provide an Enhanced level of water quality treatment corresponding to 80% long-term removal of total suspended solids (TSS).
- Implement conveyance best management practices.

Infiltration

- Infiltrate 73 mm annually based on the total drainage area; per the Carp River Subwatershed Study for low-pervious soils.

Erosion and Sediment Control

- Provide erosion and sediment control to minimize erosion and sediment transport during and after construction.

3.2 Proposed Drainage System

The proposed storm drainage system has been designed to minimise the impact to the existing storm drainage system for the cemetery. The proposed storm drainage system will drain overland towards the north property line and will expand the existing outlet ditch into a dry stormwater facility.

The area of expansion will be serviced with roadside water quality ditches along the laneways, directing drainage towards the outlet ditch / stormwater management facility. The depressed basement loading zone adjacent the building (Area B04) will be serviced with a catchbasin and trench drain. Stormwater will be collected with a sump pump system inside the proposed building and pumped to the surface.

3.3 Depressed Loading Zone

The proposed basement loading zone is located below the elevation of the surrounding parking and landscaped areas. The lowered elevation will require that any drainage to this area be pumped. It is proposed to construct a catchbasin and trench drain to collect stormwater runoff and direct it to a sump pump system. The sump pump system will be required to provide a 100-year level of service, in combination with surface storage in the depressed loading zone without impacting the basement.

It is proposed to provide a duplex sump pump system, with each pump capable of providing 3 L/s (3000gph) of constant flow, for a combined maximum flow rate of 6 L/s. The details of the sump pump system will be designed by the mechanical engineer as part of the mechanical design for the building. To be conservative, it is assumed that only one pump would be operating to determine the required storage volumes indicated in **Table 2** below.

Table 2: Depressed Loading Zone Storage

Location	Storm Event	Pump Rate (L/s)	Elevation[1] (m)	Required Volume (m^3)	Available Volume (m^3)
Catchbasin	-	-	109.70	-	0.4
Trench Drain	2-year	3	109.83	4.5	5.2
Surface Ponding	5-year	3	109.87	6.6	19.5
	100-year	3	109.96	15.1	
Basement Floor	-	-	110.00	19.5	
Power Failure	5-year (45 mm rainfall)	0	110.00	19.5	

[1] PCSWMM model results for a 4-hour Chicago Storm.

Based on the above table, a duplex sump pump system, with only one pump operating will be able to accommodate the 100-year storm event, without impacting the basement floor. In the event of a complete power failure, including the onsite automatic backup generator, the available storage provided is equivalent to the amount of runoff from a 5-year 4-hour Chicago storm (approx. 45 mm of rainfall).

3.4 Stormwater Quantity Control

The PCSWMM hydrologic / hydraulic model was used to complete the storm drainage analysis of the proposed storm drainage system and stormwater management facility. The hydrologic analysis included the delineation of storm drainage areas and the selection of modelling parameters for each subcatchment area.

3.4.1 Storm Drainage Area Plan

The drainage area plan (Drawing 101063-POST) generally maintains the existing storm drainage strategy for the cemetery. The drainage boundary between the north outlet and the drainage towards the east have been adjusted to reflect the current grading design and existing topography. They have also been delineated based on land cover (i.e. building rooftop, parking lot, grassed areas).

3.4.2 Model Parameters

Hydrologic modelling parameters for each subcatchment were developed based on soil type, land use, and topography. Modelling parameters were determined as follows:

- Soil types were identified based on the "Geotechnical Investigation" prepared by Gemtec (Jan 25, 2019);
- Land use and ground cover were determined from aerial photos images (**Figure 3**);
- SCS Curve Numbers were assigned for each ARM subcatchment based on the soil types and land use for areas with less than 20% imperviousness. The ARM subcatchments use the NASHYD routine (runoff-based calculations), which is best suited for large rural catchments.
- For areas with more than 20% imperviousness, standard subcatchments were used (Horton's infiltration-based calculations).

The subcatchment input parameters used to pre-development and post-development models are shown in **Table 3**.

Table 3: Subcatchment Parameters

Area ID	Area (ha)	CN (HSG 'C')	Ia (mm)	Tc (min)	Runoff Coef.	% Imp. (%)
Existing Conditions						
EX01	8.88	77	7.6	23	-	-
Proposed Conditions						
A01	7.56	77	7.6	10	-	-
A02	0.37	77	7.6	10	-	-
B01	0.05	-	-	-	0.90	100%
B02	0.42	-	-	-	0.85	93%
B03	0.43	77	7.6	10	-	-
C01	0.05	-	-	-	0.90	100%
C02	0.48	-	-	-	0.85	93%
C03	0.45	77	7.6	10	-	-
TOTAL	**9.81**	**-**	**-**	**-**	**-**	**-**

3.4.3 Design Storms

The hydrologic analysis was completed using the following design storms; generated using IDF parameters presented in the City of Ottawa Sewer Design Guidelines (October 2012).

<u>*3 Hour Chicago Storms*</u>:
25mm 3hr Chicago storm
2-year 3hr Chicago storm
5-year 3hr Chicago storm
100-year 3hr Chicago storm

<u>*12 Hour SCS Type II Storms*</u>:
25mm 12 hour SCS Type II storm
2-year 12 hour SCS Type II storm
5-year 12 hour SCS Type II storm
100-year 12 hour SCS Type II storm

Of the two modelled storm distributions, the 12-hour SCS distribution generated the highest peak flows and was selected as the critical distribution for this site.

3.4.4 Modelling Files and Schematics

The PCSWMM model schematic and 100-year model output are provided in **Appendix C**.

3.4.5 Ditches

The ditches have been designed to provide stormwater conveyance and water quality treatment. They have been sized to convey the 100-year peak flows, based on Manning's equation. All storm drainage will be confined within the drainage easements. The proposed ditch cross-sections are shown on the Grading and Servicing Plan (Drawing 101063-GR). In all cases, the maximum capacity of the proposed roadside ditches exceeds the 100-year design flow. Supporting Manning's calculations for the north and east ditches are included in **Appendix C**.

3.4.6 Storm Outlet

Table 4 provides a summary of the total pre-development and uncontrolled / controlled post-development peak flows at the outlet.

Table 4: Summary of Peak Flows

Area ID	Peak Flow (L/s)			
	25mm	2-year	5-year	100-year
Existing Conditions (allowable release rate)				
4-hour Chicago Storm	61.1	140.2	280.8	800.9
12-hour SCS Storm	-	189.6	342.8	860.0
Post-Development Conditions (controlled)				
4-hour Chicago Storm	82.6	111.0	146.9	695.0
12-hour SCS Storm	-	112.7	211.3	772.8

The controlled peak flows meet the allowable release rates for the 2-year, 5-year and 100-year storm events. In addition, there is existing uncontrolled runoff which is directed to the storm outlet and is being routed through the inline dry pond.

The proposed works will reduce the drainage area towards the east. Therefore, no further analysis of drainage towards the east was completed. The grading design has increased the total contributing drainage area to the north outlet from 8.88 ha to 9.81 ha (additional 0.93 ha). This represents a 9.5% increase in the overall drainage to the north outlet.

The outlet channels have been designed to convey the 100-year peak flow. The additional drainage area from the proposed works will have no adverse impact on the existing outlet ditch or downstream culverts. Peak flows will be attenuated by the inline dry pond. Manning's capacity calculations and flow depths for the outlet channel to the inline dry pond are provided in **Appendix C**.

3.4.7 Stormwater Management Facility (Inline Dry Pond)

An inline dry pond will provide stormwater management by attenuating peak flows. A low flow channel (i.e., the existing outlet channel) is provided along one side of the dry pond. The total storage volume within the dry pond is approximately 500 m^3.

The outlet control structure will consist of a 300mm PVC pipe, within a ditch inlet catchbasin, and 1.5 m wide overflow weir. The weir will be constructed of 150 mm dia. D_{50} rip-rap.

Details of the storm outlet and inline dry pond are shown on the Outlet Plan and Profile drawing (101063-PP1).

3.5 Stormwater Quality Control

The Highland Park Cemetery is located within the jurisdiction of Mississippi Valley Conservation Authority which requires an *Enhanced* level of treatment (80% long term removal of total suspended solids).

3.5.1 BMP Treatment Train

A treatment train approach will be used to provide to required quality control of stormwater. The initial part of the treatment train are site level conveyance controls and Best Management Practices. The following site level conveyance controls and Best Management Practices will be implemented to promote infiltration and filter sediment:

- The overall site drainage patterns generally remain the same. The natural landscape or pre-development conditions will be maintained where possible to promote infiltration and minimize erosion and sediment transport.
- Roof leaders are to be directed to infiltration galleries (rain gardens) consisting of 100mm rip-rap stone 0.5 m thick, which will promote retention and infiltration.
- Stormwater from roof areas is considered ‘clean’ and with roof leaders draining to the infiltration galleries, quality control of stormwater in these areas is not required.
- The drainage system for the proposed works will consists of grassed ditches instead of storm sewers. This will promote surface water infiltration within the drainage system. The proposed ditches will be constructed at minimum grades, where possible.

3.5.2 Grassed Swales (Ditches)

Although grassed ditches and swales are generally used for the conveyance of stormwater, under the appropriate conditions they permit significant amounts of total suspended solid (TSS) removal. Grassed ditches are effective for treatment when the bottom width is maximized while the depth of flow and channel slope is minimized.

The proposed ditches will have a trapezoidal cross-section, a bottom width of 2.0m, minimum depth of 0.3m, and side slopes of 3:1. The two proposed water quality ditches are approximately 100m each in length.

The grassed ditches have been designed based on guidelines from the following publications:

- Young et. al., "Evaluation and Management of Highway Runoff Water Quality (FHWA, 1996)
- Stormwater Best Management Practices in an Urban Setting: Selection and Monitoring (FHWA, 1996)
- Stormwater Management Planning and Design Manual (MOE, 2003)

Case studies on the effectiveness of grassed ditches and swales for water quality control have provided variable results, which precludes the ability to precisely calculate pollutant removal efficiencies. However, the above referenced publications indicate that properly designed grassed channels can provide in excess of 80% long-term TSS removal, which will meet the requirements for an Enhanced level of quality control as per the MOE guidelines.

Both dry and wet swales demonstrate good pollutant removal, with dry swales providing significantly better performance for metals and nitrate. Dry swales typically remove 65 percent of total phosphorus (TP), 50 percent of total nitrogen (TN), and between 80 and 90 percent of metals. Wet swale removal rates are closer to 20 percent of TP, 40 percent of TN, and between 40 and 70 percent of metals. The total suspended solids removal for both swale types is typically between 80 and 90 percent. (FHWA, 1996)

The proposed ditches and swales servicing the proposed expansion have been designed to meet MOE standards for water quality treatment. The recommended MOE & FHWA criteria for water quality are summarized in **Table 5**.

Table 5: Grassed Channel Design (Based on MOE & FHWA Guidelines)

Criteria	Recommended	West Swale Areas B1-B4	East Swale Areas C1-C3
Channel Dimensions			
Channel Slope	< 4.0% (MOE)	0.45% to 1.28%	0.34% to 1.0%
Bottom Width	> 0.75 m (MOE)	2.0 m	2.0 m
Side Slopes (H:V)	> 2.5:1 (MOE)	3:1	3:1
25mm Event (Water Quality – 4-hour Chicago)			
Peak Flow	-	0.058 m^3/s	0.067 m^3/s
Flow Depth	± 0.1 m (FHWA)	0.07 – 0.08 m	0.08 – 0.11 m
Velocity	< 0.5 m/s (MOE)	0.32 – 0.38 m/s	0.30 – 0.34 m/s
100-year Event (4-hour Chicago)			
Peak Flow	-	0.253 m^3/s	0.302 m^3/s
Flow Depth	< 0.5 m (MOE)	0.16 – 0.19 m	0.19 – 0.24 m
Velocity	< 0.5 m/s (MOE)	0.53 – 0.59 m/s	0.51 – 0.56 m/s

The results of the hydrologic / hydraulic analysis summarized in **Table 5** indicate that the flow depths and velocities in the roadside ditches meet the recommended flow depth and velocity criteria for the 25mm event (water quality event). The flow depth criteria is met during the 100-year event, but the velocity criteria is slightly exceeded. As the grass outlet channels meet the water quality criteria for frequent storm events they should provide long-term water quality control.

3.5.3 Maintenance

Pollutant removal efficiencies of swales are related to flow retardance, vegetation density and the stiffness of grass blades, providing a "scrub brush" effect (Khan, 1993). Best removal rates have been achieved through dense turf grasses where a uniform blade height is maintained at least 50mm (2 in) above the design water depth. Grasses too short do not provide sufficient flow reduction or pollutant filtration; grasses too long tend to bend and flatten, allowing the runoff to skim over the bent grass, reducing flow retardance and filtration. (FHWA, 1996).

Based on the above statement, the proposed ditches should be planted with dense turf grass or similar vegetation. The height of vegetation in the ditches should be maintained at approximately 150 to 200mm (6 to 8 inches) by the Owner.

Annual inspection of the ditches is recommended to monitor accumulation of sediment or debris:

- Sediment removal should be performed when sediment depths build up to no more than 100mm;
- Grass damaged during the sediment removal process should be promptly replaced using the same seed mix used during initial vegetation establishment; and,
- If any areas are eroded, they should be filled, compacted, and reseeded so that the final grade is level with the bottom of the ditch.

The proposed storm drainage system, in conjunction with site level best management practices, will provide the requisite level of water quality treatment.

3.6 Infiltration

Infiltration Target

The Carp River Subwatershed Study identifies the site as a low recharge zone, with an annual infiltration target of 73 mm/year based on low imperviousness soils. This is supported by the Geotechnical Report. The 73 mm / year of infiltration required corresponds to 7,161 m^3 / year, based on an overall drainage area of 9.81 ha or 730 m^3 / year based on the proposed development area (1.00 ha).

Infiltration from Initial Abstractions

The overall drainage area is predominantly pervious with an initial abstraction estimated to be 7.6 mm. The average annual rainfall is 515 mm for the months May to October. This is based on measurements at the Ottawa Macdonald–Cartier International Airport for a 30-year period (1971-2000). Infiltrating the first 7.6mm of rainfall (measured daily) corresponds to infiltrating 59% of the annual rainfall or 26,769 m^3 / year. Refer to **Table 6** for the infiltration calculations from initial abstractions.

Table 6: Infiltration from Initial Abstractions

Area ID	Area (ha)	CN	Ia (mm)	Annual Rainfall	% Infiltrated (%)	Volume Infiltrated (m^3)
Proposed Conditions						
A01	7.56	77	7.6	515 mm	59%	22,971
A02	0.37	77	7.6		59%	1,124
B03	0.43	77	7.6		59%	1,307
C03	0.45	77	7.6		59%	1,367
TOTAL	**9.75**	**-**	**-**	**50,213 m^3**	**59%**	**26,769**
					Total Infiltration required	**7,161**

Proposed Best Management Practices

To meet the 730 m^3/year annual infiltration criteria the following infiltration best management practices are proposed:

- Two (2) infiltration galleries (i.e. rain gardens).
    - Will intercept roof runoff from the west and east building rooftops / roof leaders.
- Amended topsoil within each of the two (2) outlet ditches.
    - Amended topsoil will be placed along the bottom (2.0m width) over the entire length of each outlet ditch (approx. 100m).

Each infiltration gallery (rain garden) will be filled with 0.30 m of 100 mm D_{50} Riverstone. The area, storage volumes and retention time are as follows:

Parameter	*West Infiltration Gallery*	*East Infiltration Gallery*
Bottom Area:	72 m^2	98 m^2
Storage Volume:	8.6 m^3	11.8 m^3
Retention Time:	12 hours	12 hours

The drawdown (retention) time for the infiltration galleries is approximately 12 hours. This is due to the low / moderate permeability of the surrounding silty sand soils. The estimated percolation rate for the native silty sand soils is 20 mm/hr. This value has been divided by 2 to account for clogging (10 mm/hr).

In addition to the infiltration galleries, the west and each outlet ditches will have 150 mm of amended topsoil (approx. 400 m^2). Assuming a void ratio of 15% the amended topsoil will provide approximately 9.0 m^3 of additional storage for infiltration. The retention time for the amended topsoil is approximately 2.3 hours.

Annual Rainfall and Volume Captured

Based on thirty (30) years of climate data (1971-2000) from the Ottawa CDA Environment Canada Weather Station (STA ID: 6105976), the average annual precipitation in Ottawa is 914 mm (rain + snow). The average annual rainfall is 733 mm, and the annual rainfall between May and October is 515 mm. Refer to the Climate Normals provided in **Appendix C**.

The storage provided for infiltration equates to an infiltration depth over the drainage areas. Based on the 30 years of daily rainfall data, the storage provided for infiltration equates to capturing and infiltrating a percentage of the annual rainfall (515 mm):

Infiltration System	*% of Annual Rainfall Infiltrated*	*Volume of Rainfall Infiltrated*
East Infiltration Gallery	84%	216.7 m^3/year
West Infiltration Gallery	92%	235.9 m^3/year
Amended Topsoil	7%	666.9 m^3/year
TOTAL	-	1,119.4 m^3/year

The annual volume of rainfall that will be infiltrated is 1,119.4 m3/year. This exceeds the Carp River Subwatershed Study target of 73 mm/year or 730 m^3/year. Refer to calculations provided in **Appendix C**.

4.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control measures would be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987). Details and specific locations of temporary and permanent Erosion and Sediment Control measures are shown on the Grading and Servicing Plan (101063-GR).

4.1.1 Temporary Measures

Temporary erosion and sediment control measures will be implemented on-site during construction in accordance with the Best Management Practices for Erosion and Sediment Control.

The following erosion and sediment control measures will be implemented during construction.

- Placement of geotextile or filter bags under catch basins and maintenance holes;
- Silt fences around the area under construction;
- Light duty straw bales at key locations in the ditches and swales as shown on the plans;
- Vegetating disturbed areas.

The erosion and sediment control measures are to be implemented prior to construction and will remain in place during all phases of construction. Regular inspection and maintenance of the erosion control measures are to be undertaken.

4.1.2 Permanent Measures

Permanent erosion and sediment control measures will include the following:

- Roof leaders are to be directed to the infiltration galleries / rain gardens.
- Ditches and swales are to be constructed at minimum grade, where possible.
- Ditches and swales are to be vegetated to provide permanent erosion and sediment control.
- Rip-rap will be installed at significant changes in grades of the proposed swales where shown on the plans.

5.0 CONCLUSIONS

The conclusions are as follows:

Servicing

- Potable water will be provided by means of a new well drilled as part of the Hydrogeological Assessment report and letter prepared by Gemtec.
- The proposed septic system is based on design flow pof 4,050L/day for a fully raised conventional system. A Sewage System Permit application will be required from the Ottawa Septic System Office.
- The underside of footing (USF) elevation shown on the plan was set at a minimum 0.3m above the groundwater elevation indicated in the Geotechnical Report prepared by Gemtec.

Stormwater Management

- Storm drainage and stormwater management will be provided via swales and roadside ditches.
- Quantity control of storm runoff is provided to control to the pre-development levels to the existing tributary to the Carp River.
- The vegetated swales will provide an Enhanced level of water quality treatment corresponding to 80% long-term total suspended solids removal.
- Erosion and sediment control will be provided to minimize erosion and sediment transport during and after construction.

6.0 CLOSURE

This report outlines detailed servicing and stormwater design to meet the requirements of the City of Ottawa and Mississippi Valley Conservation Authority (MVCA) and is submitted to clear the conditions of Draft Approval in support of Final Approval of the Site Plan.

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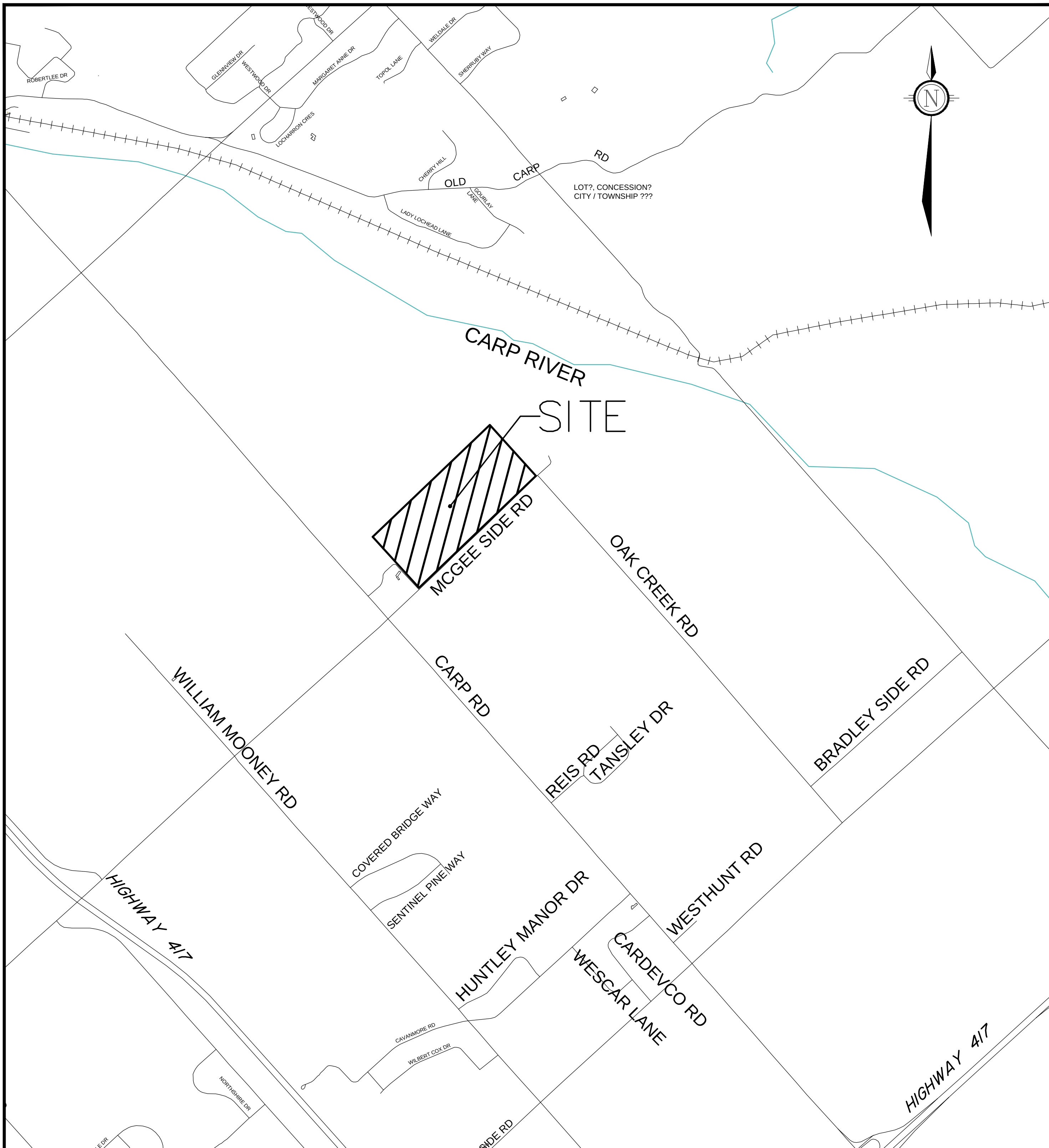

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KEY PLAN

2037 McGEE SIDE ROAD CITY OF OTTAWA

HIGHLAND PARK CEMETERY VISITATION CENTRE

DATE	JOB	FIGURE
JUNE 2019	101063	FIG 1

SHT8X11.DWG - 216mmx279mm

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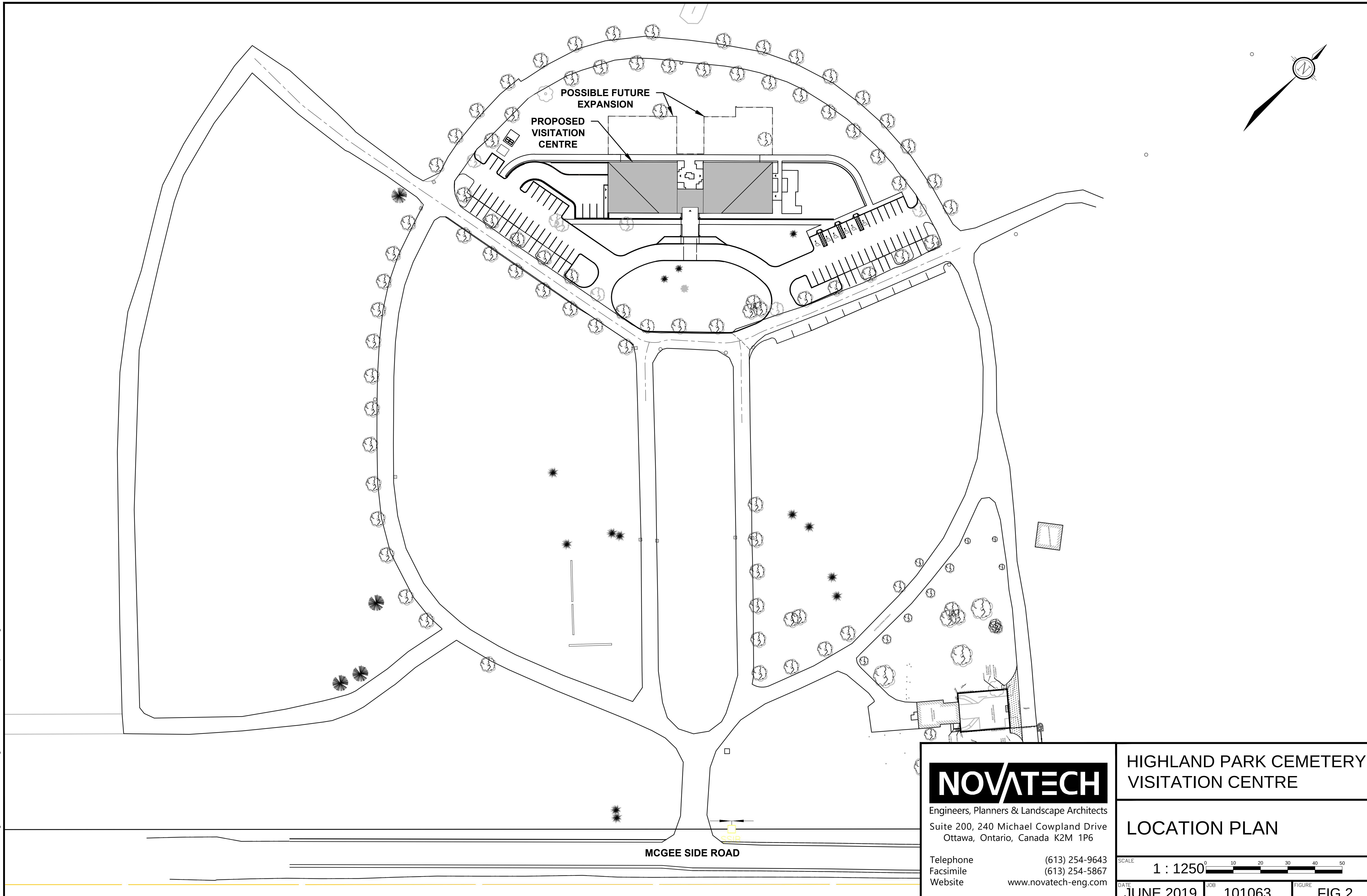

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Ottawa, Ontario, Canada K2M 1P6

Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

HIGHLAND PARK CEMETERY
VISITATION CENTRE

LOCATION PLAN

SCALE		
1 : 1250		
DATE JUNE 2019	JOB 101063	FIGURE FIG 2

M:\2001\101063\CAD\Figures\101063-FIGS.dwg, FIG3, Jun 03, 2019 - 12:11pm, lwang

NOVATECH
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HIGHLAND PARK CEMETERY
VISITATION CENTRE

EXISTING CONDITIONS

SCALE 1 : 4000 0 40 80 120 160

DATE JUNE 2019 | JOB 101063 | FIGURE FIG 3

SHT11X17.DWG - 279mmX432mm

Appendix A

Correspondence

Site Plan Control Application Pre-Consultation- 2037 McGee Side Road

Meeting Date: April 19, 2018

Attendee:

- John Cole, Pinecrest Remembrance Services
- Leila Emmrys, Hobin Architecture
- Susan Gordon, Novatech
- Alex McAuley, Novatech
- Sobha Kunjikutty, Water Resources Engineer, MVCA
- Niall Oddie, Environmental Planner, MVCA
- Kevin Hall, Infrastructure PM, City of Ottawa
- Kerry Reed, Environmental Planner, City of Ottawa
- Mark Young, Urban Designer, City of Ottawa

Information:

- Lise Guevremont, Planner 2, Parks and Recreation, City of Ottawa
- Amira Shehata, Transportation PM, City of Ottawa

Proposal:

The proponent wishes to develop a new one-storey funeral home (1019 sq m), with a partial basement (400 sq. m.). The building will consist of assembly, office and storage spaces (embalming and cremation services will continue to be done at the existing Pinecrest facility). A second phase of approx. 900 sq. m. will be considered, based on demand, in 5-10 years.

Application type:

The application will be considered as: "*Application for New Development*", "*Manager Approval, Public Consultation*", "– see link http://app06.ottawa.ca/online_services/forms/ds/site_plan_control_en.pdf

Submission requirements:

Plan of Survey (5 copies)

Site Plan (15 copies)

- Site plans should show conceptually the proposed Phase II expansion.
- Site plan should also provide total area of the proposal including parking. Parkland Cash-in-lieu will be calculated based this area.
- Site plan should show the 30 meters setback from the adjacent watercourse.
- Site plan should show accessibility design of the parking lot.
- Site plan should confirm parking compliance.
- Please separate grading from site plan. Keep the plan clear.

Landscape Plan (15copies)

- Indicate proposed paving for parking lot and around the building

Building Elevations (15 copies)

- Show façade treatments
- Show any signage location and dimensions.

Planning Rationale (4 copies)

- Please address Official Plan designation.
- Given the nature of the proposal, planning rationale can be in cover letter format.

Grading and Drainage Plan (15 copies)

Lighting Plan (7 Copies)

- A Letter from a certified Engineer to confirm the proposal lighting meets the City's Standard is sufficient.

Erosion and Sediment Control Plan (15 Copies)

Stormwater Management Brief (7copies)

- SWM Quantity: The post-development stormwater generated from the proposed site should be restricted to the pre-development flow for the 5-year and 100-year peak events.
- SWM Quality: A normal level of quality control treatment is required for the proposed development.
- Infiltration Target: The Carp River Watershed Subwatershed Study indicates that a moderate target of 104mm/yr can be used unless the soils present on site are clay or if there is a high groundwater table. If these conditions are present, a revised target of 73mm/yr can be used.

Geotechnical Study (7 copies)

Hydrogeological and Terrain Analysis (7 copies)

- The report should provide discussion relating to Recharge Area identified in the Carp Road CDP.

Please provide electronic copy (PDF) of all plans and studies required.

All plans and drawings must be produced on A1-sized paper and folded to 21.6 cm x 27.9 cm (8½"x 11").

A scale of 1:200 is recommended for the Site Plan and Landscape Plan.

Note that many of the plans and studies collected with this application must be signed, sealed and dated by a qualified engineer, architect, surveyor, planner or designated specialist.

Other Development Considerations :

- ROW protection requirement can be waived, as McGee Side Road ends at Oak Creek Road.
- A permit from MVCA will be required if any modifications to the watercourse at the northern boundary of the site are required or anticipated as a result of SWM. Surface water, groundwater features and fish habitat do not trigger the requirements for an EIS under the policies of the OP.
- Extra engineering design needs to be considered for the design of the ramp to the loading facility. Flood protection from the 100 year storm event will be critical.
- There is no requirement for a tree conservation report.
- The landowner indicated that the trees on the subject property were planted but I recommend that if they are removing trees they should survey for butternut and if butternut is present on the site, then a qualified Butternut Health Assessor (BHA) will conduct the necessary assessment to enable the MNRF to determine whether or not provincial authorization is required prior to the removal of any trees.
- There are SAR grassland bird observations in the vicinity but there is no suitable habitat on site or adjacent to the site where the septic system has been identified to be installed as the land is currently mowed lawn and active cash crops, therefore no EIS is required.
- Accessibility Design Standards – particularly for parking, as the standards are stricter that the Traffic and Parking By-law in regards to accessible parking spaces. A copy of the accessibility design standards can be found on City's Website.
- Construction activities should follow Protocol for Wildlife Protection during Construction.
- Proposal does not trigger any transportation studies
- Parkland Cash-in-lieu will be required at 5% of the proposed development area (including parking area). The value of land will be determined as of the day before planning approval is given for Site Plan Control. The calculation is based on City of Ottawa *Guidelines for Parkland Dedication*. (attached)
- Should consult with Fire Services that the proposal water tank is sufficient.

Appendix B

Septic System Design Brief

Engineers, Planners & Landscape Architects

May 31, 2019

Septic System Design Brief

Highland Park Cemetery Expansion
2037 McGee Side Road, Ottawa

Report Reference: R-2019-086
Novatech File No.: 101063

Existing Conditions

Highland Park Cemetery has been in operation for over 30 years. The cemetery property consists of approximately 49 ha and is mostly vegetated with a mix of agricultural fields, maintained grass and laneways. There is an existing office/maintenance building ($110m^2$) serviced by a well and a septic system. The existing system has a theoretical design flow of 900L/day. The office building is intended to remain.

Proposed Development Scenario

The owners of Highland Park cemetery are proposing to construct a visitation centre on the existing property. The new building ($1015m^2$) would be serviced by a well and a fully raised conventional septic system, separate from the well and septic system servicing the existing office/maintenance building.

The new building includes:

- Visitation rooms (2 rooms)
- Office space
- Kitchen (food provided by external catering)
- Water closets
- Embalming room (process liquids collected separately and disposed off-site)

The preliminary floor plans prepared by Hobin Architecture Incorporated are attached for reference.

Purpose

This report has been prepared in support of a Septic System Permit Application to the Ottawa Septic System Office.

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

Native Soil Conditions

Gemtec/Houle Chevrier Engineering prepared the following documents in support of the site development and the septic system design:

- Geotechnical Investigation - Highland Park Cemetery Visitation Centre, January 25, 2019.
- Geotechnical Investigation - Highland Park Cemetery Visitation Centre, March 2010.

A review of these documents provided the following soil information in the area of the septic tile field:

Topsoil: The investigations confirmed that the topsoil generally extends to a depth of 0.3m and 0.4m below the existing ground surface at the site of the proposed septic tile field.

Insitu Soils: The geotechnical consultant noted that the silty sand and silty clay in the area of the septic tile field has a relatively low permeability. It was recommended to design a fully raised bed and imported sand mantle.

Water Table Elevation: The static groundwater elevation is approximately 109.70, which is approximately 1.7m below the surface.

Design Flow

The theoretical design flow is based on two visitations daily with 150 guests each. Staff are on-site during visitations. The proposed building is not expected to have any full-time staff.

Activity	People	Flow (L/day)	Total Flow (L/day)
Visitors (Assembly Hall), 150 visitors per room per day = total 300 people			
Food Service provided	100	20	2,000
No Food Service provided	200	8	1,600
Employees			
Per 8 hour shift	6	75	450
			4,050

The design flow used to size the septic system is 4,050L/day.

Septic System Design

The proposed building will be serviced by a Class 4 tile field. The proposed septic system consists of a septic tank, a manhole, gravity sewer, a lift pump, and an absorption trench leaching bed.

Refer to the Grading & Servicing Plan and the Septic System Plan (**101063-GR** and **101063-SEP**) for septic system details.

Septic Tanks

The minimum septic tank required would be 3x design flow. The septic tank would require an effluent filter.

Size required: 3 x 4,050 = 12,150L

Size provided: 18,500L

Absorption Trench Leaching Bed Design

Length of distribution pipe

Length of distribution pipe required: L = QT/200 = (6,000 x 8)/200 = 240m

(Design Flow (Q) increased based on capacity of the septic tank)

Length of distribution pipe provided: L = 12 runs at 23m = 276m

Loading Rate Calculations

Contact area required: A = Q/6 = 6,000/6

A = 1,000m^2

Contact area provided: A = 1,300m^2 (including mantle)

Setbacks

The following minimum setbacks are required:

- Tile field to any Drilled well: 18.0m
- Tile field to Property line: 6.0m
- Septic tank to any Drilled well: 15.0m
- Septic tank to Building: 1.5m

Septic System Installation

The septic system is to be installed in accordance with the following engineering drawings prepared by Novatech:

- Grading & Servicing Plan (101063-GR)
- Septic System Plan (101063-SEP)

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The proposed septic system consists of a septic tank, a manhole, gravity sewer, a lift pump, and an absorption trench leaching bed.

A mantle is required in the direction of the surface drainage. The imported sand, which is to be used to construct the septic system including the mantle, is to have a percolation rate of 8 min/cm, with less than 8% silt, tested and approved before placement.

Construction traffic and materials are to be kept away from the septic system, including the mantle.

The surface area of the septic system is to be graded to provide positive drainage, and treated with 100mm permeable topsoil and seed. No impermeable material is to be placed over or adjacent to the area bed.

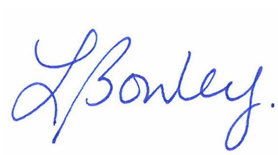
This septic system has been designed to treat domestic waste only. The following are not to be connected to the septic system:

- Water softener
- Sump pump
- Embalming waste
- Eavestroughs/Roof Drains
- Refrigeration or Condensing Units

Novatech's design and inspection services do not relieve the septic system installer of the responsibility for guaranteeing workmanship and materials.

Prepared by:

NOVATECH



Lisa Bowley, P.Eng
Project Manager | Land Development Engineering

<u>Attachments</u>

1. Preliminary floor plans prepared by Hobin Architecture Incorporated
2. <u>Drawings</u>
   Grading and Servicing Plan 101063-GR, revision 3
   Septic System Plan 101063-SEP, revision 1

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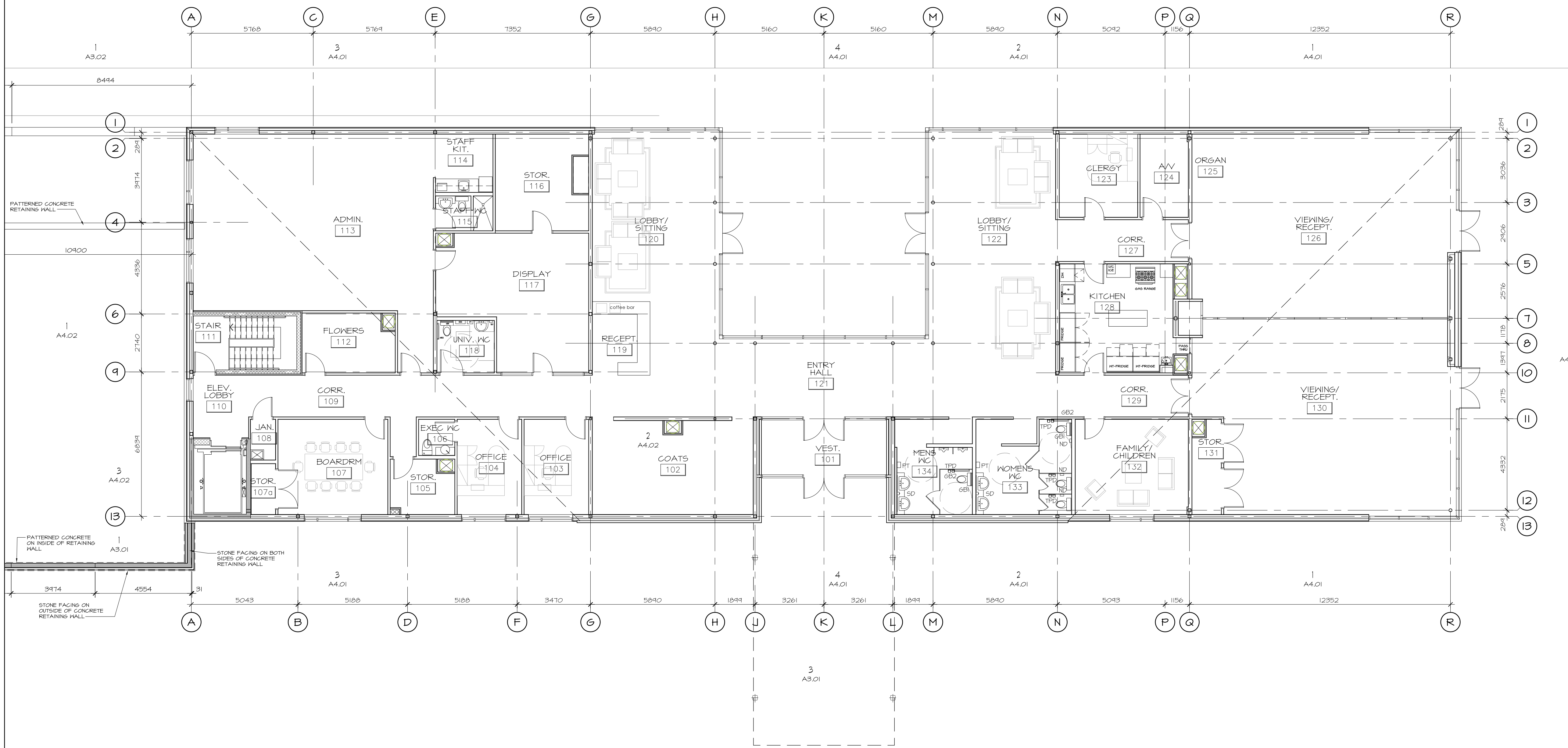


Highland Park Cemetery

no.	date	revision
4	MAY 1/19	ISSUED FOR INFORMATION
3	JAN. 8/19	ISSUED FOR INFORMATION
2	Dec. 14/18	EMBALMING ROOMS ADDED
1	AUG. 31/18	ISSUED FOR COSTING

It is the responsibility of the appropriate contractor to check and verify all dimensions on site and report all errors and/or omissions to the architect.

All contractors must comply with all pertinent codes and by-laws.

Do not scale drawings.

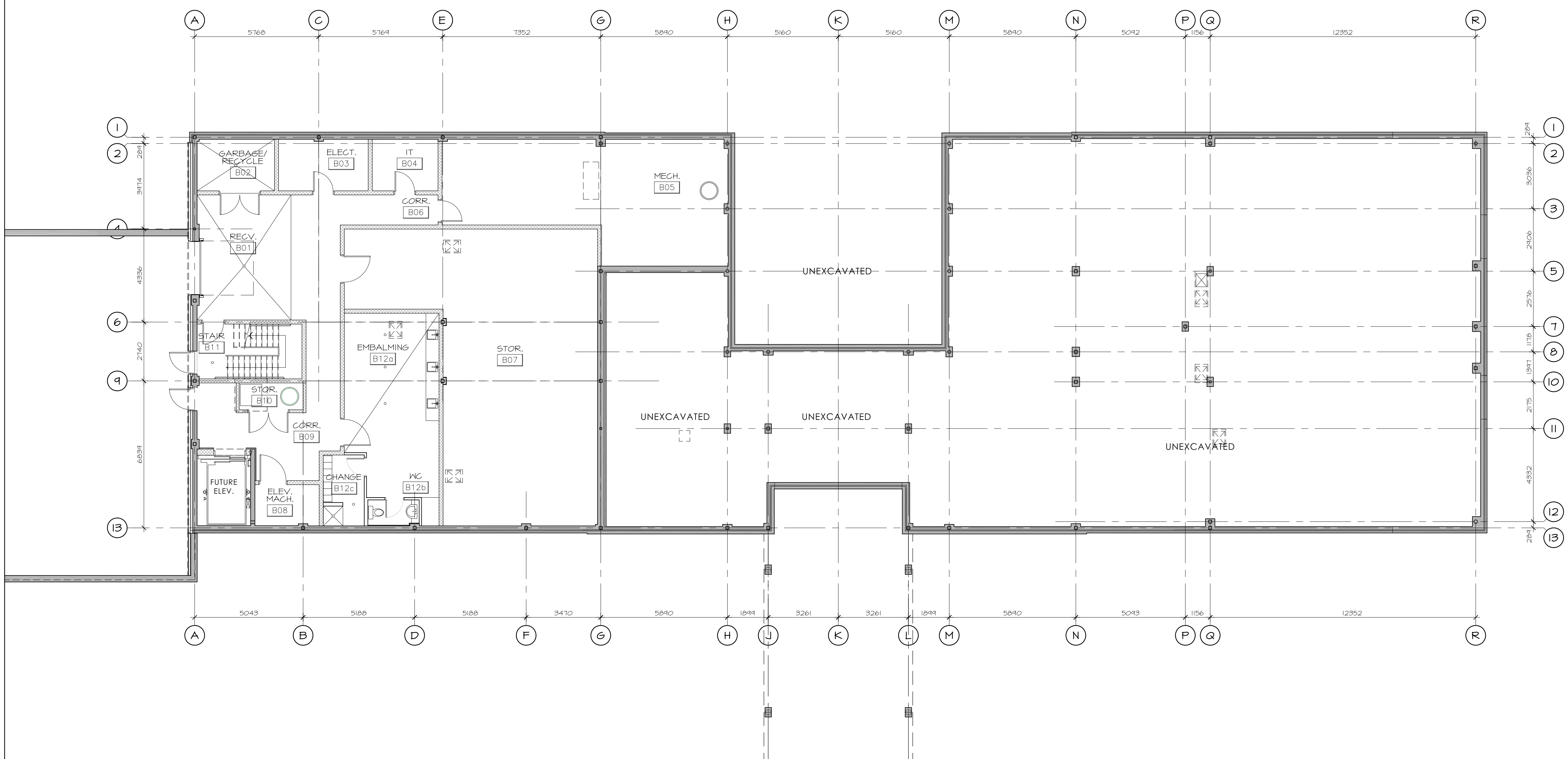
This drawing may not be used for construction until signed.

Hobin Architecture Incorporated
63 Pamilla Street
Ottawa, Ontario
Canada K1S 3K7
T: 613-238-7200
F: 613-235-2005
E: mail@hobinarc.com
hobinarc.com
HOBIN ARCHITECTURE

PROJECT/LOCATION:
HIGHLAND PARK REMEMBERANCE
2037 McGEE SIDE ROAD

DRAWING TITLE:
GROUND FLOOR PLAN

DRAWN BY:	DATE:	SCALE:
BB	17/12/10	1:100
		PROJECT: 1513
		DRAWING NO.: A2.02
		REVISION NO.:



Highland Park Cemetery

4	MAY 1/19	ISSUED FOR INFORMATION
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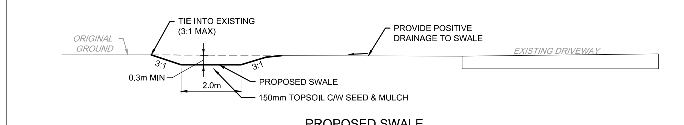
F: 613-235-2005
E: mail@hobinarc.com
hobinarc.com

HOBIN ARCHITECTURE

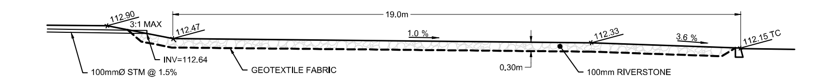
PROJECT/LOCATION:
HIGHLAND PARK REMEMBERANCE
2037 McGEE SIDE ROAD

DRAWING TITLE:
BASEMENT FLOOR PLAN

DRAWN BY:	DATE:	SCALE:
BB	18/01/02	1:100
		PROJECT: 1513
		DRAWING NO.: A2.01
		REVISION NO.:



PROPOSED SWALE
SECTION A-A (TYPICAL)
SCALE=1:100



RAIN GARDEN CROSS SECTION B-B
SCALE=1:100

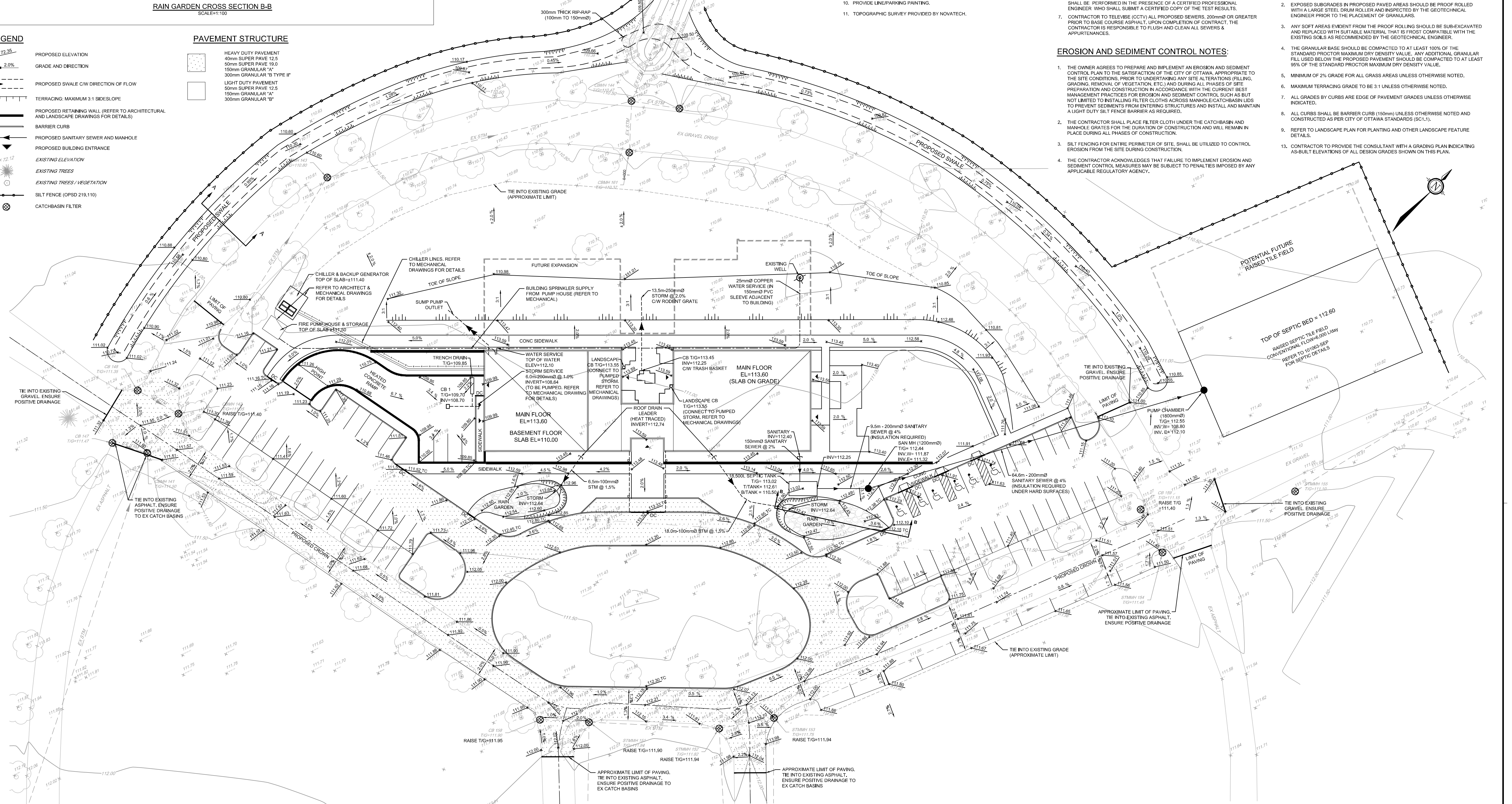
LEGEND

- PROPOSED ELEVATION
- GRADE AND DIRECTION
- PROPOSED SWALE C/W DIRECTION OF FLOW
- TERRACING: MAXIMUM 3:1 SIDESLOPE
- PROPOSED RETAINING WALL (REFER TO ARCHITECTURAL AND LANDSCAPE DRAWINGS FOR DETAILS)
- BARRIER CURB
- PROPOSED SANITARY SEWER AND MANHOLE
- PROPOSED BUILDING ENTRANCE
- *EXISTING ELEVATION*
- *EXISTING TREES*
- *EXISTING TREES / VEGETATION*
- SILT FENCE (OPSD 219.110)
- CATCHBASIN FILTER

PAVEMENT STRUCTURE

HEAVY DUTY PAVEMENT
40mm SUPER PAVE 12.5
50mm SUPER PAVE 19.0
150mm GRANULAR "A"
300mm GRANULAR "B TYPE II"

LIGHT DUTY PAVEMENT
50mm SUPER PAVE 12.5
150mm GRANULAR "A"
300mm GRANULAR "B"



KEY PLAN
N.T.S.

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, OTTAWA SEPTIC SYSTEM OFFICE (OSSO), MISSISSIPPI VALLEY CONSERVATION AUTHORITY (MVCA) AND THE MINISTRY OF THE ENVIRONMENT, CLIMATE AND PARKS (MECP) BEFORE COMMENCING CONSTRUCTION.
4. BEFORE COMMENCING CONSTRUCTION OBTAIN AND PROVIDE PROOF OF COMPREHENSIVE, ALL RISK AND OPERATIONAL LIABILITY INSURANCE FOR $2,000,000.00. 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 CITY OF OTTAWA 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 ARCHITECT'S AND LANDSCAPE ARCHITECT'S DRAWINGS FOR BUILDING AND HARDSURFACE AREAS AND DIMENSIONS.
9. REFER TO STORMWATER MANAGEMENT REPORT(R-2019-086) PREPARED BY NOVATECH, DATED JUNE 2019.
10. PROVIDE LINE/PARKING PAINTING.
11. TOPOGRAPHIC SURVEY PROVIDED BY NOVATECH.

SEWER NOTES:

1. SPECIFICATIONS:

ITEM	SPEC. No.	REFERENCE
CATCHBASIN (600x600mm)	705.010	OPSD
SANITARY MANHOLE (1200Ø)	701.010	OPSD
SANITARY MANHOLE (1800Ø)	701.012	OPSD
CB, FRAME & COVER	400.020	OPSD
STORM / SANITARY MH FRAME & COVER	401.010	OPSD
SEWER TRENCH - BEDDING (GRANULAR A) COVER (GRANULAR A OR GRANULAR B TYPE I, WITH MAXIMUM PARTICLE SIZE=25mm)		
STORM SEWER	PVC DR 35	
SANITARY SEWER	PVC DR 35	
CATCHBASIN LEAD	PVC DR 35	

2. INSULATE ALL PIPES (SAN/STM) 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 PRIOR TO BASE COURSE ASPHALT. 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 CATCHBASIN AND 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.

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 GRADES BY CURBS ARE EDGE OF PAVEMENT GRADES UNLESS OTHERWISE INDICATED.
8. ALL CURBS SHALL BE BARRIER CURB (150mm) UNLESS OTHERWISE NOTED AND CONSTRUCTED AS PER CITY OF OTTAWA STANDARDS (SC1.1).
9. REFER TO LANDSCAPE PLAN FOR PLANTING AND OTHER LANDSCAPE FEATURE DETAILS.
13. CONTRACTOR TO PROVIDE THE CONSULTANT WITH A GRADING PLAN INDICATING AS-BUILT ELEVATIONS OF ALL DESIGN GRADES SHOWN ON THIS PLAN.

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.

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No.	REVISION	DATE	BY
3	ISSUED FOR SITEPLAN APPLICATION	JUNE 03/19	ARM
2	ISSUED FOR COORDINATION	MAY 23/19	ARM
1	ISSUED FOR COORDINATION	MAY 02/19	ARM

SCALE
1:300
1:300
0 3 6 9 12

DESIGN LSC
CHECKED ARM
DRAWN LLW
CHECKED SMG
APPROVED ARM

FOR REVIEW ONLY

NOVATECH
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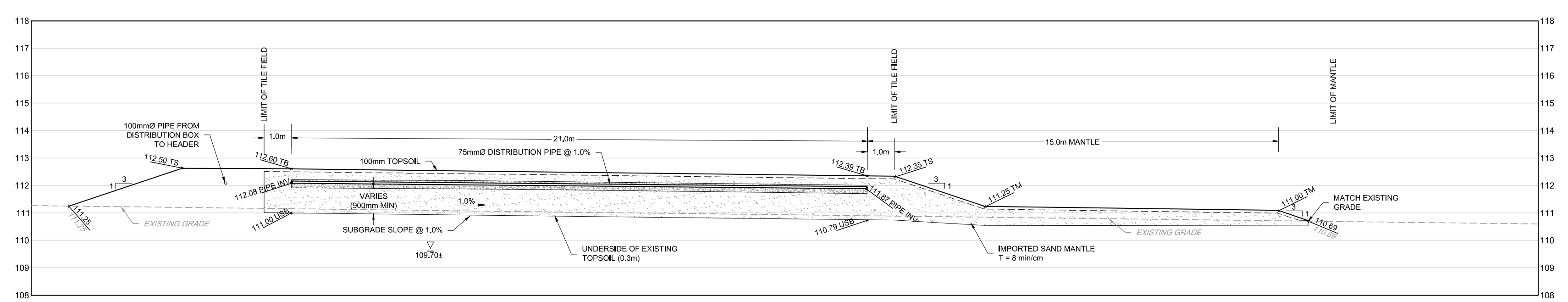
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
2037 McGEE SIDE ROAD, CITY OF OTTAWA
PINECREST REMEMBRANCE SERVICES
HIGHLAND PARK CEMETERY

DRAWING NAME
GRADING AND SERVICING PLAN

PROJECT No. 101063
REV REV # 3
DRAWING No. 101063-GR

PLANB1.DWG - 1000mmx707mm



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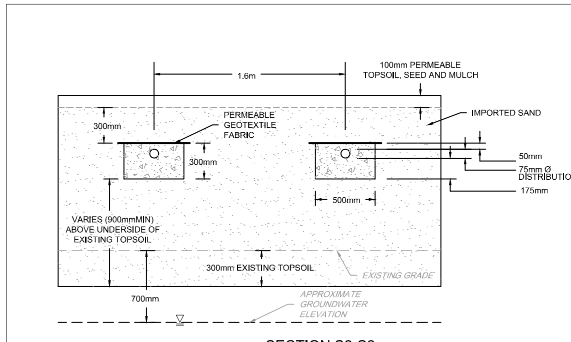

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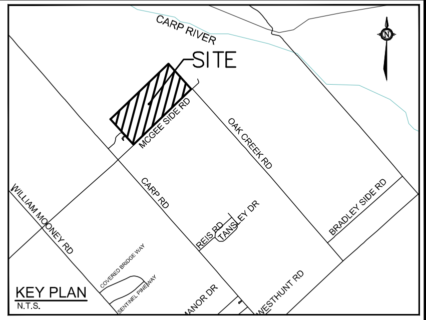
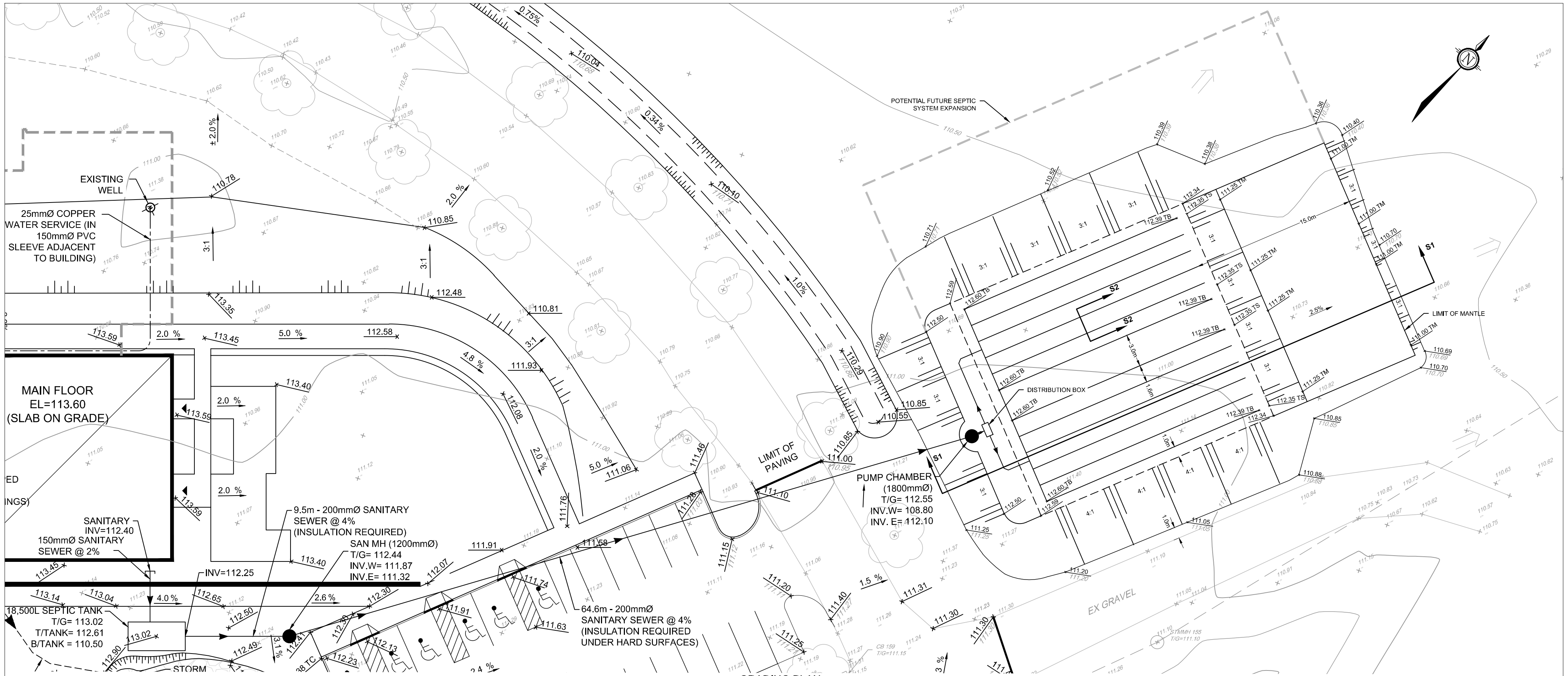


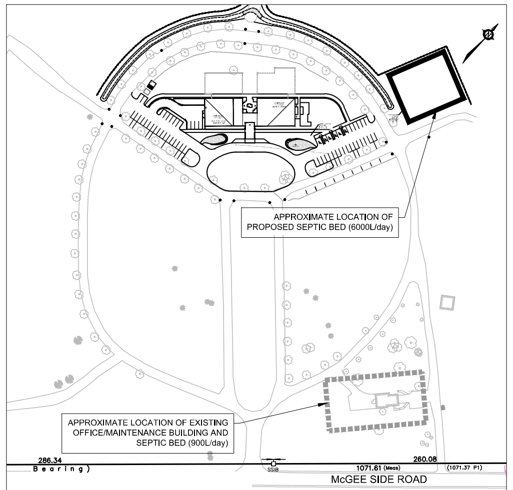
KEY PLAN
N.T.S.

LEGEND

127.55 / 126.75	PROPOSED ELEVATION / EXISTING ELEVATION
110.31 TS	PROPOSED TOP OF SLOPE ELEVATION
110.45 TB	PROPOSED TOP OF BED ELEVATION
109.15 TM	PROPOSED TOP OF MANTLE ELEVATION
109.80 INV	PROPOSED INVERT
108.52 USB	PROPOSED UNDERSIDE OF BED ELEVATION
	TERRACING: MAXIMUM 3:1 SIDESLOPE
2.0%	GRADE AND DIRECTION
	PROPOSED SANITARY SEWER AND MANHOLE



GRADING PLAN
SCALE = 1: 200



LOCATION PLAN
SCALE = 1: 2000

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, OTTAWA SEPTIC SYSTEM OFFICE (OSSO), MISSISSIPPI VALLEY CONSERVATION AUTHORITY (MVCA) AND THE MINISTRY OF THE ENVIRONMENT, CLIMATE AND PARKS (MECP) BEFORE COMMENCING CONSTRUCTION.
4. BEFORE COMMENCING CONSTRUCTION OBTAIN AND PROVIDE PROOF OF COMPREHENSIVE, ALL RISK AND OPERATIONAL LIABILITY INSURANCE FOR $2,000,000.00. 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 CITY OF OTTAWA 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 ARCHITECT'S AND LANDSCAPE ARCHITECT'S DRAWINGS FOR BUILDING AND HARDSURFACE AREAS AND DIMENSIONS.
9. PROVIDE LINE/PARKING PAINTING.
10. TOPOGRAPHIC SURVEY PROVIDED BY NOVATECH.

SEPTIC SYSTEM NOTES

1. THE PROPOSED SEPTIC SYSTEM CONSISTS OF A SEPTIC TANK, MANHOLE, GRAVITY SEWER, LIFT PUMP AND AN ABSORPTION TRENCH LEACHING BED WHICH HAS BEEN DESIGNED BASED ON A SEWAGE FLOW OF 6000 L/DAY.
2. INSTALLATION IS TO BE IN ACCORDANCE WITH CURRENT ONTARIO BUILDING CODE REQUIREMENTS AND THE ENGINEER'S REPORT PREPARED BY NOVATECH, DATED MAY 2019.
3. ALL BENDS IN THE PIPE FROM THE BUILDING TO THE HEADER ARE TO BE 22.5 OR 45.0 DEGREES.
4. THE FOLLOWING SETBACKS ARE REQUIRED:
   - -TILE FIELD TO ANY DRILLED WELL = 18.0m (min)
   - -TILE TO PROPERTY LINE = 6.0m (min)
   - -SEPTIC TANK TO ANY DRILLED WELL= 15.0m (min)
   - -SEPTIC TANK TO BUILDING= 1.5m (min)
5. TANK SIZE = 18,500L
6. THE SEPTIC TANK IS TO BE FITTED WITH AN EFFLUENT FILTER IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
7. TANK LIDS ARE TO BE LEFT ACCESSIBLE FOR PUMPING.
8. A MANTLE IS REQUIRED IN THE DIRECTION OF THE SURFACE DRAINAGE FLOW. IMPORTED SAND MATERIAL IS REQUIRED. THE IMPORTED SAND, WHICH IS TO BE USED TO CONSTRUCT THE SEPTIC SYSTEM INCLUDING THE MANTLE, IS TO HAVE A PERCOLATION RATE OF 8 MIN/CM, WITH LESS THAN 8% SILT, TESTED AND APPROVED BEFORE PLACEMENT.
9. CONSTRUCTION TRAFFIC AND MATERIALS ARE TO BE KEPT AWAY FROM THE SEPTIC SYSTEM, INCLUDING THE MANTLE.
10. SEPTIC SYSTEM ELEVATIONS ARE NOT TO BE REVISED WITHOUT THE WRITTEN PERMISSION OF NOVATECH
11. NOVATECH'S DESIGN AND INSPECTION SERVICES DO NOT RELIEVE THE SEPTIC SYSTEM INSTALLER OF THE RESPONSIBILITY FOR GUARANTEEING WORKMANSHIP AND MATERIALS.
12. THE SEPTIC SYSTEM HAS BEEN DESIGNED TO TREAT DOMESTIC WASTE ONLY. THE FOLLOWING ARE NOT TO BE CONNECTED TO THE SEPTIC SYSTEM.
   - -WATER SOFTENER
   - -SUMP PUMP
   - -EAVESTROUGHS/ROOF DRAINS
   - -EMBALMING WASTE
   - -REFRIGERATION OR CONDENSING UNIT
13. INSTALLATION OF SEPTIC SYSTEM TO BE INSPECTED BY OTTAWA SEPTIC SYSTEM OFFICE (OSSO) AND NOVATECH
14. THE CONTRACTOR IS RESPONSIBLE FOR SURVEYING ASBUILT ELEVATIONS AND PROVIDING THE REQUIRED ASBUILT INFORMATION AND DRAWING(S) TO THE OSSO.

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
1	ISSUED WITH SEPTIC SYSTEM DESIGN BRIEF	JUNE 3/19	ARM

SCALE: 1:200

DESIGN	LAB
CHECKED	ARM
DRAWN	LKS
CHECKED	LAB
APPROVED	SMG

FOR REVIEW ONLY

NOVATECH
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Ottawa, Ontario, Canada K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

LOCATION
2037 McGEE SIDE ROAD, CITY OF OTTAWA
PINECREST REMEMBRANCE SERVICES
HIGHLAND PARK CEMETERY

DRAWING NAME
SEPTIC SYSTEM PLAN

PROJECT No. 101063
REV: REV # 1
DRAWING No. 101063-SEP

Appendix C

Stormwater Management Calculations / Modelling

Highland Park Cemetery (101063)
Manning's Equation for Outlet Ditches

NOVATECH
Engineers, Planners & Landscape Architects

Parameter	Units	West Ditch Capacity		East Ditch Capacity		Outlet Ditch Capacity	
		Min Slope	Max Slope	Min Slope	Max Slope	Min Slope	Max Slope
Depth	m	0.30	0.30	0.30	0.30	1.50	1.25
Bottom Width	m	2.00	2.00	2.00	2.00	1.00	1.00
Side slope (L)	1 to X	3.0	3.0	3.0	3.0	3.0	3.0
Side slope (R)	1 to X	3.0	3.0	3.0	3.0	3.0	3.0
Top Width (L)	m	0.90	0.90	0.90	0.90	4.50	3.75
Top Width (R)	m	0.90	0.90	0.90	0.90	4.50	3.75
Top Width (total)	m	3.80	3.80	3.80	3.80	10.00	8.50
Area	m^2	0.870	0.870	0.870	0.870	8.250	5.938
Perimeter	m	3.90	3.90	3.90	3.90	10.49	8.91
R=A/P	m	0.22	0.22	0.22	0.22	0.79	0.67
n	-	0.045	0.045	0.045	0.045	0.045	0.045
Slope	m/m	0.0045	0.0128	0.0034	0.0100	0.0025	0.0200
V	**m/s**	**0.55**	**0.93**	**0.48**	**0.82**	**0.95**	**2.40**
Q	**m^3/s**	**0.48**	**0.80**	**0.41**	**0.71**	**7.81**	**14.24**

**Manning's equation for flat bottom ditch (refer to Drawing 101063-GR).*

Highland Park Cemetery (101063)
Infiltration Calculations

Engineers, Planners & Landscape Architects

Storage Provided for Infiltration and Retention Time

Location	Dimensions of Infiltration Systems				Retnetion Time		
	Height (m)	Bottom Area (m^2)	Assumed Void Ratio	Storage Volume (m^3)	Percolation Rate[1] (mm/hr)	Infiltration Rate (L/s)	Retention Time (hours)
West Rain Garden	0.30	72.0	40%	8.6	10	0.20	12.0
East Rain Garden	0.30	98.0	40%	11.8		0.27	12.0
Ammended Topsoil in Outlet Ditches	0.15	400.0	15%	9.0		1.11	2.3

[1] *Percolation rate estimated for silty sand = 20 mm/hr; divided by 2 to account for clogging.*

Location	Drainage Area to Infiltration Systems	Infiltration Criteria		Annual Infiltration			
	(ha)	Annual Infiltration Requirement[1] (mm/year)	Volume to be Infiltrated Annually[2] (m^3/year)	Infiltration Depth (mm)	% of Annual Rainfall (515mm) Infiltrated[3] (%)	Amount of Annual Rainfall Infiltrated (mm/year)	Volume of Rainfall Infiltrated / Year (m^3/year)
West Rain Garden	0.05	73	730.0	17.3	84%	433.4	216.7
East Rain Garden	0.05			23.5	92%	471.7	235.9
Ammended Topsoil in Outlet Ditches	1.88			0.5	7%	35.5	666.9
TOTAL	**1.98**	**73**	**730.0**	**-**	**-**	**-**	**1,119.4**

[1] *Annual infiltration requirement from Carp River Subwatershed Study (Dec. 2004); for low recharge areas.*

[2] *Volume to be infiltrated = 73mm / year x total development area (1.00 ha).*

[3] *Based on 30-years (1971 - 2000) of daily climate data (May - October).*

Date: 5/31/2019
M:\2001\101063\DATA\Calculations\Sewer Calcs\SWM\Infiltration Calcs.xlsx

Canadian Climate Normals 1971-2000 Station Data

The minimum number of years used to calculate these Normals is indicated by a code for each element. A "+" beside an extreme date indicates that this date is the first occurrence of the extreme value. Values and dates in bold indicate all-time extremes for the location.

Data used in the calculation of these Normals may be subject to further quality assurance checks. This may result in minor changes to some values presented here.

OTTAWA CDA * ONTARIO					
Latitude:	45°23'00.000" N	**Longitude**:	75°43'00.000" W	**Elevation**:	79.20 m
Climate ID:	6105976	**WMO ID**:		**TC ID**:	WCG

* This station meets WMO standards for temperature and precipitation.

▼ Temperature

Temperature	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Daily Average (°C)	-10.5	-8.6	-2.4	6.0	13.6	18.4	21.0	19.7	14.7	8.2	1.5	-6.6	6.3	A
Standard Deviation	2.9	2.7	2.5	1.9	1.8	1.3	1.1	1.1	1.2	1.6	1.7	3.3	0.8	A
Daily Maximum (°C)	-6.1	-3.9	2.1	10.9	19.1	23.8	26.4	25.0	19.7	12.6	4.9	-2.9	11.0	A
Daily Minimum (°C)	-14.8	-13.2	-7.0	1.1	8.0	13.0	15.5	14.3	9.7	3.7	-1.9	-10.3	1.5	A
Extreme Maximum (°C)	11.7	12.2	25.6	31.2	35.0	36.7	37.8	**37.8**	36.7	29.4	23.3	16.1		
Date (yyyy/dd)	1932/14	1953/21	1945/28	1990/27	1921/21	1921/22	1913/04	**1917/01**	1931/11	1891/03	1961/03	1951/07		
Extreme Minimum (°C)	-37.8	-38.3	-36.7	-20.6	-7.2	0.0	3.3	1.7	-4.4	-12.8	-23.9	**-38.9**		
Date (yyyy/dd)	1925/19	1934/17	1938/04	1923/01	1902/10	1910/04	1942/10	1934/30	1947/28	1933/26	1925/30	**1933/29**		

▼ Precipitation

Precipitation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Rainfall (mm)	22.9	16.1	33.6	59.7	80.9	91.2	88.9	87.6	86.8	76.2	60.5	28.8	733.2	A
Snowfall (cm)	49	41	32	7	0	0	0	0	0	3	18	52	203	A

Precipitation (mm)	64.2	51.6	64.9	67.7	81.0	91.2	88.9	87.6	86.8	79.1	77.0	74.1	914.2	A
Average Snow Depth (cm)	21	25	20	2	0	0	0	0	0	0	1	11	7	A
Median Snow Depth (cm)	21	25	20	1	0	0	0	0	0	0	1	10	7	A
Snow Depth at Month-end (cm)	23	26	9	0	0	0	0	0	0	0	4	16	7	A
Extreme Daily Rainfall (mm)	40.1	38.4	41.8	48.3	75.9	77.5	74.2	90.4	**93.2**	58.4	49.0	73.2		
Date (yyyy/dd)	1995/15	1997/21	1980/21	1956/15	1916/17	1946/17	1899/11	1943/23	**1942/09**	1995/05	1907/07	1933/31		
Extreme Daily Snowfall (cm)	**56**	46	48	33	19	0	0	0	0	22	53	38		
Date (yyyy/dd)	**1894/29**	1895/08	1947/02	1970/02	1907/04	1890/01	1890/01	1890/01	1890/01	1933/24	1912/25	1973/20		
Extreme Daily Precipitation (mm)	55.9	45.7	48.8	48.3	75.9	77.5	74.2	90.4	**93.2**	58.4	53.3	73.2		
Date (yyyy/dd)	1894/29	1895/08	1962/12	1956/15	1916/17	1946/17	1899/11	1943/23	**1942/09**	1995/05	1912/25	1933/31		
Extreme Snow Depth (cm)	53	**97**	89	66	8	0	0	0	0	18	30	51		
Date (yyyy/dd)	1971/30	**1971/24**	1971/12	1971/01	1963/11	1961/01	1961/01	1961/01	1961/01	1997/27	1995/28	1970/25		

▼ Days with Maximum Temperature

Days with Maximum Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
<= 0 °C	23.3	19.8	10.9	0.9	0.0	0.0	0.0	0.0	0.0	0.0	5.8	19.1	79.7	A
> 0 °C	7.7	8.5	20.1	29.1	31.0	30.0	31.0	31.0	30.0	31.0	24.2	11.9	285.5	A
> 10 °C	0.0	0.1	3.0	15.3	29.5	30.0	31.0	31.0	29.5	20.5	5.4	0.4	195.6	A
> 20 °C	0.0	0.0	0.1	2.6	12.8	24.1	29.8	27.4	13.6	2.6	0.1	0.0	113.2	A
> 30 °C	0.0	0.0	0.0	0.0	0.7	2.3	4.3	2.5	0.5	0.0	0.0	0.0	10.3	A
> 35 °C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	A

▼ Days with Minimum Temperature

Days with Minimum Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
> 0 °C	1.0	1.1	4.5	17.5	30.3	30.0	31.0	31.0	29.5	23.6	10.5	1.8	211.9	A

<= 2 °C	30.9	27.9	29.5	18.5	2.5	0.1	0.0	0.0	1.5	12.3	24.3	30.4	177.9	A
<= 0 °C	30.0	27.2	26.5	12.5	0.7	0.0	0.0	0.0	0.5	7.4	19.5	29.2	153.4	A
< -2 °C	29.0	25.6	21.9	7.0	0.2	0.0	0.0	0.0	0.0	2.7	13.1	26.2	125.7	A
< -10 °C	21.8	18.7	10.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.9	15.2	67.9	A
< -20 °C	8.6	5.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	18.9	A
< - 30 °C	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7	A

▼ Days with Rainfall

Days with Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
>= 0.2 mm	3.9	3.3	6.3	10.8	13.4	12.9	12.4	12	14.1	13.7	10.7	5.1	118.5	A
>= 5 mm	1.5	1.1	2.1	4	5.3	5.2	5.1	4.9	5.3	4.7	3.7	2.1	45	A
>= 10 mm	0.73	0.47	1	1.9	2.7	3.1	3.1	2.6	2.8	2.3	1.9	1.1	23.9	A
>= 25 mm	0.23	0.07	0.20	0.30	0.37	0.80	0.70	0.83	0.63	0.47	0.40	0	5	A

▼ Days With Snowfall

Days With Snowfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
>= 0.2 cm	14.8	10.6	8.2	2.7	0.17	0	0	0	0	1.1	5.5	13.4	56.6	A
>= 5 cm	3.4	2.7	2.6	0.37	0	0	0	0	0	0.10	1.2	3.6	13.9	A
>= 10 cm	0.80	0.93	0.83	0.17	0	0	0	0	0	0.07	0.40	1.4	4.6	A
>= 25 cm	0	0.13	0	0	0	0	0	0	0	0	0.03	0.07	0.23	A

▼ Days with Precipitation

Days with Precipitation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
>= 0.2 mm	16.6	12.2	12.4	12.4	13.4	12.9	12.4	12.0	14.1	14.2	14.7	16.1	163.4	A
>= 5 mm	4.3	3.0	4.3	4.6	5.3	5.2	5.1	4.9	5.3	4.9	4.7	5.2	57.0	A
>= 10 mm	1.4	1.5	1.9	2.2	2.7	3.1	3.1	2.6	2.8	2.4	2.4	2.3	28.5	A
>= 25 mm	0.2	0.2	0.2	0.3	0.4	0.8	0.7	0.8	0.6	0.5	0.4	0.1	5.3	A

▼ Days with Snow Depth

Days with Snow Depth

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
>= 1 cm	30.3	28	25.7	5.4	0.04	0	0	0	0	0.40	5.9	23.8	119.5	A
>= 5 cm	28.2	27.6	23.5	3.6	0	0	0	0	0	0.13	3.7	20.3	107.1	A
>= 10 cm	24.2	24.3	20.5	2.6	0	0	0	0	0	0.03	1.6	13.8	87	A
>= 20 cm	15.6	16.4	12.8	1.5	0	0	0	0	0	0	0.17	5.3	51.7	A

▼ Degree Days

Degree Days

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Above 24 °C	0	0	0	0	0.2	2.7	6.9	3.2	0.5	0	0	0	13.4	A

Above 18 °C	0	0	0	0.9	13	51	99.8	71.6	16.4	0.5	0	0	253	A
Above 15 °C	0	0	0	3.8	37.3	114.2	186.1	147.7	46.2	3.4	0	0	538.6	A
Above 10 °C	0	0	0.6	19.8	125.9	253.7	340.6	299.7	148.4	31.6	2.7	0	1222.8	A
Above 5 °C	0.1	0.3	8	76	266.3	403.2	495.6	454.7	291.1	115.3	21.1	0.8	2132.4	A
Above 0 °C	4.7	6.9	43.7	188.6	420.7	553.2	650.6	609.7	441	254.2	85.7	12.1	3270.9	A
Below 0 °C	329.8	249.1	118.9	8.5	0	0	0	0	0	0.3	39.8	217.5	963.9	A
Below 5 °C	480.2	383.8	238.2	46	0.7	0	0	0	0.1	16.5	125.2	361.2	1651.7	A
Below 10 °C	635.1	524.9	385.8	139.7	15.2	0.5	0	0	7.4	87.7	256.8	515.4	2568.5	A
Below 15 °C	790.1	666.2	540.2	273.7	81.6	11	0.5	3	55.3	214.5	404.1	670.4	3710.6	A
Below 18 °C	883.1	751	633.2	360.8	150.3	37.8	7.2	20	115.4	304.6	494.1	763.4	4520.8	A

▼ Soil Temperature

Soil Temperature

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
at 5 cm depth (AM obs) (°C)	-0.2	-0.7	-0.2	3.0	11.1	16.6	19.1	18.2	14.2	8.3	3.5	0.5	7.8	A
at 5 cm depth (PM obs) (°C)	-0.2	-0.6	-0.0	5.2	14.4	20.2	23.0	21.8	17.0	10.3	4.1	0.5	9.6	A
at 10 cm depth (AM obs) (°C)	0.0	-0.5	-0.1	3.2	11.2	16.7	19.2	18.4	14.6	8.8	3.8	0.8	8.0	A
at 10 cm depth (PM obs) (°C)	0.0	-0.4	0.0	4.7	13.6	19.4	22.1	21.1	16.6	10.2	4.2	0.8	9.4	A
at 20 cm depth (AM obs) (°C)	0.5	-0.1	0.3	3.4	11.5	17.0	19.6	19.0	15.3	9.7	4.6	1.4	8.5	A
at 20 cm depth (PM obs) (°C)	0.5	-0.0	0.3	4.1	12.6	18.3	21.0	20.2	16.2	10.2	4.8	1.4	9.1	A
at 50 cm depth (AM obs) (°C)	1.1	0.3	0.3	2.5	9.8	15.0	17.8	17.8	15.2	10.4	5.6	2.2	8.2	A
at 100 cm depth (AM obs) (°C)	2.9	2.0	1.6	2.5	7.6	12.3	15.2	16.2	15.0	11.7	7.8	4.5	8.3	A
at 150 cm depth (AM obs) (°C)	5.0	3.9	3.3	3.5	6.8	10.7	13.6	15.0	14.8	12.7	9.7	6.7	8.8	C
at 300 cm depth (AM obs) (°C)	7.0	5.9	5.1	4.6	5.7	8.1	10.4	12.1	12.9	12.3	10.7	8.7	8.6	A

▼ 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

▼ Bright Sunshine

Bright Sunshine

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Total Hours	101.2	129.8	159.8	189.4	230.3	253.3	276.8	246.7	171.5	136.7	83.6	82.0	2061.1	C
Days with measureable	21.6	22.3	24.7	25.5	27.9	28.6	30.2	29.7	26.5	25.8	20.9	19.7	303.4	C

% of possible daylight hours	35.7	44.3	43.3	46.8	50.0	54.1	58.4	56.5	45.5	40.2	29.1	30.1	44.5	C
Extreme Daily	8.9	10.4	11.6	13.5	14.9	**15.2**	15.0	14.0	12.7	10.6	9.6	8.1		A
Date (yyyy/dd)	1981/31	1974/26	1987/24	1974/26	1997/27	**1979/25**	1978/01	1978/05	1991/01	1976/01	1985/01	1979/30		

▼ Radiation

Radiation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Extreme Global - RF1 (MJ/m2)	11.4	16.7	22.6	27.9	31.3	32.5	30.8	28.8	23.6	17.2	11.7	8.7		
Date (yyyy/dd)	1994/31	1994/27	1994/30	1986/23	1990/30	1987/20	1996/01	1987/01	1991/01	1992/01	1985/01	1989/01		
Extreme Net - RF4 (MJ/m2)	2.6	1.8	11.8	15.3	17.7	19.3	19.3	15.7	12.5	7.8	3.7	1.7		
Date (yyyy/dd)	1988/31	1986/28	1996/31	1993/14	1987/15	1987/17	1997/16	1995/07	1996/01	1995/01	1988/03	1987/10		

Legend

- A = WMO "3 and 5 rule" (i.e. no more than 3 consecutive and no more than 5 total missing for **either** temperature **or** precipitation)
- B = At least 25 years
- C = At least 20 years
- D = At least 15 years

Date modified: 2014-07-09

Time of Concentration Calculations

(Uplands Overland Flow Method)

	Subcatchment Parameters			Overland Flow[1]				Concentrated Flow[2]				Overall	
Area ID	Area (ha)	CN (HSG C/D)	Ia (mm)	Length (m)	Slope (%)	Velocity (m/s)	Travel Time (min)	Length (m)	Slope (%)	Velocity (m/s)	Travel Time (min)	Time of Concentration (min)	Min Time of Concentration[3] (min)
Existing Conditions													
EX01	8.88	79	6.8	100	0.5%	0.20	8.33	400	0.5%	0.32	20.83	29	29
Proposed Conditions													
A01	7.50	79	6.8	100	0.5%	0.20	8.33	350	0.5%	0.32	18.23	27	27
A02	0.37	77	7.6	50	0.5%	0.20	4.17	150	0.5%	0.32	7.81	12	12
B03	0.43	77	7.6	50	2.0%	0.40	2.08	100	1.0%	0.46	3.62	6	10
C03	0.45	77	7.6	50	2.0%	0.40	2.08	100	1.0%	0.46	3.62	6	10

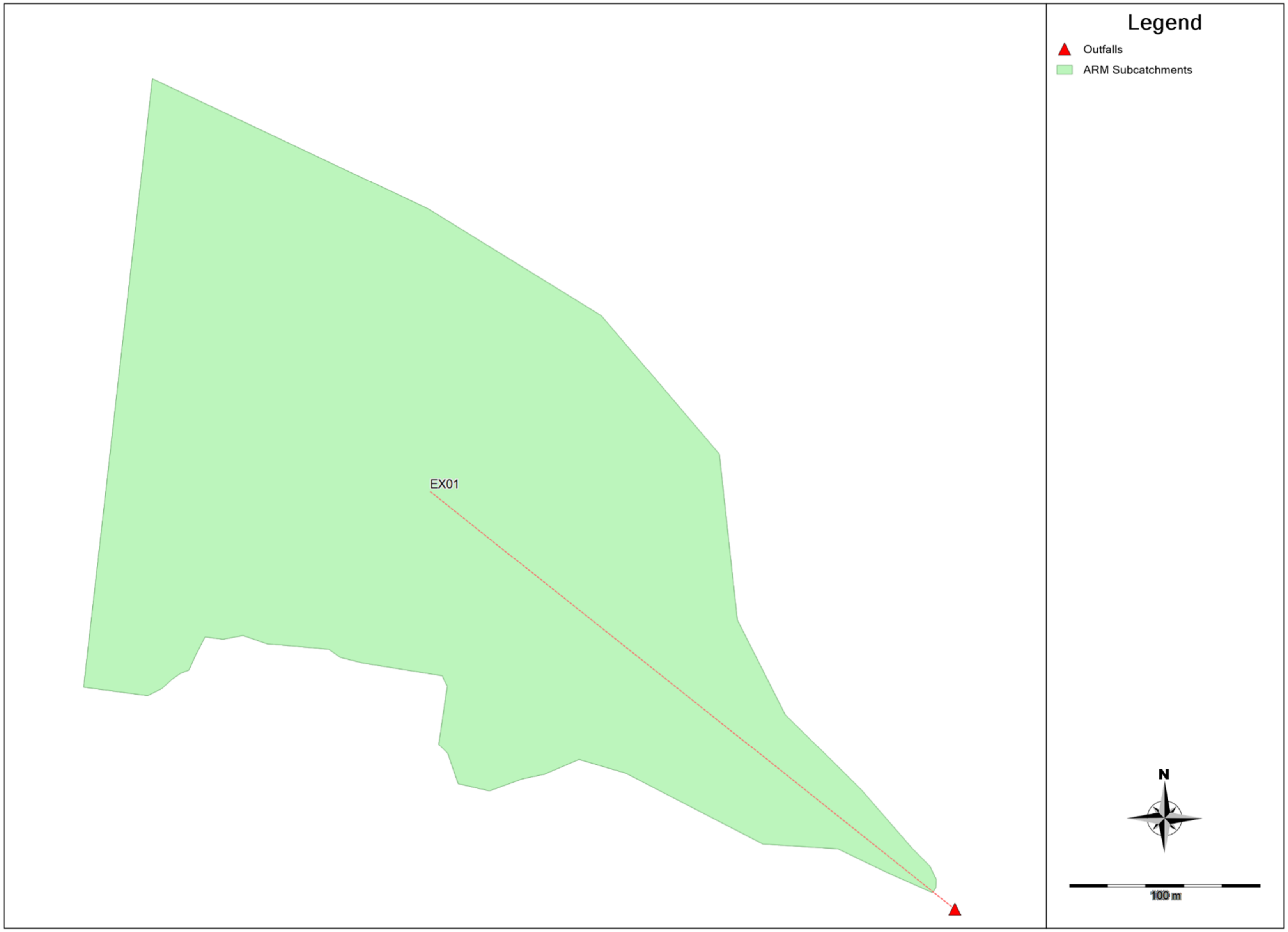
[1] Cultivated staight row

[2] Grassed waterways

[3] Minimum 10-minutes

Highland Park Cemetery (101063)
PCSWMM Model Schematic – Pre-Development

Overall Model Schematic (Subcatchment IDs)

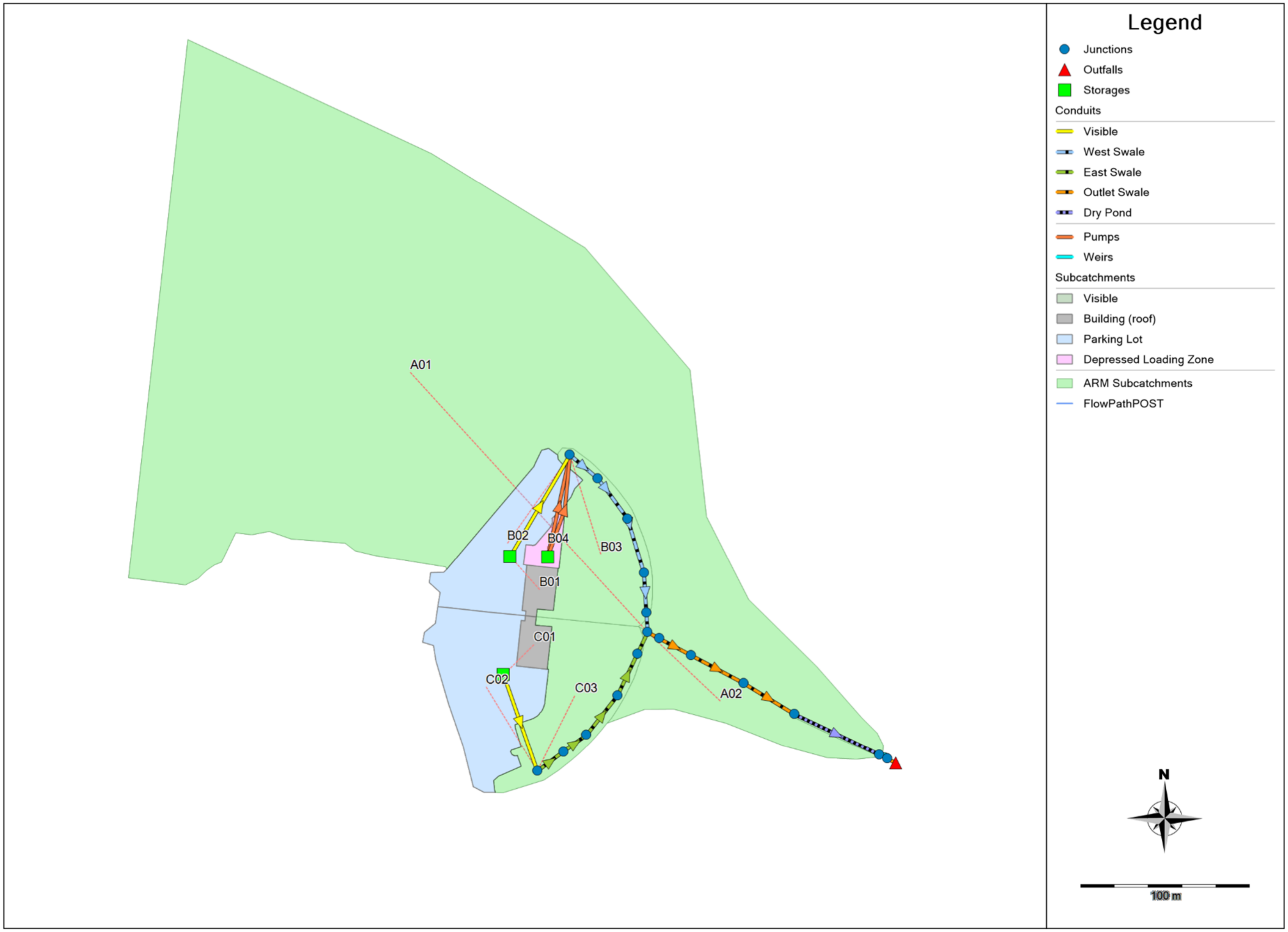


Date: 2019-05-31
M:\2001\101063\DATA\Calculations\Sewer Calcs\SWM\PCSWMM\Model Schematic-Output\PCSWMM Model Schematic(PRE).docx

Highland Park Cemetery (101063)
PCSWMM Model Schematic – Post-Development

NOVATECH
Engineers, Planners & Landscape Architects

Overall Model Schematic (Subcatchment IDs)



Date: 2019-05-31
M:\2001\101063\DATA\Calculations\Sewer Calcs\SWM\PCSWMM\Model Schematic-Output\PCSWMM Model Schematic(POST).docx

```
ALTERNATIVE RUNOFF METHOD (ARM) - PCSWMM BETA VERSION 7.2.2780
--------------------------------------------------------------

This is a *BETA* version of ARM - your feedback and suggestions are solicited.
Create a ticket, post on the PCSWMM feature request forum, or email us directly!

Simulation start time:                4/16/2019 00:00
Simulation end time:                  4/17/2019 00:00
Runoff wet weather time steps:        300 seconds
Report time steps:                    60 seconds
Number of data points:                1441

******************************
Unit Hydrographs Runoff Method
******************************

---------------------------------------------------------------------------------------------------------------------------------
                                                                Area   Time of Concentration  Time to Peak    Time after Pe
Subcatchment        Runoff Method             Raingage          (ha)   (min)                  (min)           (min)
---------------------------------------------------------------------------------------------------------------------------------
EX01                Nash IUH                  Raingage          8.88   29                     19.33           125.67

******************
ARM Runoff Summary
******************

-------------------------------------------------------------------------------------------
                    Total       Total       Total       Total       Peak        Runoff
                    Precip      Losses      Runoff      Runoff      Runoff      Coeff
Subcatchment        (mm)        (mm)        (mm)        10^6 ltr    LPS         (fraction)
-------------------------------------------------------------------------------------------
EX01                93.91       44.837      49.054      4.356       821.39      0.522


EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.013)
--------------------------------------------------------------


*************
Element Count
*************
```

```
Number of rain gages ...... 1
Number of subcatchments ... 0
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                       Data       Recording
Name                Data Source                        Type       Interval
------------------------------------------------------------------------
Raingage            S12hr-100yr                        INTENSITY   30 min.


************
Node Summary
************
                                            Invert      Max.    Ponded    External
Name                Type                     Elev.     Depth      Area    Inflow
-------------------------------------------------------------------------------
OF1                 OUTFALL                 107.90      0.00       0.0


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... NO
  Water Quality .......... NO
Surcharge Method ......... EXTRAN
Starting Date ............ 04/16/2019 00:00:00
```

```
Ending Date .............. 04/17/2019 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.436         4.356
External Outflow .........         0.436         4.356
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


Analysis begun on:  Fri May 31 10:58:08 2019
Analysis ended on:  Fri May 31 10:58:08 2019
Total elapsed time: < 1 sec
```

```
ALTERNATIVE RUNOFF METHOD (ARM) - PCSWMM BETA VERSION 7.2.2780
--------------------------------------------------------------

This is a *BETA* version of ARM - your feedback and suggestions are solicited.
Create a ticket, post on the PCSWMM feature request forum, or email us directly!

Simulation start time:                  04/16/2019 00:00:00
Simulation end time:                    04/17/2019 00:00:00
Runoff wet weather time steps:          300 seconds
Report time steps:                      60 seconds
Number of data points:                  1441


******************************
Unit Hydrographs Runoff Method
******************************

---------------------------------------------------------------------------------------------------------------------------------
                                                                    Area   Time of Concentration  Time to Peak    Time after Pe
Subcatchment         Runoff Method            Raingage              (ha)   (min)                  (min)           (min)
---------------------------------------------------------------------------------------------------------------------------------
A01                  Nash IUH                 Raingage              7.56   27                     18              117
A02                  Nash IUH                 Raingage              0.37   12                     8               47
C03                  Nash IUH                 Raingage              0.45   10                     6.67            38.33
B03                  Nash IUH                 Raingage              0.43   10                     6.67            38.33


******************
ARM Runoff Summary
******************

-------------------------------------------------------------------------------------------
                     Total        Total        Total        Total        Peak         Runoff
                     Precip       Losses       Runoff       Runoff       Runoff       Coeff
Subcatchment         (mm)         (mm)         (mm)         10^6 ltr     LPS          (fraction)
-------------------------------------------------------------------------------------------
A01                  93.91        44.837       49.048       3.708        730.677      0.522
A02                  93.91        47.977       45.514       0.168        44.604       0.485
C03                  93.91        47.977       45.089       0.203        56.232       0.48
B03                  93.91        47.977       45.093       0.194        53.733       0.48


WARNING ARM01: Computed UH depth for ARM subcatchment C03 is not unity. Consider reducing wet weather time step.
WARNING ARM01: Computed UH depth for ARM subcatchment B03 is not unity. Consider reducing wet weather time step.
```

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.013)
--------------------------------------------------------------

WARNING 02: maximum depth increased for Node Outlet_Structure01
WARNING 02: maximum depth increased for Node West_Swale01

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 5
Number of nodes ........... 21
Number of links ........... 22
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                               Data       Recording
Name                 Data Source                               Type       Interval
-------------------------------------------------------------------------------------
Raingage             S12hr-100yr                               INTENSITY   30 min.


********************
Subcatchment Summary
********************
Name                       Area     Width   %Imperv    %Slope Rain Gage            Outlet
-----------------------------------------------------------------------------------------------------------
B01                        0.05     33.33   100.00    0.5000 Raingage             West_Infil
B02                        0.37    140.00    93.00    0.5000 Raingage             West_Swale01
B04                        0.05     30.00    95.00    0.5000 Raingage             Pump_Storage
C01                        0.05     33.33   100.00    0.5000 Raingage             East_Infil
C02                        0.48     80.00    93.00    0.5000 Raingage             East_Swale01


************
Node Summary
************
                                          Invert      Max.    Ponded    External
Name                 Type                  Elev.     Depth      Area    Inflow
```

Dry_Pond01	JUNCTION	107.96	1.45	0.0
East_Swale01	JUNCTION	110.29	1.00	0.0
East_Swale02	JUNCTION	110.10	1.00	0.0
East_Swale03	JUNCTION	110.04	1.00	0.0
East_Swale04	JUNCTION	109.82	1.00	0.0
East_Swale05	JUNCTION	109.62	1.00	0.0
Outlet_Structure01	JUNCTION	107.75	1.45	0.0
Outlet_Structure02	JUNCTION	107.72	1.48	0.0
Outlet_Swale01	JUNCTION	109.00	1.50	0.0
Outlet_Swale02	JUNCTION	108.63	1.00	0.0
Outlet_Swale03	JUNCTION	108.18	1.02	0.0
Outlet_Swale04	JUNCTION	108.05	1.15	0.0
West_Swale01	JUNCTION	110.72	1.00	0.0
West_Swale02	JUNCTION	110.58	1.00	0.0
West_Swale03	JUNCTION	110.30	1.00	0.0
West_Swale04	JUNCTION	109.87	1.00	0.0
West_Swale05	JUNCTION	109.66	1.00	0.0
Out-Site	OUTFALL	107.70	1.00	0.0
East_Infil	STORAGE	110.84	0.50	0.0
Pump_Storage	STORAGE	109.70	0.30	0.0
West_Infil	STORAGE	111.27	0.50	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
Control_Pipe	Outlet_Structure01	Outlet_Structure02	CONDUIT	7.0	0.4286	0.0130
Dry_Pond01	Dry_Pond01	Outlet_Structure01	CONDUIT	50.0	0.4200	0.0450
East_Infil	East_Infil	East_Swale01	CONDUIT	5.0	1.0001	0.0150
East_Swale01	East_Swale01	East_Swale02	CONDUIT	19.3	0.9845	0.0450
East_Swale02	East_Swale02	East_Swale03	CONDUIT	16.8	0.3571	0.0450
East_Swale03	East_Swale03	East_Swale04	CONDUIT	29.8	0.7383	0.0450
East_Swale04	East_Swale04	East_Swale05	CONDUIT	27.4	0.7299	0.0450
East_Swale05	East_Swale05	Outlet_Swale01	CONDUIT	14.3	0.8392	0.0450
Outlet_Swale01	Outlet_Swale01	Outlet_Swale02	CONDUIT	8.0	4.6300	0.0450
Outlet_Swale02	Outlet_Swale02	Outlet_Swale03	CONDUIT	22.0	2.0459	0.0450
Outlet_Swale03	Outlet_Swale03	Outlet_Swale04	CONDUIT	35.0	0.3714	0.0450
Outlet_Swale04	Outlet_Swale04	Dry_Pond01	CONDUIT	35.0	0.2571	0.0450
Site_Outlet	Outlet_Structure02	Out-Site	CONDUIT	4.0	0.5000	0.0450
West_Infil	West_Infil	West_Swale01	CONDUIT	5.0	1.0001	0.0150
West_Swale01	West_Swale01	West_Swale02	CONDUIT	21.5	0.6512	0.0450
West_Swale02	West_Swale02	West_Swale03	CONDUIT	30.0	0.9334	0.0450
West_Swale03	West_Swale03	West_Swale04	CONDUIT	33.5	1.2837	0.0450
West_Swale04	West_Swale04	West_Swale05	CONDUIT	23.7	0.8861	0.0450
West_Swale05	West_Swale05	Outlet_Swale01	CONDUIT	11.5	1.3914	0.0450
Pump1	Pump_Storage	West_Swale01	TYPE3 PUMP			
Pump2	Pump_Storage	West_Swale01	TYPE3 PUMP			
Control_Weir	Outlet_Structure01	Outlet_Structure02	WEIR			

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
Control_Pipe	CIRCULAR	0.30	0.07	0.07	0.30	1	63.31
Dry_Pond01	Dry_Pond	1.45	19.32	0.99	18.95	1	27670.07
East_Infil	RECT_OPEN	0.20	0.60	0.18	3.00	1	1258.57
East_Swale01	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	7848.71
East_Swale02	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	4727.29
East_Swale03	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	6796.71
East_Swale04	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	6758.26
East_Swale05	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	7246.36
Outlet_Swale01	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	17020.72
Outlet_Swale02	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	11314.36
Outlet_Swale03	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	4820.91
Outlet_Swale04	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	4011.23
Site_Outlet	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	5593.42
West_Infil	RECT_OPEN	0.20	0.60	0.18	3.00	1	1258.57
West_Swale01	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	6383.21
West_Swale02	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	7642.18
West_Swale03	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	8962.30
West_Swale04	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	7446.18
West_Swale05	TRAPEZOIDAL	1.00	5.00	0.60	8.00	1	9330.86

****
Transect Summary
****

Transect Dry_Pond
Area:

0.0016	0.0035	0.0057	0.0081	0.0108
0.0151	0.0236	0.0365	0.0533	0.0712
0.0893	0.1077	0.1263	0.1452	0.1644
0.1838	0.2035	0.2235	0.2437	0.2642
0.2849	0.3059	0.3272	0.3487	0.3705

```
           0.3925     0.4149     0.4374     0.4603     0.4833
           0.5067     0.5303     0.5542     0.5783     0.6027
           0.6274     0.6523     0.6775     0.7029     0.7286
           0.7546     0.7808     0.8073     0.8340     0.8610
           0.8883     0.9158     0.9436     0.9717     1.0000
Hrad:
           0.0268     0.0500     0.0711     0.0906     0.1090
           0.0678     0.0639     0.0705     0.0870     0.1144
           0.1414     0.1680     0.1943     0.2201     0.2457
           0.2709     0.2958     0.3204     0.3447     0.3688
           0.3925     0.4160     0.4393     0.4623     0.4851
           0.5077     0.5301     0.5523     0.5742     0.5960
           0.6176     0.6390     0.6603     0.6814     0.7023
           0.7230     0.7437     0.7641     0.7845     0.8047
           0.8247     0.8447     0.8645     0.8842     0.9038
           0.9232     0.9426     0.9618     0.9810     1.0000
Width:
           0.0620     0.0711     0.0803     0.0895     0.0987
           0.2250     0.3758     0.5265     0.6235     0.6327
           0.6419     0.6511     0.6603     0.6694     0.6786
           0.6878     0.6970     0.7062     0.7154     0.7245
           0.7337     0.7429     0.7521     0.7613     0.7704
           0.7796     0.7888     0.7980     0.8072     0.8164
           0.8255     0.8347     0.8439     0.8531     0.8623
           0.8715     0.8806     0.8898     0.8990     0.9082
           0.9174     0.9265     0.9357     0.9449     0.9541
           0.9633     0.9725     0.9816     0.9908     1.0000


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
```

```
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 04/16/2019 00:00:00
Ending Date .............. 04/17/2019 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 5.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.094        93.910
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.004         3.948
Surface Runoff ...........         0.089        88.979
Final Storage ............         0.001         1.319
Continuity Error (%) .....        -0.357


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.089         0.886
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.427         4.273
External Outflow .........         0.514         5.138
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.002         0.021
Continuity Error (%) .....         0.000


***************************
```

```
Time-Step Critical Elements
***************************
Link Control_Pipe (72.29%)


********************************
Highest Flow Instability Indexes
********************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.86 sec
Average Time Step           :     2.61 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :    -0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00


***************************
Subcatchment Runoff Summary
***************************

-----------------------------------------------------------------------------------------------------------------------------
                        Total      Total      Total      Total     Imperv       Perv      Total       Total     Peak  Runoff
                       Precip      Runon       Evap      Infil     Runoff     Runoff     Runoff      Runoff   Runoff   Coeff
Subcatchment               mm         mm         mm         mm         mm         mm         mm    10^6 ltr      LPS
-----------------------------------------------------------------------------------------------------------------------------
B01                     93.91       0.00       0.00       0.00      94.20       0.00      94.20        0.05    11.16   1.003
B02                     93.91       0.00       0.00       4.43      86.19       2.18      88.37        0.33    81.60   0.941
B04                     93.91       0.00       0.00       3.15      87.98       1.57      89.56        0.04    10.18   0.954
C01                     93.91       0.00       0.00       0.00      94.20       0.00      94.20        0.05    11.16   1.003
C02                     93.91       0.00       0.00       4.47      86.17       2.13      88.30        0.42   105.83   0.940


******************
Node Depth Summary
******************

---------------------------------------------------------------------------------
                                 Average  Maximum  Maximum  Time of Max    Reported
                                   Depth    Depth      HGL   Occurrence   Max Depth
Node                 Type         Meters   Meters   Meters  days hr:min      Meters
---------------------------------------------------------------------------------
Dry_Pond01           JUNCTION       0.36     1.09   109.05     0  06:50        1.09
East_Swale01         JUNCTION       0.02     0.14   110.43     0  06:30        0.14
East_Swale02         JUNCTION       0.03     0.18   110.28     0  06:30        0.18
East_Swale03         JUNCTION       0.03     0.15   110.19     0  06:30        0.15
East_Swale04         JUNCTION       0.03     0.15   109.97     0  06:30        0.15
East_Swale05         JUNCTION       0.03     0.16   109.78     0  06:31        0.16
Outlet_Structure01   JUNCTION       0.49     1.30   109.05     0  06:50        1.30
Outlet_Structure02   JUNCTION       0.10     0.29   108.01     0  06:50        0.29
Outlet_Swale01       JUNCTION       0.05     0.24   109.24     0  06:33        0.24
Outlet_Swale02       JUNCTION       0.09     0.43   109.06     0  06:49        0.43
Outlet_Swale03       JUNCTION       0.25     0.87   109.05     0  06:50        0.87
Outlet_Swale04       JUNCTION       0.32     1.00   109.05     0  06:50        1.00
West_Swale01         JUNCTION       0.03     0.14   110.86     0  06:30        0.14
West_Swale02         JUNCTION       0.02     0.14   110.72     0  06:30        0.14
West_Swale03         JUNCTION       0.02     0.12   110.42     0  06:30        0.12
West_Swale04         JUNCTION       0.02     0.13   110.00     0  06:31        0.13
West_Swale05         JUNCTION       0.03     0.13   109.79     0  06:31        0.13
Out-Site             OUTFALL        0.06     0.22   107.92     0  06:50        0.22
East_Infil           STORAGE        0.27     0.31   111.15     0  06:15        0.31
Pump_Storage         STORAGE        0.04     0.24   109.94     0  06:35        0.24
West_Infil           STORAGE        0.27     0.31   111.58     0  06:15        0.31


*******************
Node Inflow Summary
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-------------------------------------------------------------------------------------------------
                                  Maximum  Maximum                  Lateral       Total        Flow
                                  Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                   Inflow   Inflow   Occurrence      Volume      Volume       Error
Node                 Type             LPS      LPS  days hr:min    10^6 ltr    10^6 ltr     Percent
-------------------------------------------------------------------------------------------------
Dry_Pond01           JUNCTION        0.00   838.95     0  06:40           0        5.14      -0.068
East_Swale01         JUNCTION      162.04   173.21     0  06:30       0.627       0.662      -0.005
East_Swale02         JUNCTION        0.00   173.00     0  06:30           0       0.662      -0.000
East_Swale03         JUNCTION        0.00   172.57     0  06:30           0       0.662      -0.006
East_Swale04         JUNCTION        0.00   172.15     0  06:30           0       0.662       0.005
East_Swale05         JUNCTION        0.00   171.68     0  06:30           0       0.662       0.009
Outlet_Structure01   JUNCTION        0.00   781.36     0  06:47           0        5.14       0.096
Outlet_Structure02   JUNCTION        0.00   772.82     0  06:50           0        5.14       0.000
Outlet_Swale01       JUNCTION      764.14  1002.39     0  06:33        3.88        5.14      -0.003
Outlet_Swale02       JUNCTION        0.00  1002.43     0  06:33           0        5.14      -0.024
Outlet_Swale03       JUNCTION        0.00  1002.34     0  06:33           0        5.14      -0.003
Outlet_Swale04       JUNCTION        0.00   932.78     0  06:33           0        5.14       0.008
```

West_Swale01	JUNCTION	135.32	149.49	0	06:30	0.521	0.6	-0.007
West_Swale02	JUNCTION	0.00	149.23	0	06:30	0	0.6	-0.002
West_Swale03	JUNCTION	0.00	148.77	0	06:30	0	0.6	0.002
West_Swale04	JUNCTION	0.00	148.35	0	06:30	0	0.6	0.002
West_Swale05	JUNCTION	0.00	148.00	0	06:31	0	0.6	0.005
Out-Site	OUTFALL	0.00	772.82	0	06:50	0	5.14	0.000
East_Infil	STORAGE	11.16	11.16	0	06:15	0.0471	0.0471	-0.006
Pump_Storage	STORAGE	10.18	10.18	0	06:30	0.0412	0.0412	-0.003
West_Infil	STORAGE	11.16	11.16	0	06:15	0.0471	0.0471	-0.003

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Node Surcharge Summary
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No nodes were surcharged.

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Node Flooding Summary
****

No nodes were flooded.

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Storage Volume Summary
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Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
East_Infil	0.010	88	0	0	0.012	100	0 06:04	11.16
Pump_Storage	0.002	10	0	0	0.012	64	0 06:35	3.00
West_Infil	0.008	90	0	0	0.009	100	0 06:04	11.16

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Outfall Loading Summary
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Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
Out-Site	85.68	156.32	772.82	5.138
System	85.68	156.32	772.82	5.138

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Link Flow Summary
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Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
Control_Pipe	CONDUIT	212.59	0 06:50	3.02	3.36	0.98
Dry_Pond01	CHANNEL	781.36	0 06:47	0.18	0.03	0.82
East_Infil	CONDUIT	11.16	0 06:15	0.33	0.01	0.06
East_Swale01	CONDUIT	173.00	0 06:30	0.44	0.02	0.16
East_Swale02	CONDUIT	172.57	0 06:30	0.42	0.04	0.16
East_Swale03	CONDUIT	172.15	0 06:30	0.47	0.03	0.15
East_Swale04	CONDUIT	171.68	0 06:30	0.45	0.03	0.16
East_Swale05	CONDUIT	171.36	0 06:31	0.58	0.02	0.12
Outlet_Swale01	CONDUIT	1002.43	0 06:33	1.33	0.06	0.32
Outlet_Swale02	CONDUIT	1002.34	0 06:33	0.73	0.09	0.65
Outlet_Swale03	CONDUIT	932.78	0 06:33	0.50	0.19	0.94
Outlet_Swale04	CONDUIT	838.95	0 06:40	0.49	0.21	1.00
Site_Outlet	CONDUIT	772.82	0 06:50	1.10	0.14	0.25
West_Infil	CONDUIT	11.16	0 06:15	0.33	0.01	0.06
West_Swale01	CONDUIT	149.23	0 06:30	0.44	0.02	0.14
West_Swale02	CONDUIT	148.77	0 06:30	0.50	0.02	0.13
West_Swale03	CONDUIT	148.35	0 06:30	0.50	0.02	0.12
West_Swale04	CONDUIT	148.00	0 06:31	0.48	0.02	0.13
West_Swale05	CONDUIT	147.83	0 06:31	0.63	0.02	0.10
Pump1	PUMP	3.00	0 06:01		1.00	
Pump2	PUMP	0.00	0 00:00		0.00	
Control_Weir	WEIR	560.23	0 06:50			0.69

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Flow Classification Summary
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Adjusted ---------- Fraction of Time in Flow Class ----------

Conduit	/Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
Control_Pipe	1.00	0.04	0.00	0.00	0.11	0.85	0.00	0.00	0.00	0.00
Dry_Pond01	1.00	0.04	0.00	0.00	0.96	0.00	0.00	0.00	0.65	0.00
East_Infil	1.00	0.35	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.00
East_Swale01	1.00	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.94	0.00
East_Swale02	1.00	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00
East_Swale03	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.76	0.00
East_Swale04	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.92	0.00
East_Swale05	1.00	0.03	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00
Outlet_Swale01	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.93	0.00
Outlet_Swale02	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.84	0.00
Outlet_Swale03	1.00	0.04	0.00	0.00	0.96	0.00	0.00	0.00	0.70	0.00
Outlet_Swale04	1.00	0.04	0.00	0.00	0.96	0.00	0.00	0.00	0.65	0.00
Site_Outlet	1.00	0.05	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00
West_Infil	1.00	0.33	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00
West_Swale01	1.00	0.02	0.00	0.00	0.98	0.00	0.00	0.00	0.49	0.00
West_Swale02	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.48	0.00
West_Swale03	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.93	0.00
West_Swale04	1.00	0.03	0.00	0.00	0.97	0.00	0.00	0.00	0.89	0.00
West_Swale05	1.00	0.03	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00

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Conduit Surcharge Summary
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Conduit	Hours Full Both Ends	Hours Full Upstream	Hours Full Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
Control_Pipe	0.01	6.38	0.01	6.50	0.01
Outlet_Swale04	0.01	0.01	0.61	0.01	0.01

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Pumping Summary
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Pump	Percent Utilized	Number of Start-Ups	Min Flow LPS	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr	Power Usage Kw-hr	% Time Off Pump Curve Low	% Time Off Pump Curve High
Pump1	48.45	1	0.00	1.30	3.00	0.041	0.11	0.0	100.0
Pump2	0.00	0	0.00	0.00	0.00	0.000	0.00	0.0	0.0

Analysis begun on: Fri May 31 10:40:17 2019
Analysis ended on: Fri May 31 10:40:18 2019
Total elapsed time: 00:00:01