Stormwater Management & Servicing Report

Multi-Tenant Commercial Development

2822 Carp Road, Carp
City of Ottawa

PEARSON ENGINEERING
PEARSONENG.COM

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19124

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Stormwater Management & Servicing Report
Commercial Development, 2822 Carp Road

1. Introduction

PEARSON Engineering Ltd. (Pearson) has been retained by Argue Construction Inc. (Client) to prepare a Stormwater Management (SWM) & Servicing Report (Report) in support of the proposed Industrial Development (Project), located in the village of Carp in the City of Ottawa (City). The project proposes to develop two (2) multi-tenant commercial buildings.

The subject property is approximately 1.01 ha in size and currently mostly vacant with a 1-storey brick dwelling on the north side of the site. The existing site is relatively flat and generally drains to the southwest towards Carp road and northeast towards an existing drainage course. The site is bound by Carp Road to the southwest a proposed access road to the southeast, farmland to the northwest, and an existing industrial site and farmland to the northwest. The location of the site can be seen on Figure 1.

1.1. Terms of Reference

The intent of this SWM & Servicing Report is to:

- Identify the existing site characteristics including any external drainage conditions;
- Illustrate the design of the stormwater conveyance and detention system, capable of accommodating both minor and major storm flows from the site;
- Incorporate the appropriate Best Management Practices for controlling on-site erosion and sedimentation during construction while ultimately ensuring that the post-development release of stormwater is of adequate quality; and
- Summarize this design in a technically comprehensive and concise manner.

2. Water Supply and Distribution

The Project will be serviced by a proposed well for domestic water supply and designed as per City standards. The proposed well is to be located in the parking lot island east of Building 1. The site will be serviced by connecting to the proposed well with a water service to each building. The water system for this Project is intended for domestic and firefighting use. The proposed layout of the watermain can be seen on Drawing SGS-1 in Appendix E.

3. Sanitary Servicing Overview

The design of the sanitary sewage system is intended to minimize the impact to the environment, and more specifically to minimize the impact on the ground water and surface water systems. The *Ontario Building Code* (OBC) requirements have been considered in determining the sanitary servicing requirements for this Project. The design daily sewage flow was based on the established flows outlined in Table 8.2.1.3.B. of the OBC. The proposed units were calculated using the Service Station flows based on the assumed building uses. A total flow of 3,960 L/d was calculated for the proposed commercial development. Refer to the sanitary flow calculations in Appendix A for details.

The effluent will be treated using a Level 4 Tertiary Treatment system conforming to the OBC. The specified treatment unit to provide this will be a Biofilter and Denitrifying treatment system provided by Waterloo Biofilter. Full details of the system can be found within Appendix A. The maximum influent concentrations used in the design are the typical domestic strength characteristics.

MULTI–TENANT COMMERCIAL BLDGS
2822 CARP ROAD
CITY OF OTTAWA

SITE LOCATION PLAN

PEARSON ENGINEERING LTD.
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	NW/MWD	HORIZ SCALE	HORIZ	PROJECT #	19124
DRAWN BY	NW	VERT SCALE	VERT	DRAWING #	FIG–1
CHECKED BY	GMP	DATE	SEPTEMBER 2020	REVISION #	0

3.1. Proposed Subsurface Effluent Distribution System

GEMTEC Consulting Engineers and Scientists Ltd. completed a Geotechnical Investigation, dated October 2020 for the project site. The report included seven boreholes ranging from a depth of 3.0 m to 5.0 m below ground surface and did not encounter any groundwater except in Borehole 20-03 at 1.4 m below the existing ground surface. The report concluded that the soils had an average infiltration rate of 8 min/cm to 20 min/cm for the Loamy Sand between the borehole locations. As such, a T-time of 20 min/cm was selected for septic bed sizing.

A Type ‘A’ Dispersal Bed has been designed as per OBC 8.7.7 for 3,960 L/day of sanitary design flow. The effective surface area required depth of the filter medium, and particle size of required sand shall conform to OBC 8.7.7.1 paragraph (5) which states that the maximum loading shall not exceed 50 L/m^2. Imported sand conforming to the requirements shall be installed to ensure sufficient effluent distribution as well as to reduce the risk of lateral movement of the flows near the top of the bed. The required base area of the filter medium shall be installed as per OBC 8.7.7.1 paragraph (5). Furthermore, a stone layer shall be installed as per OBC 8.7.7.1 paragraph (6) to allow for proper distribution of the effluent flows. Please refer to Appendix B for the required and provided stone and sand area calculations.

Further design details can be found included in Appendix A.

4. Stormwater Management

A key component of the development is the need to address environmental and related SWM issues to meet the City of Ottawa, Mississippi Valley Conservation Authority (MVCA), and Ministry of the Environment, Conservation, and Parks (MECP) requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems and this report focuses on the necessary measures to satisfy the MECP’s SWM requirements.

It is understood the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion.
- Maintain water quality for ecological integrity, recreational opportunities etc.
- Protect and maintain groundwater flow regime(s).
- Protect aquatic and fishery communities and habitats.
- Maintain and protect significant natural features.
- Incorporate Low Impact Development (LID) practices to promote infiltration and reduce phosphorus levels to downstream watercourses.

4.1. Analysis Methodology

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment Stormwater Management Planning and Design Manual, March 2003
- Mississippi Valley Conservation Authority, Regulation Policies, Updated September 2019
- City of Ottawa, Sewer Design Guidelines, Second Edition, October 2012

In order to design the facilities to meet these requirements, it is essential to select the appropriate modeling methodology for the storm system design. Given the size of the site, the Modified Rational Method is appropriate for the design for the SWM system.

4.2. Existing Conditions

The subject property is approximately 1.01 ha in size and currently mostly vacant with a 1-storey brick dwelling on the north side of the site. An existing gravel access road from Carp Road extends through the site to access the area to the rear of the property. The site is bound by Carp Road to the southwest a proposed access road to the southeast, farmland to the northwest, and an existing industrial site and farmland to the northwest. The existing site is relatively flat and generally drains to the southwest towards Carp Road and northeast towards an existing drainage course. A catchment along the southwest side of the property is approximately 0.59 ha in size and drains to the existing drainage ditch on Carp Road, ultimately draining southeast to the Huntley Creek. The remaining 0.42 ha drains northeast towards the rear of the property. Details of existing storm drainage conditions can be seen on Drawing STM-1 in Appendix E.

Allowable peak flows for the site were calculated using the site's current conditions and can be seen in Table 2 below. Detailed calculations for the existing drainage conditions can be found in Appendix B.

Table 1: Pre-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Peak Flow to Carp Road (m^3/s)	0.04	0.05	0.06	0.07	0.08	0.09
Peak Flow to Northeast (m^3/s)	0.02	0.03	0.03	0.04	0.04	0.05
Total Site Peak Flow (m^3/s)	**0.06**	**0.08**	**0.09**	**0.11**	**0.12**	**0.14**

4.3. Proposed Conditions

The post-development storm drainage for the project site will generally follow pre-development conditions. The majority of the proposed drainage from the project will be conveyed northwesterly via overland sheet flow to a SWM pond located in the east corner of the site. Before being conveyed into the SWM Pond, the flows from the majority of the parking and building area will be conveyed through a grassed drainage channel. Peak flows released from the SWM pond will be conveyed through a Hickenbottom outlet structure to an existing drainage ditch on Carp Road. The drainage from the rooftops of the buildings will be conveyed via roof leaders to the parking area to be conveyed via overland sheet flow. The eastern edge of the project site will drain uncontrolled along the property line towards Carp Road. A small portion of the southern and western edges of the site will drain uncontrolled towards the existing ditch adjacent to the neighbouring gravel road as they do in pre-development. Refer to Drawing STM-2 in Appendix E for the proposed drainage patterns.

4.4. Stormwater Quantity Control

The proposed development will increase the imperviousness of the site and as such the post-development peak flows will increase. Considerations were taken to reduce post-development peak flows to pre-development values. Given the size of the site, the Modified Rational Method will be used to determine the SWM release rates. It is important to quantify the increase in stormwater runoff rates and attenuate these increases. The calculated post-development runoff coefficient of 0.39 is greater than the pre-development runoff coefficient of 0.28. Runoff coefficient calculations can be found in Appendix B.

The Project's building rooftop and gravel parking area will drain via overland flow to a grass drainage channel. Quantity control on site will be provided through the use of a proposed SWM pond located on the northwest corner of the site adjacent to Carp Road. Stormwater from all storm events will enter the pond via overland flow through the grassed drainage channel located north of the pond. A 150 mm diameter orifice tube located within a hickenbottom outlet structure and a 5.00 m wide emergency overflow weir over the side berm will control outflow from the pond and reduce it to lower than pre-development values for all storm events.

The proposed SWM pond has been designed with 4:1 side slope as per MECP guidelines. Calculations contained in Appendix C indicate that 119 m^3 of quantity control storage volume in the SWM pond is required to reduce post-development peak flows for the 100-year storm events. The dry pond has a storage volume of 119 m^3 at an elevation of 114.97, providing approximately 0.30 m of freeboard to the top of berm. Table 2 shows the Stage-Storage-Discharge (SSD) values for the proposed SWM pond.

The storm system was analyzed under the City of Ottawa Sewer Guidelines Climate Change requirements. Storage in the pond increased to 134 m^3 when applying a 20% stress test to the 100-year storm event. Under these conditions, the stormwater will pass through the emergency overflow weir before the water level reaches the building envelope. Additional calculations can be found in Appendix B.

Table 2: Pond Release Rates and Water Levels

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm	100 Year + 20%
Peak Flow (m^3/s)	0.023	0.028	0.030	0.033	0.038	0.044	0.058
Storage Volume (m^3)	47	67	82	101	112	119	134
Ponding Elevation (m)	114.80	114.86	114.90	114.94	114.96	114.97	115.00

Table 3 below summarizes the post-development peak flows for the site. As can be seen by comparing Table 1 and Table 3, post-development peak flows are at or below pre-development values.

Table 3: Post-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm	100 Year + 20%
Uncontrolled Flow(m^3/s)	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Controlled Flow to Carp Road (m^3/s)	0.02	0.03	0.03	0.03	0.04	0.04	0.04
Total Site Flow (m^3/s)	**0.03**	**0.04**	**0.04**	**0.04**	**0.05**	**0.05**	**0.06**

4.5. Stormwater Quality Control

The MECP in March 2003 issued a "Stormwater Management Planning and Design Manual". This manual has been adopted by a variety of agencies including the City of Ottawa. The objective of the Stormwater Quality Control will be to ensure Enhanced Protection quality control as stated in the MECP manual. To achieve enhanced protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

4.5.1. Permanent Quality Control

The development's driveway and parking areas pose a potential risk to stormwater quality through the collection of grit, sand, and oils on the paved surfaces. The MECP standard stipulates a Total Suspended Solids (TSS) removal of at least 80% in order to treat to the MECP's Enhanced Level Protection standard. Typically, an Oil/Grit Separator (OGS) would be utilized to treat stormwater runoff to the required values. However, due to no storm sewer located on the site, quality control will be provided through infiltration in the SWM pond. Based on a total imperviousness of 42%, 23 m^3 of storage will need to be infiltrated to achieve 80% TSS removal, 29.2 m^3 of infiltration volume is being provided. The runoff from the proposed site is to be directed through a vegetated grassed drainage channel where stormwater will be infiltrated prior to entering the main area of the SWM pond. Quality control calculations can be found in Appendix B.

4.5.2. Quality Control During Construction Activities

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure stormwater runoff's quality.

Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of silt fence along the entire perimeter of the site to reduce sediment migration onto surrounding properties;
- Installation of a construction entrance mat to minimize transportation of sediment onto roadways;
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit. The duration in which surfaces are disturbed/exposed shall not exceed 30 days;
- Reduce stormwater drainage velocities where possible; and,
- Minimize the amount of existing vegetation removed.

4.6. Water Balance

Since the post-development state will increase the imperviousness of the site, considerations were taken in regard to groundwater recharge. Under pre-development conditions, the majority of the project site consists of pasture and shrubs, which infiltrates approximately 2,132 m^3 annually over the grassed areas. As per the Hydrogeological Investigation (Gemtec, 2004), the infiltration target to be used for this site is 2,650 m^3/year. With the increased imperviousness of the site, this recharge will be reduced to 1,608 m^3, resulting in a deficit volume of 1,042 m^3.

In order to infiltrate an additional 1,042 m^3 annually, a yearly rainfall depth of approximately 120.8 mm from the controlled area is required to be infiltrated resulting in a storage volume of 25.9 m^3. This percentage of annual rainfall occurs for rain events of 3 mm or less. Water balance will be achieved through the use of infiltration volume in the bottom of the proposed SWM pond. The SWM Pond have been sized to infiltrate 3 mm over the controlled area and requires a total volume of 25.9 m^3 of storage for the development. The SWM Pond has been designed to have a total of 29.2 m^3 of infiltration storage below the hickenbottom orifice. Detailed calculations can be found in Appendix C.

5. Maintenance of SWM Facilities

5.1. Grassed Drainage Channel

Enhanced grass swales require minimal maintenance once the vegetation has established. Vehicles should not drive or park on the vegetated area, and light mowing equipment should be utilized in order to avoid soil compaction which will reduce the infiltration capacity of the underlying soil. Grass should be cut to a height of 75 mm to 150 mm.

The swales should be inspected twice a year or after a major storm event (greater than the 25 mm storm) for damage or channelization. If any trash/debris is observed during inspections, it should be removed. Sediment buildup with a depth in excess of 25 mm should be removed during dry weather.

5.2. Stormwater Management Pond

The stormwater management (SWM) pond should be inspected on a monthly basis and after significant rainfall events. With the inclusion of the channel upstream of the SWM pond, it is not anticipated that any significant sediment loading will occur in the SWM pond. However, it is recommended that upon visual inspection of significant sediment buildup, that this material be removed. Similarly, trash removal, when applicable, should be done on a routine basis to ensure the proper ongoing functioning of the outlet control structure. If permanent water is noticed, the outlet structure should be inspected for clogging. The vegetation should be allowed to grow without grass cutting. The grass in the remaining area of the pond should not be cut unless absolutely necessary for aesthetic reasons.

5.3. Orifice Tube

The orifice tube controlling flows towards Carp Road is located in the hickenbottom outlet structure and should be inspected monthly during the first year of operation and in the spring and fall thereafter. Any standing water observed during inspection of the catchbasin manhole that does not drain away may indicate a blocked orifice tube. The orifice tube should be kept clear of debris and any offending debris should be removed. Access to the orifice tube can be achieved through the hickenbottom outlet structure.

6. Conclusions

The proposed development water supply will be from a drilled well on site to service both buildings. Sanitary services for the development will be conveyed and treated using a proposed septic bed system.

Quantity control for the development is provided in the SWM pond allowing post-development peak flows to be released at pre-development values.

A treatment train approach is implemented consisting of the grassed drainage channel and the proposed SWM pond to obtain quality control for the site. Water balance for the site will be achieved through the use of the SWM pond.

All of which is respectfully submitted,
PEARSON ENGINEERING LTD.

Gary Pearson, P. Eng
Principal

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Manager of Engineering Services

Appendix A

Sanitary Servicing Calculations

Argue, 2822 Carp Rd, Ottawa
Sanitary Flow Calculations

Design Criteria

Flow per capita (Q):	28,000 L/gross ha/d	
Peak Flow:	Qp = P * Q * M / 86,400	
Peaking Factor (Harmon Formula):	M = 1 + ((14 / (4 + (P / 1000) ^ 0.5)) x 0.8)	2 <= "M" <= 4
Infiltration Allowance:	0.33 L/s/effective gross ha (for all areas	

Design Daily Sewage Flow:

Building	Description (As per OBC 8.2.1.3.B)	Flow (L/d)	
Service Stations (No Vehicle Washing)			
(a) per Water Closet, and;	950 L/d per W.C. = 950 L/d x 7 W.C.'s =	3,800	
(ii) per Vehicle Served.	20 L/d per Veh. Served = 20 L/d x 26 Veh. =	160	
	Total Design Flow (Q) =	**3,960**	L/d

Calculate Average Daily Demand

ADD	=	3,960	L/d
ADD	=	0.05	L/s

Calculate Peaking Factor

$$M = 1 + \frac{14}{4 + \left(\frac{0}{1,000}\right)^{0.5}} \times 0.8$$

M = 3.80

Infiltration Allowance	=	0.33	x	1.01	ha
	=	0.33	L/s		

Calculate Peak Flow

Qp (w. Infiltration Allowance)	=	0.05	x	3.80	+	0.33
	=	0.51	L/s			

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Argue, 2822 Carp Rd, Ottawa
Calculation of Septic Design Flows - Type A Dispersal Bed

Design Daily Sewage Flow:

Building	Description (As per OBC 8.2.1.3.B)	Flow (L/d)	
Service Stations (No Vehicle Washing)			
(a) per Water Closet, and;	950 L/d per W.C. = 950 L/d x 7 W.C.'s =	3,800	
(ii) per Vehicle Served.	20 L/d per Veh. Served = 20 L/d x 26 Veh. =	160	
	Total Design Flow (Q) =	**3,960**	L/d

Septic Design

Septic Tank:

Required (OBC 8.2.2.3. (1))	Q x 3 =	11,880	L/d
Provided	23,000 L Tank =	**23,000**	**L/d**
	Precast Concrete Septic Tank		

Type A Dispersal Bed:	To accept 7,170 L/d		As per OBC 8.7.7.	
Stone Area - Required	A = Q / B = 7,170 / 50 =	79	m^2	OBC 8.7.7.1.(6)
Stone Area - Provided	A = L x W = 5.0 m x 16.0 m =	**80**	$\mathbf{m^2}$	
Sand Area - Required	A = QT / 400 = (7,170 x 20) / 400 =	198	m^2	OBC 8.7.7.1.(5)
Sand Area - Provided	A = L x W = 21.0 m x 18.0 m =	**378**	$\mathbf{m^2}$	

Appendix B

Stormwater Management Calculations

Argue, 2822 Carp Rd, Ottawa
Calculation of Runoff Coefficients

Runoff Coefficient	=	0.20	0.90	0.90	0.70	0.90		Weighted Runoff Coefficient
Surface Cover	=	Grass	Asphalt	Building	Gravel	Conc.		
Pre-Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	5897	4654	60	155	1017	11		0.23
2	4219	3949	0	0	269	0		0.23
Pre Total	10115	8604	60	155	1287	11		0.28
Post-Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	8631	5005	87	600	2871	69		0.43
2	1484	1484	0	0	0	0		0.20
Post Total	10115	6488	87	600	2871	69		0.39

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Argue, 2822 Carp Rd, Ottawa
Pre-Development Peak Flows

Storm Event (yrs)	City of Ottawa Coeff A	Coeff B	Coeff C
2	732.951	6.199	0.81
5	998.071	6.053	0.81
10	1174.184	6.014	0.82
25	1402.884	6.018	0.82
50	1569.580	6.014	0.82
100	1735.688	6.014	0.82

Modified Rational Method
Q = CiCIA / 360

Where:
- Q - Flow Rate (m^3/s)
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)
- Ci - Peaking Coefficient

	Area Draining to Carp Road		Area Draining to SE Ditch	
Area Number	1		2	
Area	0.59	ha	0.42	ha
Runoff Coefficient	0.20		0.20	
Time of Concentration	10	min	10	min
Return Rate	2	year	2	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	76.8	mm/hr	76.8	mm/hr
Pre-Development Peak Flow	0.03	m^3/s	0.02	m^3/s
Return Rate	5	year	5	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	104.2	mm/hr	104.2	mm/hr
Pre-Development Peak Flow	0.03	m^3/s	0.02	m^3/s
Return Rate	10	year	10	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	122.1	mm/hr	122.1	mm/hr
Pre-Development Peak Flow	0.04	m^3/s	0.03	m^3/s
Return Rate	25	year	25	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	144.7	mm/hr	144.7	mm/hr
Pre-Development Peak Flow	0.05	m^3/s	0.03	m^3/s
Return Rate	50	year	50	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	161.5	mm/hr	161.5	mm/hr
Pre-Development Peak Flow	0.05	m^3/s	0.04	m^3/s
Return Rate	100	year	100	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	178.6	mm/hr	178.6	mm/hr
Pre-Development Peak Flow	0.06	m^3/s	0.04	m^3/s

Note:
As per City of Ottawa pre-consultation comments, a pre-development runoff coefficient of 0.20 was used for the site.

Argue, 2822 Carp Rd, Ottawa
Post-Development Peak Flows

Storm Event (yrs)	City of Ottawa Coeff A	Coeff B	Coeff C
2	732.951	6.199	0.81
5	998.071	6.053	0.81
10	1174.184	6.014	0.82
25	1402.884	6.018	0.82
50	1569.580	6.014	0.82
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Modified Rational Method
Q = CiCIA / 360

Where:

- Q - Flow Rate (m^3/s)
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)
- Ci - Peaking Coefficient

	Uncontrolled Area		Area Draining to SWM Pond	
Area Number	Area 1		Area 2	
Area	0.15	ha	0.86	ha
Runoff Coefficient	0.20		0.43	
Time of Concentration	10	min	10	min
Return Rate	2	year	2	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	76.8	mm/hr	76.8	mm/hr
Post-Development Peak Flow	0.01	m^3/s	0.08	m^3/s
Return Rate	5	year	5	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	104.2	mm/hr	104.2	mm/hr
Post-Development Peak Flow	0.01	m^3/s	0.11	m^3/s
Return Rate	10	year	10	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	122.1	mm/hr	122.1	mm/hr
Post-Development Peak Flow	0.01	m^3/s	0.13	m^3/s
Return Rate	25	year	25	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	144.7	mm/hr	144.7	mm/hr
Post-Development Peak Flow	0.01	m^3/s	0.15	m^3/s
Return Rate	50	year	50	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	161.5	mm/hr	161.5	mm/hr
Post-Development Peak Flow	0.01	m^3/s	0.17	m^3/s
Return Rate	100	year	100	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	178.6	mm/hr	178.6	mm/hr
Post-Development Peak Flow	0.01	m^3/s	0.18	m^3/s
City of Ottawa 20% Stress Test*				
Return Rate	100	year	100	year
Peaking Coefficient (Ci)	1.20		1.20	
Rainfall Intensity	178.6	mm/hr	178.6	mm/hr
Post-Development Peak Flow	0.02	m^3/s	0.22	m^3/s

*Refer to Quantity Control Stress Test

Argue, 2822 Carp Rd, Ottawa
Stage-Storage-Discharge Table

Elevation (m)	Area (m^2)	Volume (m^3)	Cum. Vol. (m^3)	Orifice Tube Head (m)	Orifice Tube Flow (m^3/s)	Weir Head (m)	Weir Flow (m^3/s)	Total Flow (m^3/s)
Infiltration Volume								
114.34	75	0	0	0.000	0.000	0.000	0.000	0.000
114.35	78	1	1	0.000	0.000	0.000	0.000	0.000
114.40	95	4	5	0.000	0.000	0.000	0.000	0.000
114.45	111	5	10	0.000	0.000	0.000	0.000	0.000
114.50	128	6	16	0.000	0.000	0.000	0.000	0.000
114.55	146	7	23	0.000	0.000	0.000	0.000	0.000
114.59	160	6	29	0.000	0.000	0.000	0.000	0.000
Quantity Control Volume								
114.59	160	0	0	0.000	0.000	0.000	0.000	0.000
114.60	164	2	2	0.000	0.000	0.000	0.000	0.000
114.65	188	9	10	0.000	0.000	0.000	0.000	0.000
114.70	218	10	21	0.035	0.012	0.000	0.000	0.012
114.75	257	12	32	0.085	0.018	0.000	0.000	0.018
114.80	307	14	47	0.135	0.023	0.000	0.000	0.023
114.85	367	17	63	0.185	0.027	0.000	0.000	0.027
114.90	441	20	84	0.235	0.030	0.000	0.000	0.030
114.95	523	24	108	0.285	0.033	0.000	0.000	0.033
115.00	606	28	136	0.335	0.036	0.020	0.024	0.060
115.05	697	33	168	0.385	0.039	0.070	0.157	0.196
115.10	830	38	207	0.435	0.041	0.120	0.353	0.395
115.15	1007	46	253	0.485	0.044	0.170	0.596	0.639
115.20	1224	56	308	0.535	0.046	0.220	0.877	0.923
115.25	1475	67	376	0.585	0.048	0.270	1.193	1.240

Orifice Tube	
Diameter	150 mm
Invert Elevation	114.59
Orifice Constant	0.80
Orifice Centroid	114.67
Orifice Flow Formula	$0.80\pi(D/2000)^2x(2x9.81xH)^{0.5}$

Emergency Overflow Weir	
Width	5.00 m
Invert of Weir	114.98 m
Weir Flow Formula	$1.7WH^{1.5}$

PEARSON ENGINEERING

Argue, 2822 Carp Rd, Ottawa
Quantity Control Volume Calculations

DATE:	07-Jan-22
FILE:	19124
CONTRACT/PROJECT:	Argue, 2822 Carp Rd
COMPLETED BY:	NW

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre Development Runoff Coefficient	Post Development Runoff Coefficient
1.012	0.863	10	1	0.20	0.43

Note: Refer to page Calculation of Runoff Coefficients for detailed calculations of Modified Rational Method parameters.

Pre-Development Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.20	0.20	0.20	0.20	0.20	0.20
I	76.81	104.19	122.14	144.69	161.47	178.56
A	1.01	1.01	1.01	1.01	1.01	1.01
Q	0.043	0.059	0.069	0.081	0.091	0.100

Note: Q= 0.00278CIA

Rainfall Station	City of Ottawa

Design Input

Storm Event (yrs)	Chicago Storm Coefficient A	Chicago Storm Coefficient B	Chicago Storm Coefficient C	Target Outflow (m3/s)	Actual Outflow (m3/s)	Post Development Runoff Coefficient
2	732.951	6.199	0.81	0.037	0.023	0.43
5	998.071	6.053	0.81	0.050	0.028	0.43
10	1174.184	6.014	0.82	0.059	0.030	0.43
25	1402.884	6.018	0.82	0.069	0.033	0.43
50	1569.580	6.014	0.82	0.077	0.037	0.43
100	1735.688	6.014	0.82	0.086	0.044	0.43
100 + 20%	1735.688	6.014	0.82	0.086	0.059	0.51

Results

Storm Event (yrs)	Storage (m^3)	Time (min)
2	47	35
5	67	38
10	82	41
25	101	44
50	112	43
100	119	40
100 + 20%	134	36

Note: Storage volume calculated as per Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996

Time (min)	2 Year Intensity mm/hr	2 Year Inflow m^3/s	2 Year Outflow m^3/s	2 Year Storage m^3	Difference	5 Year Intensity mm/hr	5 Year Inflow m^3/s	5 Year Outflow m^3/s	5 Year Storage m^3	Difference
1	148.14	0.152	0.023	2	7	203.51	0.209	0.028	3	9
2	133.33	0.137	0.023	8	5	182.69	0.187	0.028	13	7
3	121.46	0.125	0.023	13	4	166.09	0.170	0.028	20	6
4	111.72	0.115	0.023	18	4	152.51	0.156	0.028	26	5
5	103.57	0.106	0.023	22	3	141.18	0.145	0.028	31	4
6	96.64	0.099	0.023	25	3	131.57	0.135	0.028	35	4
7	90.66	0.093	0.023	27	2	123.30	0.126	0.028	39	3
8	85.46	0.088	0.023	30	2	116.11	0.119	0.028	42	3
9	80.87	0.083	0.023	32	2	109.79	0.113	0.028	45	2
10	76.81	0.079	0.023	33	2	104.19	0.107	0.028	48	2
11	73.17	0.075	0.023	35	1	99.19	0.102	0.028	50	2
12	69.89	0.072	0.023	36	1	94.70	0.097	0.028	52	2
13	66.93	0.069	0.023	38	1	90.63	0.093	0.028	53	2
14	64.23	0.066	0.023	39	1	86.93	0.089	0.028	55	1
15	61.77	0.063	0.023	40	1	83.56	0.086	0.028	56	1
16	59.50	0.061	0.023	41	1	80.46	0.082	0.028	58	1
17	57.42	0.059	0.023	41	1	77.61	0.080	0.028	59	1
18	55.49	0.057	0.023	42	1	74.97	0.077	0.028	60	1
19	53.70	0.055	0.023	43	1	72.53	0.074	0.028	61	1
20	52.03	0.053	0.023	43	1	70.25	0.072	0.028	62	1
21	50.48	0.052	0.023	44	0	68.13	0.070	0.028	62	1
22	49.02	0.050	0.023	44	0	66.15	0.068	0.028	63	1
23	47.66	0.049	0.023	45	0	64.29	0.066	0.028	64	1
24	46.37	0.048	0.023	45	0	62.54	0.064	0.028	64	0
25	45.17	0.046	0.023	45	0	60.90	0.062	0.028	65	0
26	44.03	0.045	0.023	46	0	59.35	0.061	0.028	65	0
27	42.95	0.044	0.023	46	0	57.88	0.059	0.028	65	0
28	41.93	0.043	0.023	46	0	56.49	0.058	0.028	66	0
29	40.96	0.042	0.023	46	0	55.18	0.057	0.028	66	0
30	40.04	0.041	0.023	46	0	53.93	0.055	0.028	66	0
31	39.17	0.040	0.023	46	0	52.74	0.054	0.028	67	0
32	38.34	0.039	0.023	47	0	51.61	0.053	0.028	67	0
33	37.54	0.039	0.023	47	0	50.53	0.052	0.028	67	0
34	36.78	0.038	0.023	47	0	49.50	0.051	0.028	67	0
35	36.06	0.037	0.023	47	0	48.52	0.050	0.028	67	0
36	35.37	0.036	0.023	47	0	47.58	0.049	0.028	67	0
37	34.70	0.036	0.023	47	0	46.67	0.048	0.028	67	0
38	34.06	0.035	0.023	47	0	45.81	0.047	0.028	67	0
39	33.45	0.034	0.023	46	0	44.98	0.046	0.028	67	0
40	32.86	0.034	0.023	46	0	44.18	0.045	0.028	67	0
41	32.30	0.033	0.023	46	0	43.42	0.045	0.028	67	0
42	31.76	0.033	0.023	46	0	42.68	0.044	0.028	67	0
43	31.23	0.032	0.023	46	0	41.97	0.043	0.028	67	0
44	30.73	0.032	0.023	46	0	41.29	0.042	0.028	67	0

Time (min)	10 Year Intensity mm/hr	10 Year Inflow m^3/s	10 Year Outflow m^3/s	10 Year Storage m^3	Difference	25 Year Intensity mm/hr	25 Year Inflow m^3/s	25 Year Outflow m^3/s	25 Year Storage m^3	Difference
1	239.57	0.246	0.030	5	11	284.43	0.292	0.033	7	13
2	214.88	0.220	0.030	16	9	255.03	0.261	0.033	20	10
3	195.22	0.200	0.030	24	7	231.63	0.237	0.033	30	9
4	179.16	0.184	0.030	31	6	212.51	0.218	0.033	39	7
5	165.77	0.170	0.030	37	5	196.58	0.202	0.033	46	6
6	154.42	0.158	0.030	43	4	183.08	0.188	0.033	52	5
7	144.67	0.148	0.030	47	4	171.48	0.176	0.033	57	5
8	136.19	0.140	0.030	51	3	161.39	0.165	0.033	62	4
9	128.74	0.132	0.030	54	3	152.54	0.156	0.033	66	4
10	122.14	0.125	0.030	57	3	144.69	0.148	0.033	69	3
11	116.25	0.119	0.030	60	2	137.69	0.141	0.033	73	3
12	110.96	0.114	0.030	62	2	131.40	0.135	0.033	75	3
13	106.17	0.109	0.030	64	2	125.71	0.129	0.033	78	2
14	101.82	0.104	0.030	66	2	120.55	0.124	0.033	80	2
15	97.85	0.100	0.030	68	2	115.83	0.119	0.033	82	2
16	94.21	0.097	0.030	69	1	111.50	0.114	0.033	84	2
17	90.86	0.093	0.030	71	1	107.52	0.110	0.033	86	2
18	87.76	0.090	0.030	72	1	103.84	0.106	0.033	88	1
19	84.88	0.087	0.030	73	1	100.43	0.103	0.033	89	1
20	82.21	0.084	0.030	74	1	97.26	0.100	0.033	90	1
21	79.72	0.082	0.030	75	1	94.30	0.097	0.033	91	1
22	77.39	0.079	0.030	76	1	91.53	0.094	0.033	93	1
23	75.21	0.077	0.030	77	1	88.94	0.091	0.033	94	1
24	73.15	0.075	0.030	77	1	86.51	0.089	0.033	94	1
25	71.22	0.073	0.030	78	1	84.22	0.086	0.033	95	1
26	69.40	0.071	0.030	79	1	82.05	0.084	0.033	96	1
27	67.68	0.069	0.030	79	0	80.01	0.082	0.033	97	1
28	66.05	0.068	0.030	79	0	78.08	0.080	0.033	97	1
29	64.51	0.066	0.030	80	0	76.25	0.078	0.033	98	1
30	63.05	0.065	0.030	80	0	74.51	0.076	0.033	98	0
31	61.65	0.063	0.030	81	0	72.86	0.075	0.033	99	0
32	60.33	0.062	0.030	81	0	71.29	0.073	0.033	99	0
33	59.06	0.061	0.030	81	0	69.79	0.072	0.033	100	0
34	57.85	0.059	0.030	81	0	68.36	0.070	0.033	100	0
35	56.70	0.058	0.030	81	0	66.99	0.069	0.033	100	0
36	55.60	0.057	0.030	82	0	65.68	0.067	0.033	100	0
37	54.54	0.056	0.030	82	0	64.43	0.066	0.033	101	0
38	53.53	0.055	0.030	82	0	63.22	0.065	0.033	101	0
39	52.55	0.054	0.030	82	0	62.07	0.064	0.033	101	0
40	51.62	0.053	0.030	82	0	60.97	0.062	0.033	101	0
41	50.72	0.052	0.030	82	0	59.90	0.061	0.033	101	0
42	49.86	0.051	0.030	82	0	58.88	0.060	0.033	101	0
43	49.03	0.050	0.030	82	0	57.89	0.059	0.033	101	0
44	48.23	0.049	0.030	82	0	56.94	0.058	0.033	101	0

Time (min)	50 Year Intensity mm/hr	50 Year Inflow m^3/s	50 Year Outflow m^3/s	50 Year Storage m^3	Difference	100 Year Intensity mm/hr	100 Year Inflow m^3/s	100 Year Outflow m^3/s	100 Year Storage m^3	Difference
1	317.75	0.326	0.037	7	14	351.38	0.360	0.044	7	16
2	284.86	0.292	0.037	22	12	315.00	0.323	0.044	23	13
3	258.67	0.265	0.037	33	10	286.05	0.293	0.044	36	10
4	237.29	0.243	0.037	43	8	262.41	0.269	0.044	46	9
5	219.48	0.225	0.037	51	7	242.70	0.249	0.044	55	7
6	204.38	0.210	0.037	58	6	226.01	0.232	0.044	62	6
7	191.41	0.196	0.037	63	5	211.67	0.217	0.044	69	6
8	180.14	0.185	0.037	69	4	199.20	0.204	0.044	74	5
9	170.24	0.175	0.037	73	4	188.25	0.193	0.044	79	4
10	161.47	0.166	0.037	77	4	178.56	0.183	0.044	83	4
11	153.65	0.158	0.037	81	3	169.91	0.174	0.044	87	3
12	146.62	0.150	0.037	84	3	162.13	0.166	0.044	91	3
13	140.26	0.144	0.037	87	3	155.11	0.159	0.044	94	3
14	134.49	0.138	0.037	89	2	148.72	0.152	0.044	96	2
15	129.22	0.132	0.037	91	2	142.89	0.146	0.044	99	2
16	124.39	0.128	0.037	93	2	137.55	0.141	0.044	101	2
17	119.94	0.123	0.037	95	2	132.63	0.136	0.044	103	2
18	115.83	0.119	0.037	97	2	128.08	0.131	0.044	105	2
19	112.01	0.115	0.037	99	1	123.87	0.127	0.044	106	1
20	108.47	0.111	0.037	100	1	119.95	0.123	0.044	108	1
21	105.17	0.108	0.037	101	1	116.30	0.119	0.044	109	1
22	102.08	0.105	0.037	102	1	112.88	0.116	0.044	110	1
23	99.18	0.102	0.037	104	1	109.68	0.112	0.044	112	1
24	96.47	0.099	0.037	105	1	106.68	0.109	0.044	113	1
25	93.91	0.096	0.037	105	1	103.85	0.106	0.044	113	1
26	91.50	0.094	0.037	106	1	101.18	0.104	0.044	114	1
27	89.22	0.091	0.037	107	1	98.66	0.101	0.044	115	1
28	87.06	0.089	0.037	108	1	96.27	0.099	0.044	116	1
29	85.02	0.087	0.037	108	1	94.01	0.096	0.044	116	1
30	83.08	0.085	0.037	109	0	91.87	0.094	0.044	117	0
31	81.23	0.083	0.037	109	0	89.83	0.092	0.044	117	0
32	79.47	0.081	0.037	110	0	87.89	0.090	0.044	117	0
33	77.80	0.080	0.037	110	0	86.03	0.088	0.044	118	0
34	76.20	0.078	0.037	110	0	84.27	0.086	0.044	118	0
35	74.68	0.077	0.037	111	0	82.58	0.085	0.044	118	0
36	73.22	0.075	0.037	111	0	80.96	0.083	0.044	119	0
37	71.82	0.074	0.037	111	0	79.42	0.081	0.044	119	0
38	70.48	0.072	0.037	111	0	77.93	0.080	0.044	119	0
39	69.19	0.071	0.037	111	0	76.51	0.078	0.044	119	0
40	67.95	0.070	0.037	111	0	75.15	0.077	0.044	119	0
41	66.77	0.068	0.037	112	0	73.83	0.076	0.044	119	0
42	65.62	0.067	0.037	112	0	72.57	0.074	0.044	119	0
43	64.52	0.066	0.037	112	0	71.35	0.073	0.044	119	0
44	63.46	0.065	0.037	112	0	70.18	0.072	0.044	119	0

Notes:

: Maximum Storage Volume

1. Target Outflow equal to Pre-Development Peak Flow - Post-Development Uncontrolled Flow.
2. Actual Outflow calculated based on Stage-Storage-Discharge Table.
3. City of Ottawa Stress Test calculated by increasing the 100 year post-development peak flow by 20%.

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Argue, 2822 Carp Rd, Ottawa
Water Quality Storage Requirements

Infiltration volumes from MOE Stormwater Management Planning and Design Manual
Table 3.2 Water Quality Storage Requirements are as follows:

Design Area Total	=	0.86	ha		
Total Imperviousness	=	42%			
Storage Volume	=	26.7	m^3/ha		(Enhanced 80% long-term S.S. removal)
Area 1 Storage Volume Required	=	0.86	x	26.7	
	=	23.0	m^3		

Appendix C

Water Balance Calculations

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Argue, 2822 Carp Rd, Ottawa
Water Balance Calculations

Pre-Development Recharge

Precipitation data taken from Environment Canada information for the City of Ottawa.

Yearly Precipitation	=	885.0	mm				

Using Table 3.1 of the MOE's SWM Planning & Design Manual, the infiltration amount is approximately 28.0% of the precipitation value for Pasture and Shrubs for Fine Sandy Loam. Using site specific rainfall data, the infiltration can be calculated:

Pasture & Shrubs	=	0.86	ha				
Annual Site Area Recharge Volume	=	(0.86		x	0.28)	x	885.0
	=	2,650	m^3				

Therefore, 2650 m³ per year of recharge volume is required for the proposed project.

Post-Development Recharge

Using Table 3.1 of the MOE's SWM Planning & Design Manual, the infiltration amount for Urban Lawns is approximately 24% for Fine Sandy Silt.

Urban Lawn	=	0.65	ha				
Annual Site Area Recharge Volume	=	(0.65		x	0.28)	x	885.0
	=	1,608	m^3				

Therefore, post-development infiltration deficit is as follows:

Deficit Volume	=	Pre Development - Post Development			
	=	2,650		-	1,608
	=	1,042	m^3		

Recharge Basin

Find the depth of annual rainfall required to infiltrate 1042 m³ from the area into the ground.

Area contributing to the infiltration locations	=	8,631	m^2
Infiltration Deficit	=	1,042	m^3

Annual Precipitation Depth Required

$$\text{Req'd Precipitation Depth} = \frac{1{,}042 \ m^3}{8{,}631 \ m^2} = 120.8 \ \text{mm}$$

Assuming the average runoff for the contributing area is 0.42 the following yearly precipitation depth is required to get 120.8 mm of runoff, however, an infiltration target of 2,650 m³/year is being used, as per Hydrogeological Investigation Terrain Analysis & Impact Assessment by Gemtec

Precipitation Depth	=	120.8	mm	
		0.43		
	=	282.4	mm	

Find Percent of Annual Precipitation that Required Precipitation Depth represents:

Annual Precipitation for Study Area	=	885.0	mm	
% Annual Rainfall	=	282.4	mm	
		885.0	mm	
	=	32%		

From MOE Figure C-2, 32% of annual rainfall occurs for storm events of 3.0 mm or less.

Contributing Area	=	8,631	m^2	
Precipitation Depth	=	3.0	mm	
Storage Volume Required	=	A	x	D
	=	8,631	x	3.0
	=	25.9	m^3	
Volume Provided In Bottom of Pond	=	29.2	m^3	

Therefore, water balance for the site has been achieved through the use of the proposed SWM Pond.

Appendix D

Development Servicing Study Checklist

4. Development Servicing Study Checklist

The following section describes the checklist of the required content of servicing studies. It is expected that the proponent will address each one of the following items for the study to be deemed complete and ready for review by City of Ottawa Infrastructure Approvals staff.

The level of required detail in the Servicing Study will increase depending on the type of application. For example, for Official Plan amendments and re-zoning applications, the main issues will be to determine the capacity requirements for the proposed change in land use and confirm this against the existing capacity constraint, and to define the solutions, phasing of works and the financing of works to address the capacity constraint. For subdivisions and site plans, the above will be required with additional detailed information supporting the servicing within the development boundary.

4.1 General Content

☐ Executive Summary (for larger reports only).

☒ Date and revision number of the report.

☒ Location map and plan showing municipal address, boundary, and layout of proposed development.

☒ Plan showing the site and location of all existing services.

☒ Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.

☒ Summary of Pre-consultation Meetings with City and other approval agencies.

☒ Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.

☒ Statement of objectives and servicing criteria.

☒ Identification of existing and proposed infrastructure available in the immediate area.

☐ Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).

☒ Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.

☐ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.

☐ Proposed phasing of the development, if applicable.

☐ Reference to geotechnical studies and recommendations concerning servicing.

☒ All preliminary and formal site plan submissions should have the following information:

- Metric scale
- North arrow (including construction North)
- Key plan
- Name and contact information of applicant and property owner
- Property limits including bearings and dimensions
- Existing and proposed structures and parking areas
- Easements, road widening and rights-of-way
- Adjacent street names

4.2 Development Servicing Report: Water

☐ Confirm consistency with Master Servicing Study, if available

☒ Availability of public infrastructure to service proposed development

☐ Identification of system constraints

☐ Identify boundary conditions

☐ Confirmation of adequate domestic supply and pressure

☐ Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.

☐ Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.

☐ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design

☐ Address reliability requirements such as appropriate location of shut-off valves

☐ Check on the necessity of a pressure zone boundary modification.

☐ Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range

☐ Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.

☐ Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.

☐ Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.

☐ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

4.3 Development Servicing Report: Wastewater

☒ Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).

☐ Confirm consistency with Master Servicing Study and/or justifications for deviations.

☐ Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.

☒ Description of existing sanitary sewer available for discharge of wastewater from proposed development.

☐ Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)

☒ Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix ‘C’) format.

☒ Description of proposed sewer network including sewers, pumping stations, and forcemains.

- ☐ Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).
- ☐ Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.
- ☐ Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.
- ☐ Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.
- ☐ Special considerations such as contamination, corrosive environment etc.

4.4 Development Servicing Report: Stormwater Checklist

- ☐ Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)
- ☐ Analysis of available capacity in existing public infrastructure.
- ☒ A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.
- ☒ Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.
- ☒ Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.
- ☒ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.
- ☐ Set-back from private sewage disposal systems.
- ☐ Watercourse and hazard lands setbacks.
- ☒ Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.
- ☐ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

- ☒ Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).
- ☐ Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.
- ☒ Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.
- ☐ Any proposed diversion of drainage catchment areas from one outlet to another.
- ☐ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.
- ☐ If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.
- ☐ Identification of potential impacts to receiving watercourses
- ☐ Identification of municipal drains and related approval requirements.
- ☒ Descriptions of how the conveyance and storage capacity will be achieved for the development.
- ☒ 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.
- ☐ Inclusion of hydraulic analysis including hydraulic grade line elevations.
- ☒ Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.
- ☐ Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.
- ☐ Identification of fill constraints related to floodplain and geotechnical investigation.

4.5 Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

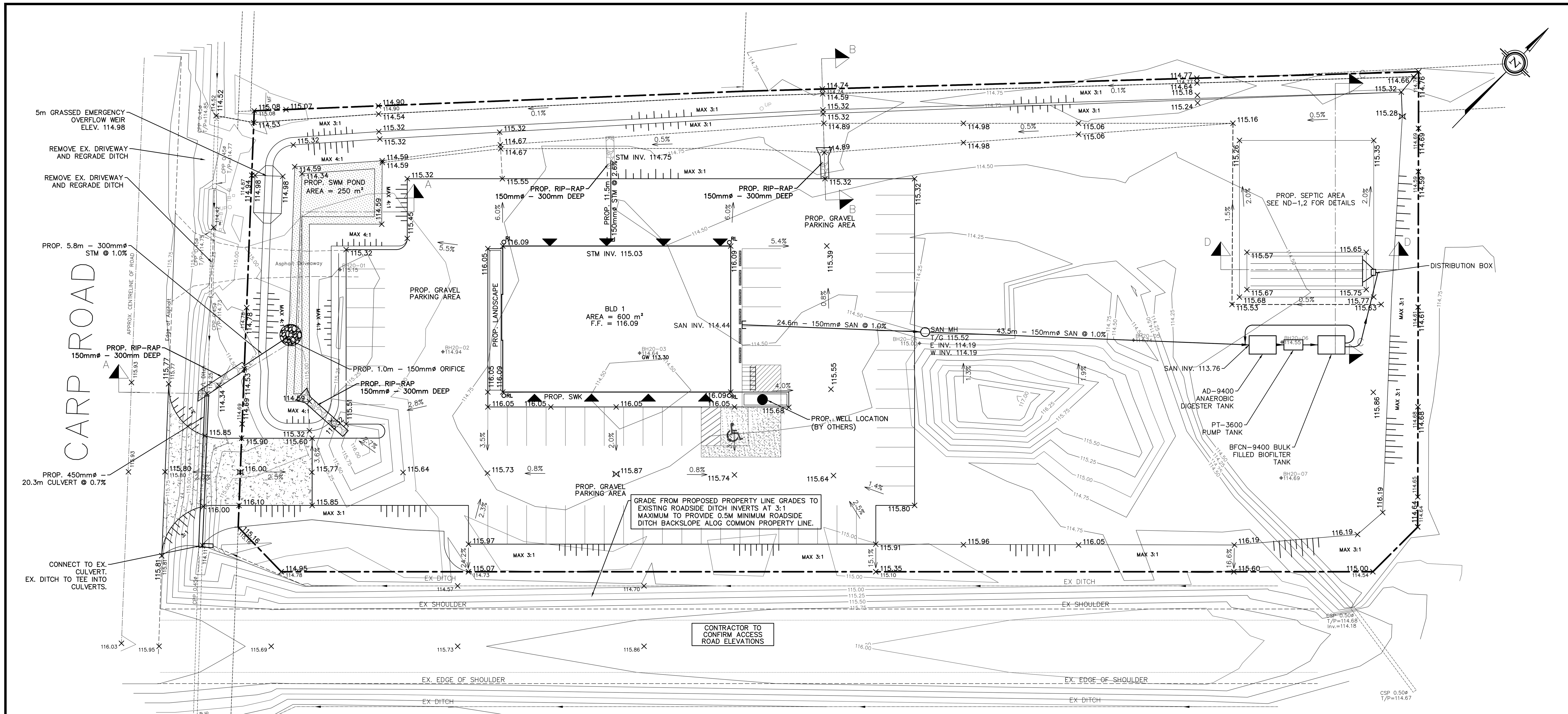
- [ ] Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.
- [ ] Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.
- [ ] Changes to Municipal Drains.
- [ ] Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

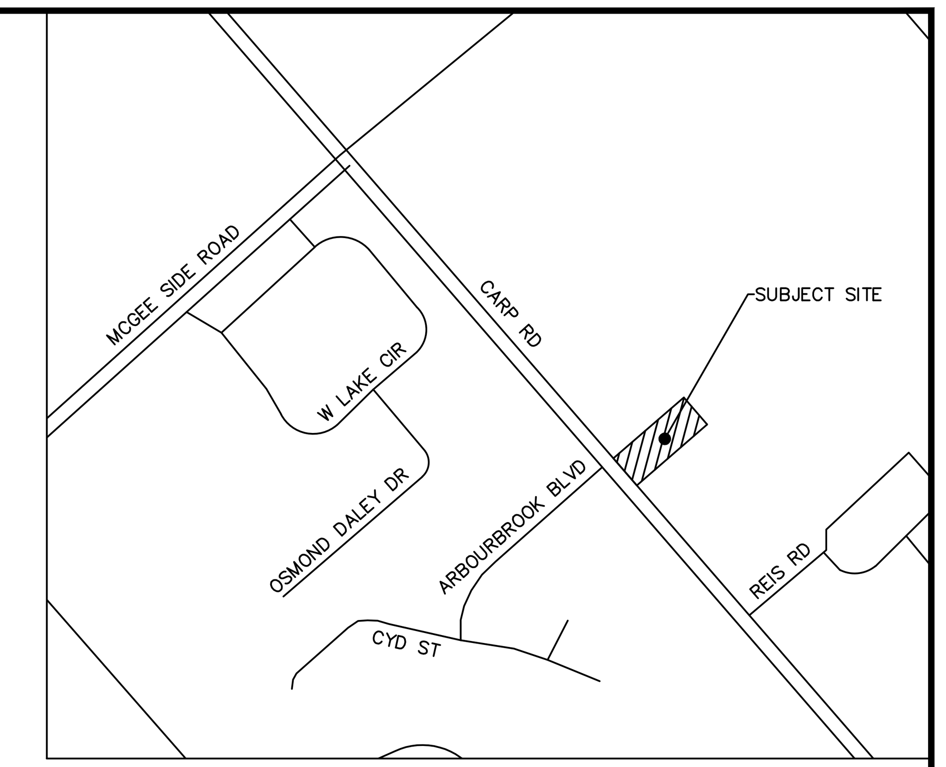
4.6 Conclusion Checklist

- [x] Clearly stated conclusions and recommendations
- [ ] Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.
- [x] All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

Appendix E

Pearson Engineering Drawings

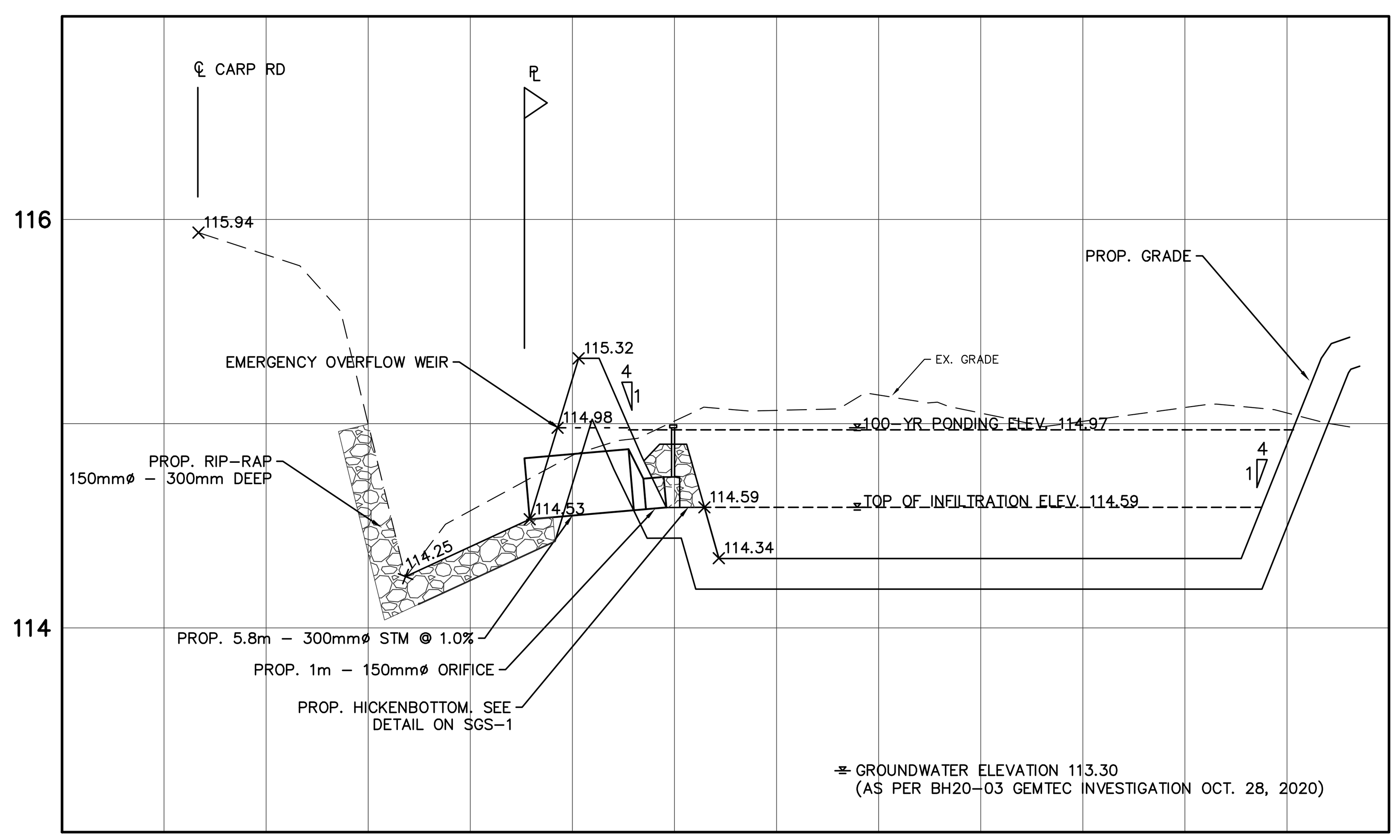




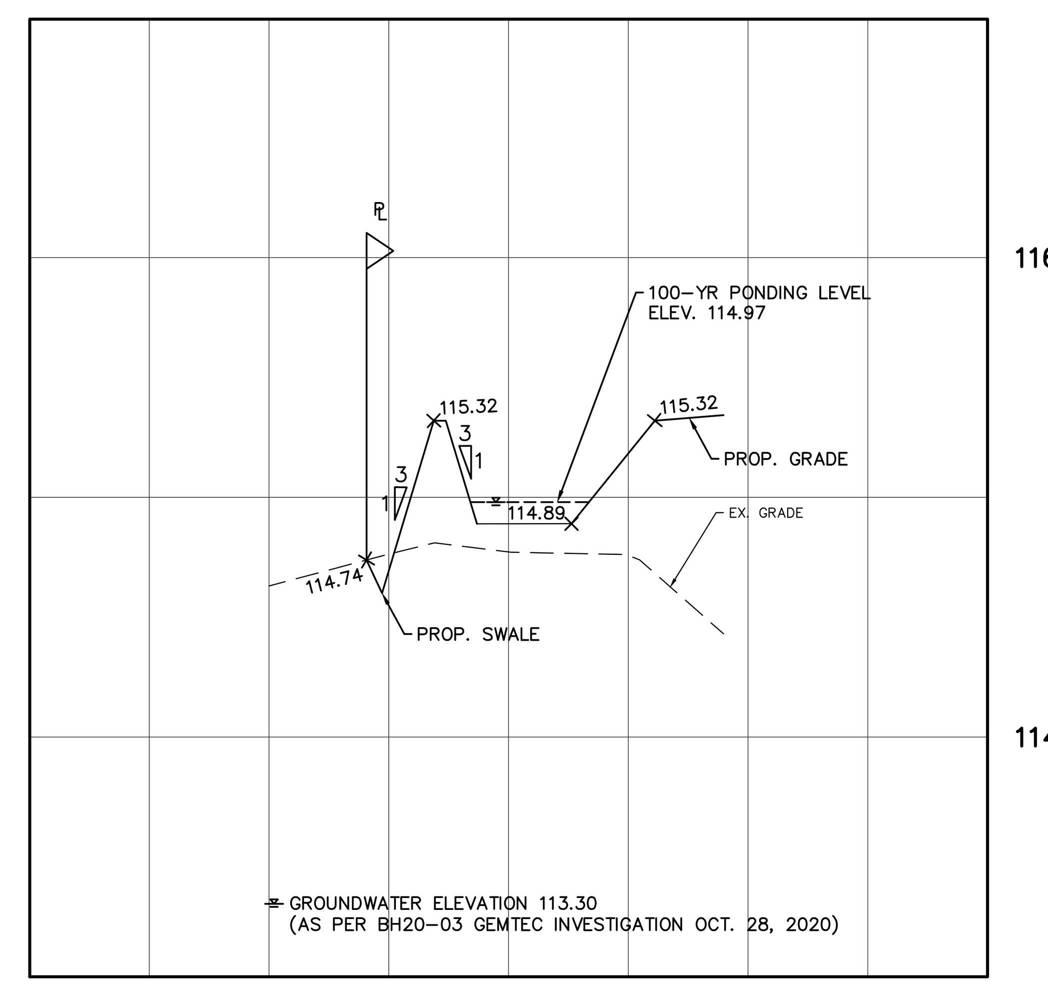
KEY MAP N.T.S

LEGEND

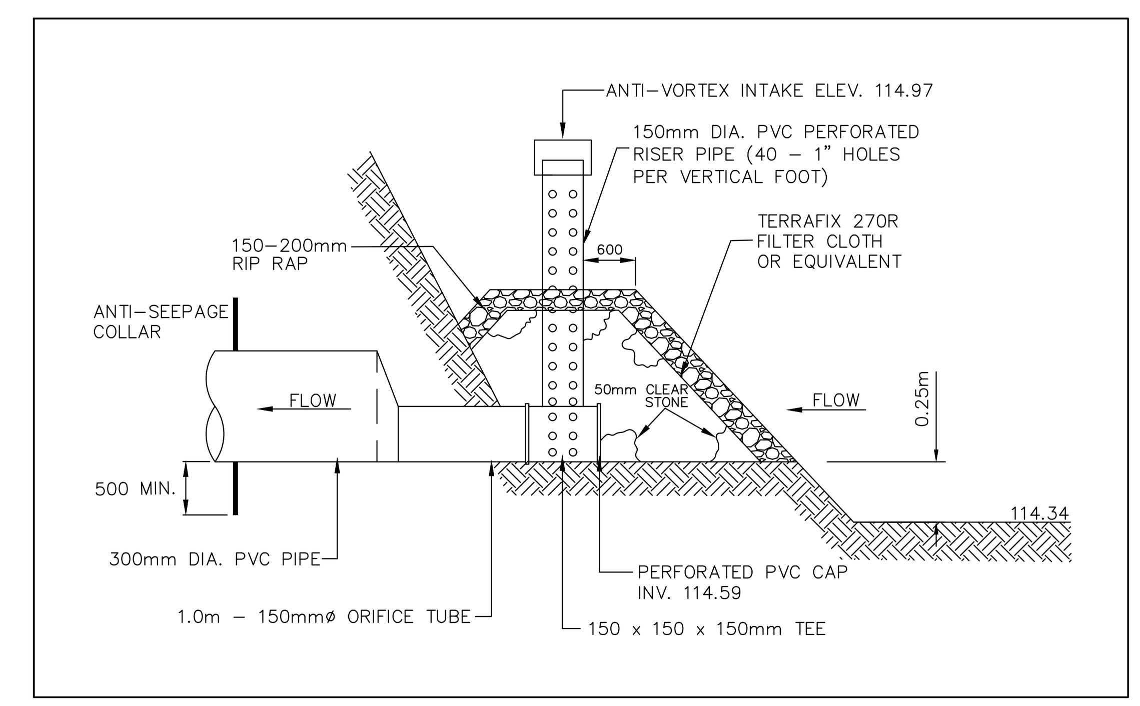
MH	SANITARY MANHOLE
254.63 / 254.09	PROPOSED ELEVATION / EXISTING ELEVATION
1.5%	PROPOSED DIRECTION AND GRADE
) (	HIGH POINT
BH20-1 / 115.00 / GW 113.30	BORE HOLE NUMBER / EX. GROUND ELEVATION / GROUNDWATER ELEVATION
	INFILTRATION AREA
	EXTENT OF ASPHALT DRIVEWAY
RL	ROOF LEADER c/w SPLASH PAD



SECTION A–A
HORIZONTAL SCALE 1:250
VERTICAL SCALE 1:50



SECTION B–B
HORIZONTAL SCALE 1:250
VERTICAL SCALE 1:50



HICKENBOTTOM DETAIL
N.T.S.

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BENCHMARK

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BEARINGS ARE GRID, DERIVED FROM THE SOUTHWESTERLY LIMIT OF PART 1 PLAN 4R-30382 SHOWN TO BE N41°38'40"W THERON AND ARE REFERRED TO THE CENTRAL MERIDIAN OF MTM ZONE 9 (76°30' WEST LONGITUDE) NAD-83 (ORIGINAL)

LICENSED PROFESSIONAL ENGINEER G. M. PEARSON 100081986 06/16/22 PROVINCE OF ONTARIO

MULTI-TENANT COMMERCIAL BLDGS
2822 CARP ROAD
CITY OF OTTAWA

GRADING AND SERVICING PLAN

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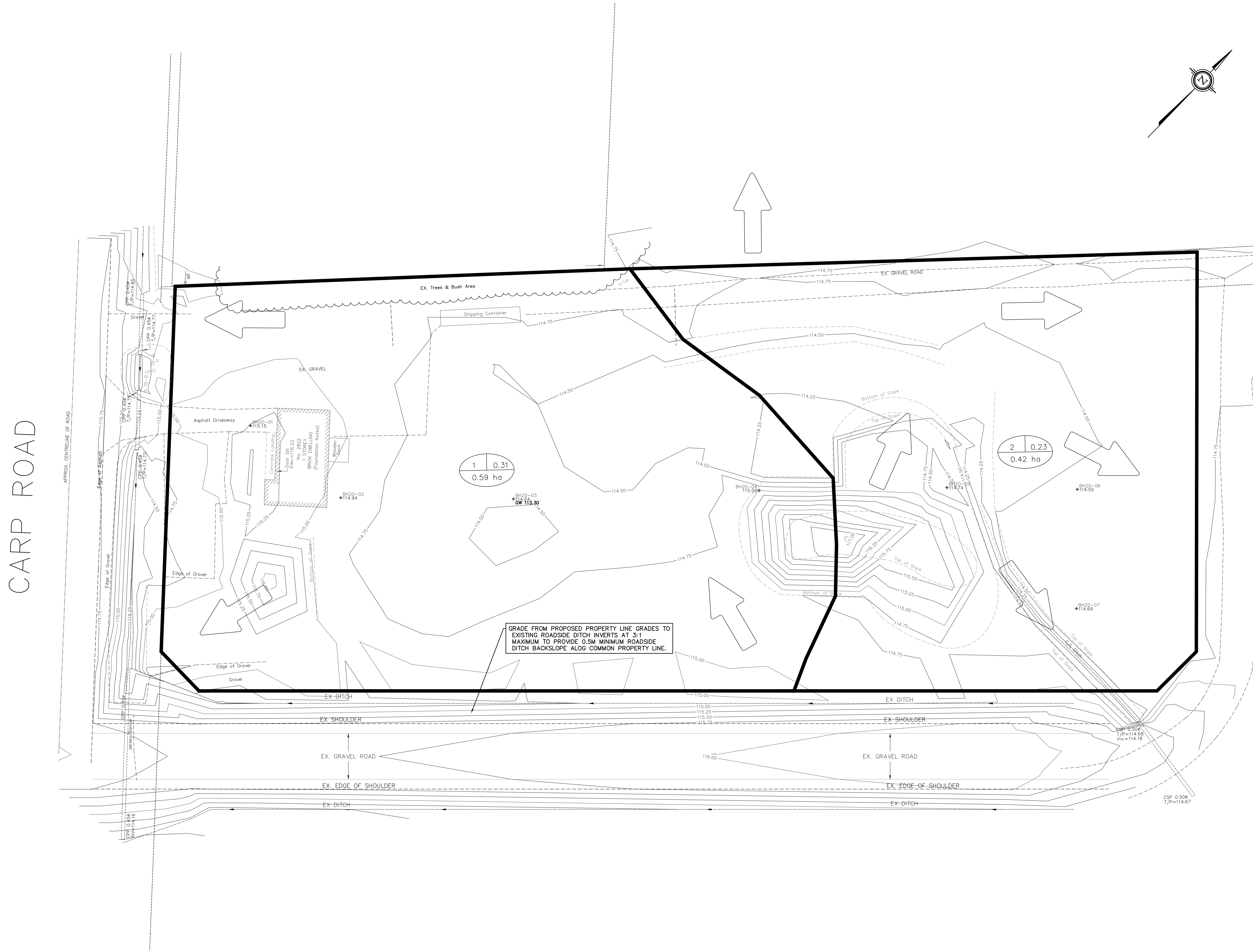

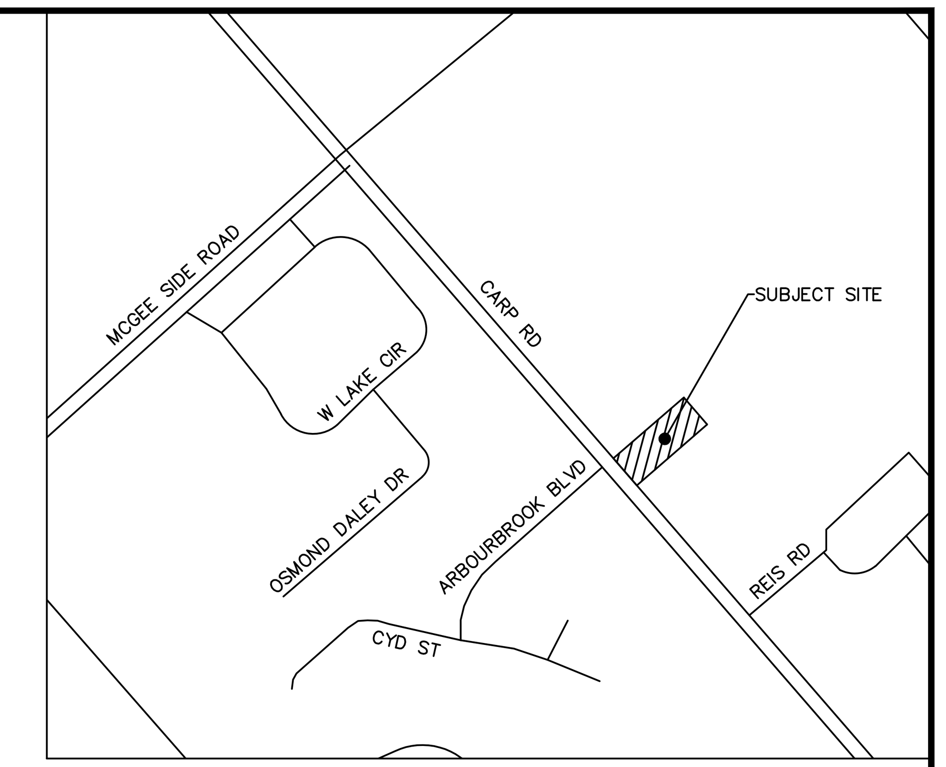

KEY MAP N.T.S

LEGEND

OVERLAND FLOW DIRECTION

CATCHMENT AREA | 1 | 0.75 | RUNOFF COEFFICIENT
1.00 ha — AREA IN HECTARES

CATCHMENT BOUNDARY

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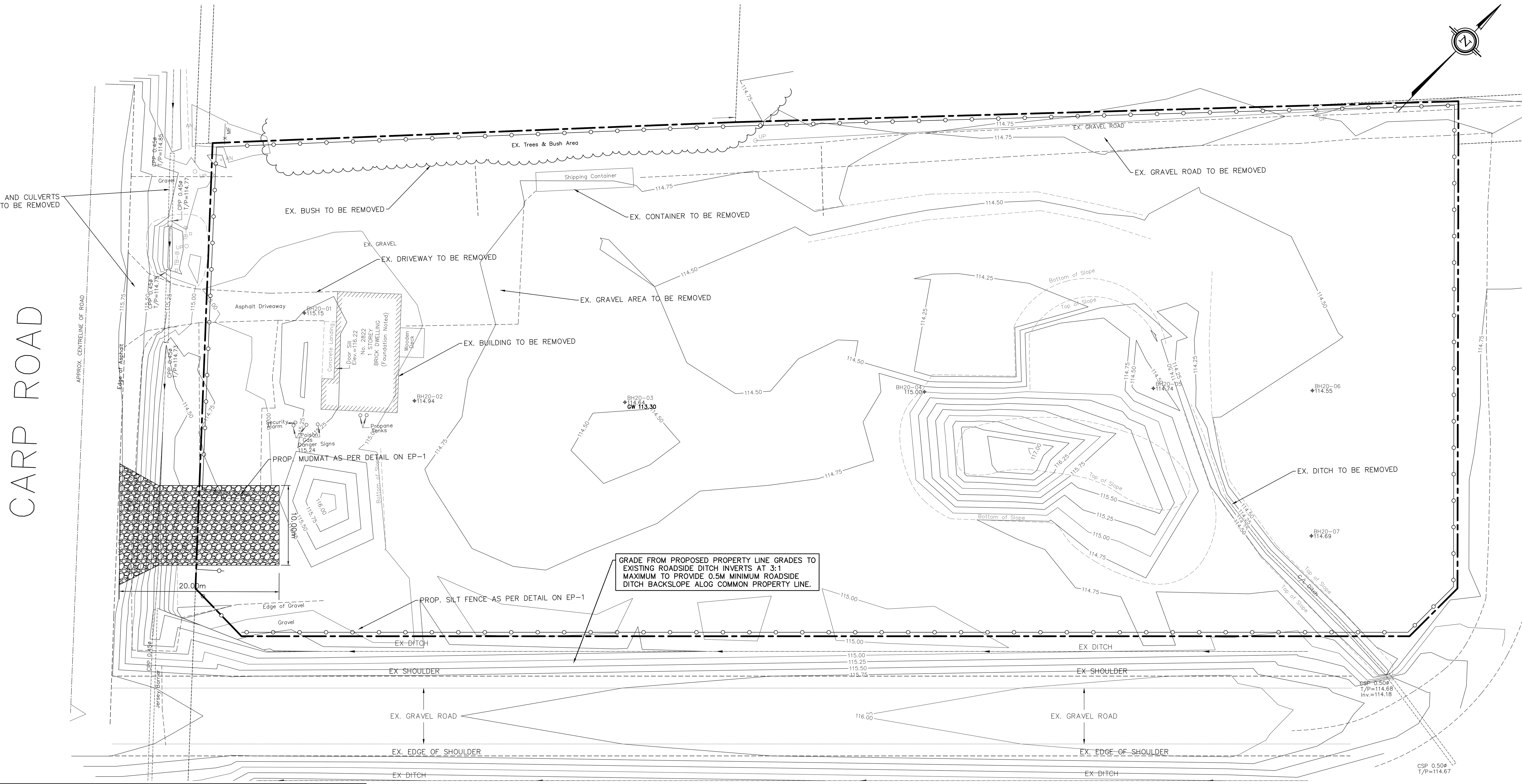
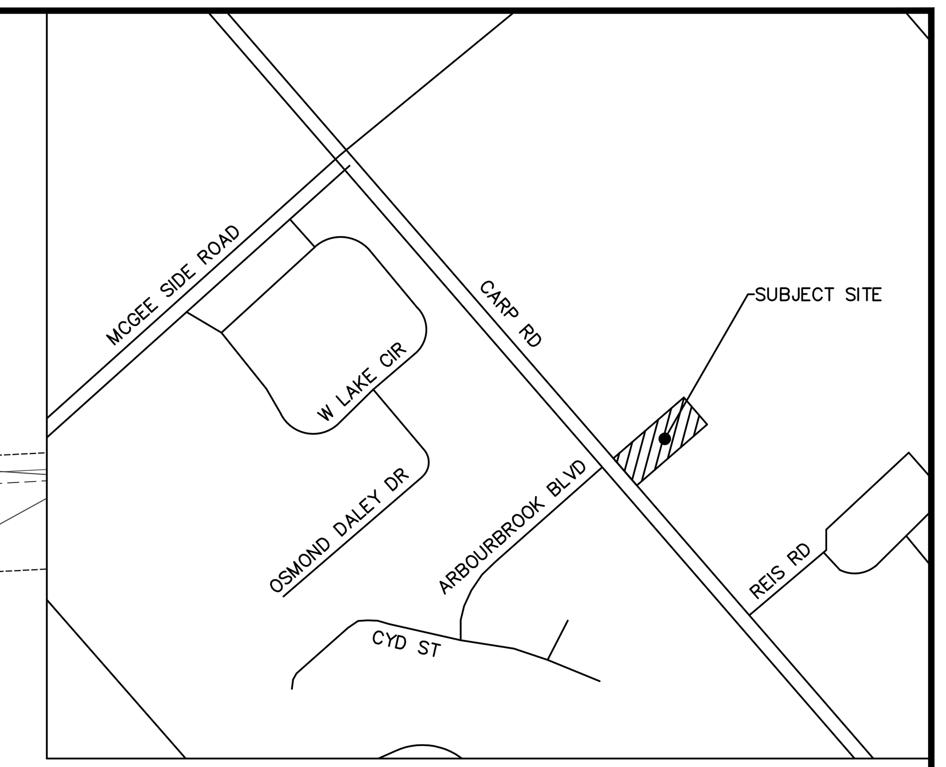
CHECKED BY	GMP	DATE	SEPTEMBER 2020	REVISION #	2





KEY MAP N.T.S

LEGEND

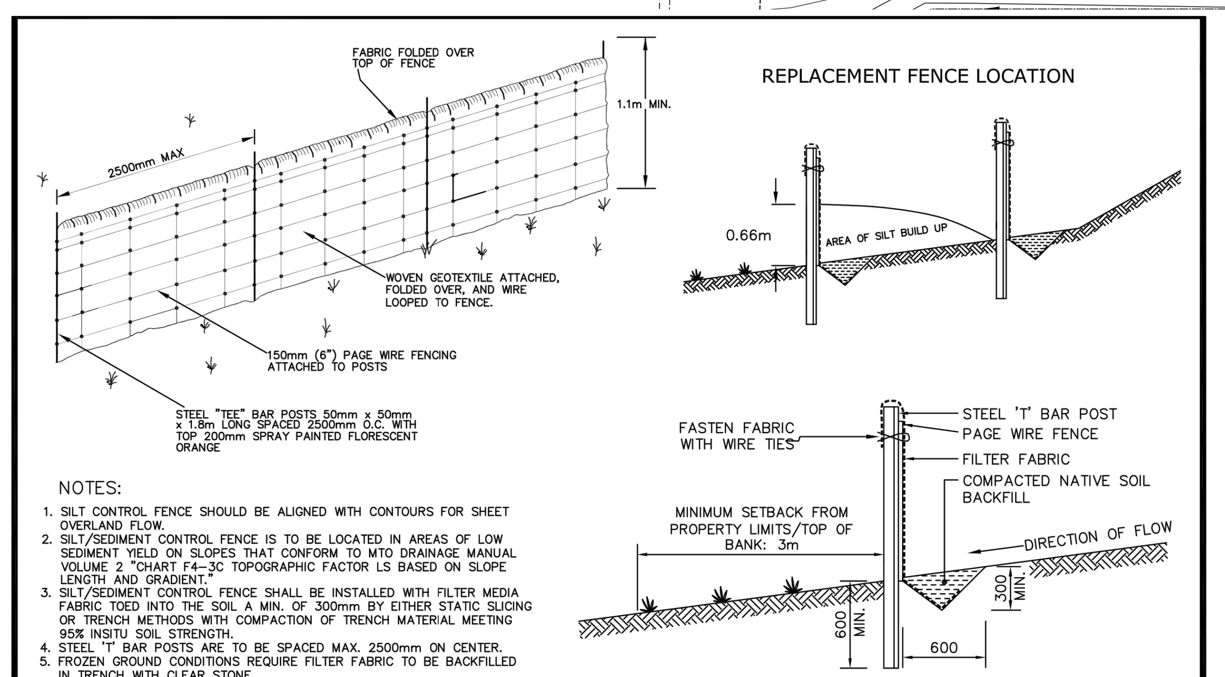
SILT FENCE

NOTES FOR SEDIMENT & EROSION CONTROL

1. DISTURBED AREAS THAT HAVE FAILED TO HAVE STABLE GROUND COVER ESTABLISHED BY OCTOBER 30TH SHALL BE PROTECTED WITH A SILTATION CONTROL FENCE OR STRAW MULCH ETC. AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION BECOMES ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
2. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30m FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE ADMINISTRATOR.
3. SILT FENCE SHALL BE PUT IN PLACE PRIOR TO AND MAINTAINED DURING ALL GRADING. SILT FENCE TO BE INSPECTED PRIOR TO COMMENCEMENT OF EARTH GRADING ACTIVITIES. SILT FENCE TO BE INSPECTED AND REPAIRED OR REPLACED IF DAMAGED AS DIRECTED BY THE SITE ADMINISTRATOR.SILT CONTROLS TO BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAIN EVENT. INSTALLATION SHALL BE TO THE MANUFACTURER'S RECOMMENDED SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE A WEEK, AND AFTER EVERY RAINFALL EVENT.
6. CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 577, CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AS WELL AS ALL APPLICABLE MUNICIPAL STANDARDS.
7. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES. SUCH MEASURES SHOULD BE PRESENTED IN WRITING FOR APPROVAL OF THE SITE ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE MUNICIPALITY AND CONSERVATION AUTHORITY.
8. THE TOPS OF ALL FILTER FABRIC MUST BE A MINIMUM OF 1.0 METRE ABOVE THE GROUND LEVEL AND ATTACHED TO THE FENCE WITH A CONTINUOUS STEEL WIRE. ALTERNATIVELY, THE FILTER FABRIC MUST BE FOLDED OVER THE TOP OF THE FENCE AND ATTACHED TO THE FENCE WITH WIRE LOOPED THROUGH THE FABRIC ON BOTH SIDES OF THE FENCE. FILTER FABRIC IS TO BE TERRAFIX 270R OR EQUIVALENT.
9. ALL DISTURBED GROUND LEFT FOR MORE THAN 30 DAYS SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, OR COVERING OR OTHER EQUIVALENT CONTROL MEASURES. THIS PERIOD OF INACTIVITY SHALL BE AT THE DISCRETION OF THE CITY OF OTTAWA'S MANAGER OF ENGINEERING BUT SHALL NOT EXCEED THIRTY DAYS OR SUCH LONGER PERIOD DEEMED ADVISABLE BY THE CITY OF OTTAWA'S MANAGER OF ENGINEERING.
10. CONTRACTOR RESPONSIBLE FOR MUD TRACKING, PREVENTION, AND MAINTENANCE ON CARP ROAD.
11. ROADS TO BE LEFT IN A BROOM SWEPT CONDITION AT THE END OF EACH WORK DAY.

SEQUENCE OF CONSTRUCTION

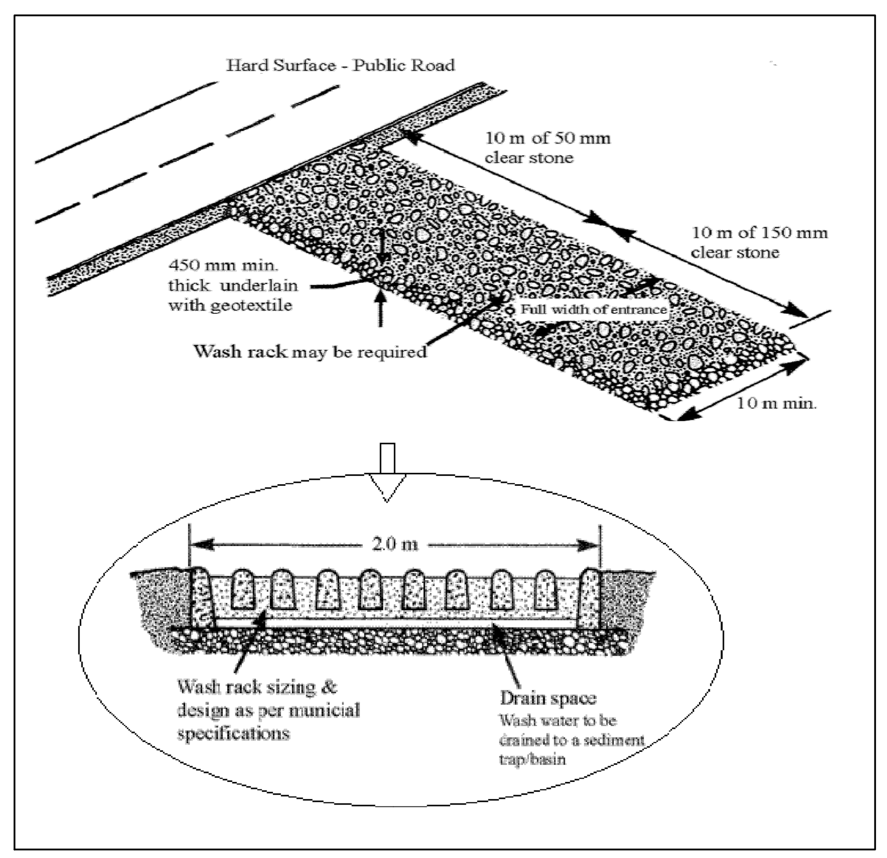
1. ENGINEER TO BE NOTIFIED PRIOR TO INITIATION OF ANY ON SITE WORKS.
2. SILT FENCE AS PER DETAIL FOUND ON EP–1. CONSTRUCTION ACCESS MATS AS PER DETAIL FOUND ON EP–1 AND ARE TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY WORKS ONSITE.
3. VEGETATION REMOVAL MAY COMMENCE AFTER ALL SILT FENCE IS INSTALLED AND APPROVED BY THE ENGINEER.
4. COMMENCE WITH EARTH WORKS AND SITE SERVICING.
5. INSTALLATION OF PROPOSED INFILTRATION FACILITIES AT THE TIME OF LANDSCAPING WORKS.
6. EROSION CONTROL MEASURES TO BE MAINTAINED AS DIRECTED BY THE ENGINEER DURING THE CONSTRUCTION PERIOD. ADDITIONAL CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
7. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED WITH SEED, SOD, MULCH OR OTHER ADEQUATE COVERING, AS INSTRUCTED BY THE ENGINEER.



NOTES:

1. SILT CONTROL FENCE SHOULD BE ALIGNED WITH CONTOURS FOR SHEET OVERLAND FLOW.
2. SILT/SEDIMENT CONTROL FENCE IS TO BE LOCATED IN AREAS OF LOW SEDIMENT YIELD ON SLOPES THAT CONFORM TO MTO DRAINAGE MANUAL VOLUME 2 "CHART F4–3C TOPOGRAPHIC FACTOR LS BASED ON SLOPE LENGTH AND GRADIENT."
3. SILT/SEDIMENT CONTROL FENCE SHALL BE INSTALLED WITH FILTER MEDIA FABRIC TOED INTO THE SOIL A MIN. OF 300mm BY EITHER STATIC SLICING OR TRENCH METHODS WITH COMPACTION OF TRENCH MATERIAL MEETING 95% INSITU SOIL STRENGTH.
4. STEEL 'T' BAR POSTS ARE TO BE SPACED MAX. 2500mm ON CENTER.
5. FROZEN GROUND CONDITIONS REQUIRE FILTER FABRIC TO BE BACKFILLED IN TRENCH WITH CLEAR STONE.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
7. GEOTEXTILE FABRIC TO BE COMPRISED OF WOVEN OR NON–WOVEN U.V. STABILIZED MATERIAL. FABRIC TO BE FOLDED OVER TOP OF FENCE MIN. 300mm AND WIRE FASTENED.

TYPICAL DETAIL OF SILT/SEDIMENT FENCE	NO.	REVISION	APR'D	DATE
APR'D:	DATE: 03.03.06	DRAWN: A.S.C	SCALE: NTS	



MUD MAT DETAIL N.T.S.

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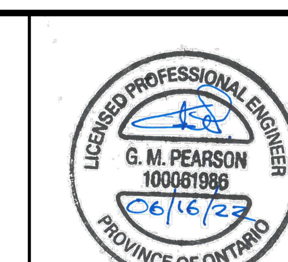

MULTI–TENANT COMMERCIAL BLDGS
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CITY OF OTTAWA

EROSION AND REMOVALS PLAN

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