Functional Servicing and Stormwater Management Report Centre Wellington Operations Centre

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April 2023
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PROVINCE OF ONTARIO

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1.0 Introduction and Background

R.J. Burnside & Associates Limited (Burnside) has been retained by the Township of Centre Wellington (the Township) to prepare a Functional Servicing Report and Stormwater Management (SWM) Report for the proposed Operations Centre located at 965 Gartshore Street, Fergus. This report is in support of the proposed Official Plan Amendment (OPA) and Zoning By-Law Amendment (ZBA), demonstrating that the subject lands can be developed in accordance with regulatory requirements and criteria.

The purpose of this report is to:

- Evaluate the existing municipal water system, including:
  - Calculate the proposed domestic water and firefighting supply needs.
  - Confirm that it has adequate flow to meet the additional required domestic and fire flow demands for the proposed development.
- Evaluate on a preliminary basis the SWM opportunities and constraints, including:
  - Calculate allowable and proposed runoff rates for the development.
  - Evaluate suitable methods for attenuation and treatment of stormwater runoff.
  - Develop and propose onsite control measures and examine theoretical performance.
  - Demonstrate compliance of the proposed stormwater control measures with the Centre Wellington Development Manual (Draft 2018).
- Identify sanitary servicing opportunities and constraints, including:
  - Calculate existing and proposed sanitary flows.
  - Evaluate the feasibility of connection to municipal infrastructure.

1.1 Background Studies and Documentation

The following documents, studies, and reports have been reviewed by Burnside and incorporated into this report:

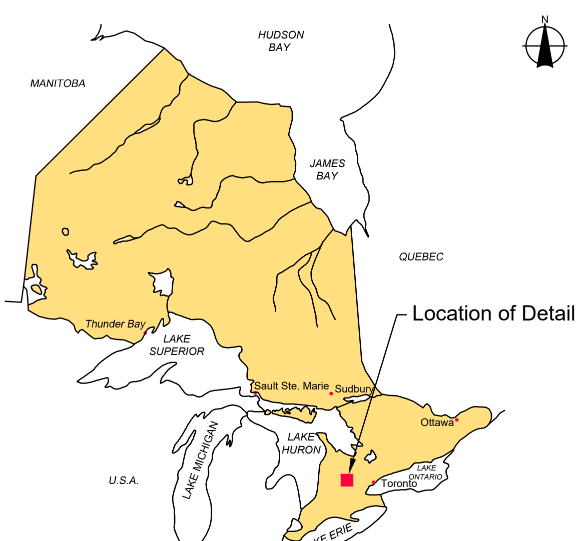
Table 1: Supporting Documents

Document Title	Prepared By	Date
Arborist Report	R.J. Burnside & Associates Ltd.	February 2023
Stage 1 Archaeological Assessment	Archaeological Research Associates Ltd.	October 17, 2022
Building Condition Assessment	R.J. Burnside & Associates Ltd.	November 17, 2022
Designated Substances and Hazardous Materials Survey	R.J. Burnside & Associates Ltd.	January 30, 2023

Environmental Impact Study	R.J. Burnside & Associates Ltd.	February 3, 2023
Preliminary Geotechnical Investigation	JLP Services Inc.	December 19, 2022
Hydrogeological Study	R.J. Burnside & Associates Ltd.	February 2023
Plan of Survey	Callon Dietz	September 12, 2022
Transportation Study	R.J. Burnside & Associates Ltd.	November 2022

1.2 Site Description

The subject site is a 8.426 ha parcel of land located within the Township of Centre Wellington former geographic Township of Nichol. Referring to true north, the site sits just northwest of the Town of Fergus boundary on Gartshore Street occupying concession 16 part lots 17 and 18. The site is bound by Gartshore Street to the northeast, agricultural lands directly west and southwest, Harper Crescent Park to the southeast, a municipal well directly north, and the municipal water tower directly south. Within the subject property is a single-family farmhouse with various secondary structures associated with current farming practices. The house is proposed to be repurposed and used within the proposed development. Figure 1 below shows the site location.



KEY MAP OF ONTARIO

BURNSIDE

Client

TOWNSHIP OF CENTRE WELLINGTON

Figure Title

CENTRE WELLINGTON OPERATIONS CENTRE

SITE LOCATION PLAN

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JR	FG	23/02/03	1
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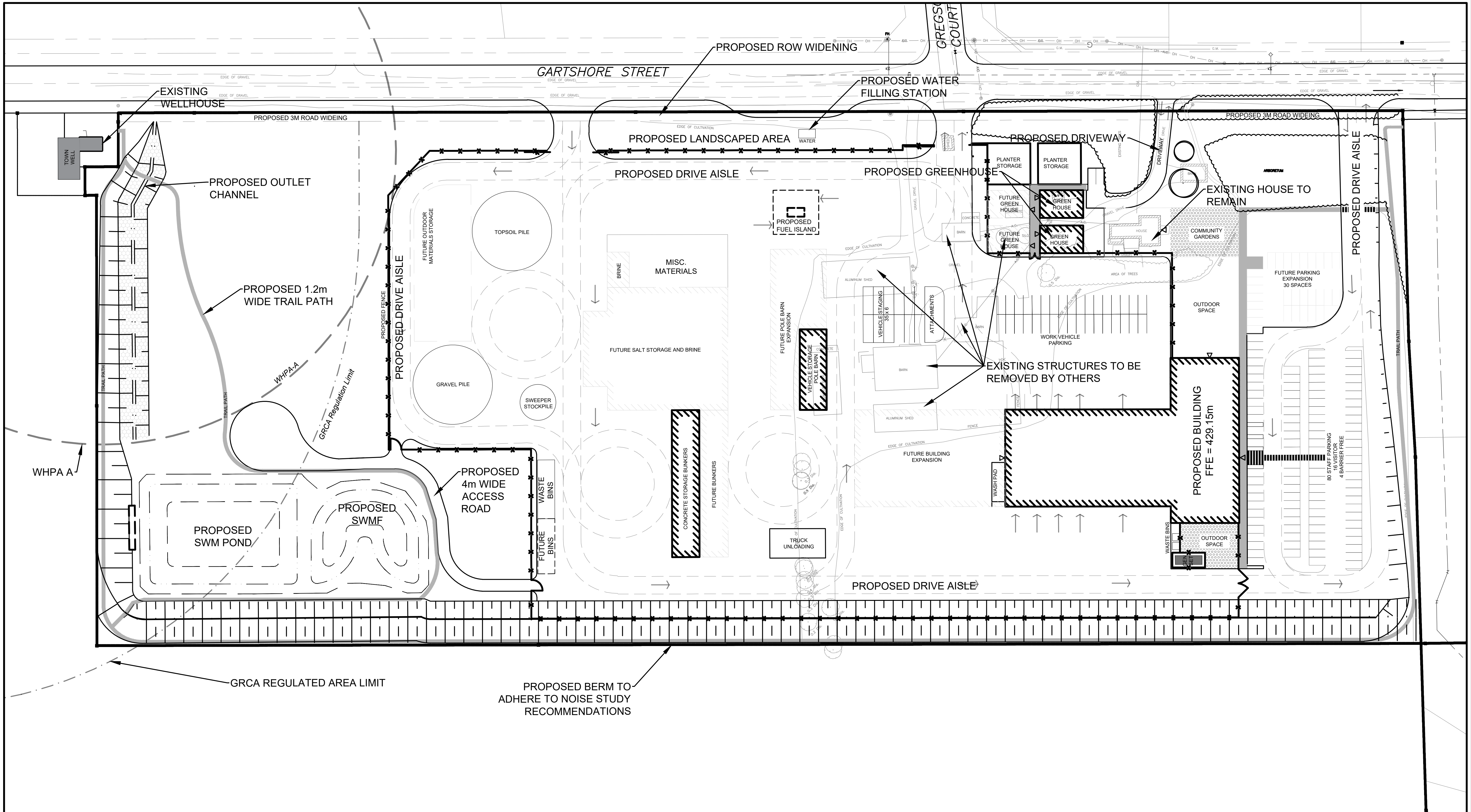
File: \\sherlock\shared work areas\055234 centre wellington operations ctr\07_Figures\055234 FIG1 SITE LOCATION PLAN.dwg Date Plotted: April 17, 2023 - 9:28 AM

1.3 Proposed Development

The project proposes an Operations Centre for the Township of Centre Wellington. The project is proposed to occur in two phases. The operations building will include a phase one gross floor area (GFA) of 3,560 m^2 (38,321 ft^2). It also contains a 250 m^2 (2,702 ft^2) vehicle storage, pole barn and a two 149 m^2 (1,603 ft^2) greenhouses. Phase 2 includes 1,476 m^2 (15,888 ft^2) of additional GFA in the operations building as well as a 1,951 m^2 (21,000 ft^2) salt and storage building including interior loading. Phase 2 will also include an additional 219 m^2 (2,357 ft^2) of GFA to the operations building, and two additional greenhouses with 149 m^2 (1,603 ft^2) of GFA directly adjacent to the primary greenhouse will be considered.

There are four proposed entrances to the site, which are all located along Gartshore Street. The north end of the site is within the Grand River Conservation Authority's (GRCA) regulation limit. The subject property is located in a wellhead protection area (WHPA). A WHPA is the area around a wellhead that contributes source water to a drinking water system. A WHPA shows where the groundwater is coming from to source the water system, and how fast it is getting there. A WHPA-A is a 100 m radius around the wellhead and a WHPA-B is an area where water and any contaminants that may be present can reach the well within 2-5 years. The northeast corner of the site intersects with the WHPA-A while the remainder of the property is within a WHPA-B.

Figure 2 below shows the proposed site plan.



LEGEND

- SITE BOUNDARY
- PROPERTY LINE
- PROPOSED BUILDING

BURNSIDE

Figure Title
CENTRE WELLINGTON OPERATIONS CENTRE
PROPOSED SITE PLAN

Client
TOWNSHIP OF CENTRE WELLINGTON

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JR	AB	23/02/03	2
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2.0 Water Servicing

2.1 Existing Water Supply

Based on as-built drawings provided by the Township, the site has an existing 300 mm dia. PVC watermain along Gartshore Street. Fergus's water tower borders the property on the southeast corner. The existing farmhouse is serviced from the Gartshore Street watermain.

2.2 Proposed Water Supply

The proposed Operations Centre containing offices and maintenance facilities will require new service connections for both domestic and fire use. The proposed greenhouse and water filling station will also require a domestic connection. The proposed water service connection configuration will be as per Township of Centre Wellington's standards. The water service was designed to account for the full build out size of the facility and the future uses within phase 2. A 150 mm diameter fire service is proposed to connect to the existing 300 mm diameter watermain along Gartshore Street with a 100 mm diameter domestic service split off the main service connection. Both fire and domestic watermain connections will be equipped with a valve and box at the property line. The 150 mm diameter fire connection will be equipped with a detector check assembly in the building. The 100 mm diameter domestic connection will enter a 3000 mm diameter water meter chamber. Refer to Figure 3 and Drawing S1 for preliminary servicing layout.

2.3 Water Demand

The proposed fire demand for the development was calculated based on the criteria outlined by the Fire Underwriters Survey (FUS) Water Supply for Public Fire Protection (2020). The proposed domestic demands for office space were calculated using the Ontario Building Code's (OBC) guidelines. The guidelines specify an average of 75 L/day/9.3 m^2 of GFA. Further, domestic flows for industrial space and wash bays were calculated using OBC and MOE guidelines. The OBC states 950 L/day per water closet and MOE states 400 L/wash for wash bays.

The anticipated domestic demand for the Site has been calculated to be 0.65 L/s based on the design criteria. The maximum hourly demand peaking factor was assumed to be 3.0 L/s. This was also used in the sanitary calculations. Therefore, this results in a peak domestic demand of 4.18 L/s. See Appendix A for full calculations.

The required fire flow for the development was calculated to be 133.33 L/s (8,000 L/min or 2,114 USGPM). The total required fire flows and domestic demand should be delivered at a pressure no less than 140 kPa (20.3 psi). Hydrant tests to confirm acceptable pressures will be completed following zoning approval.

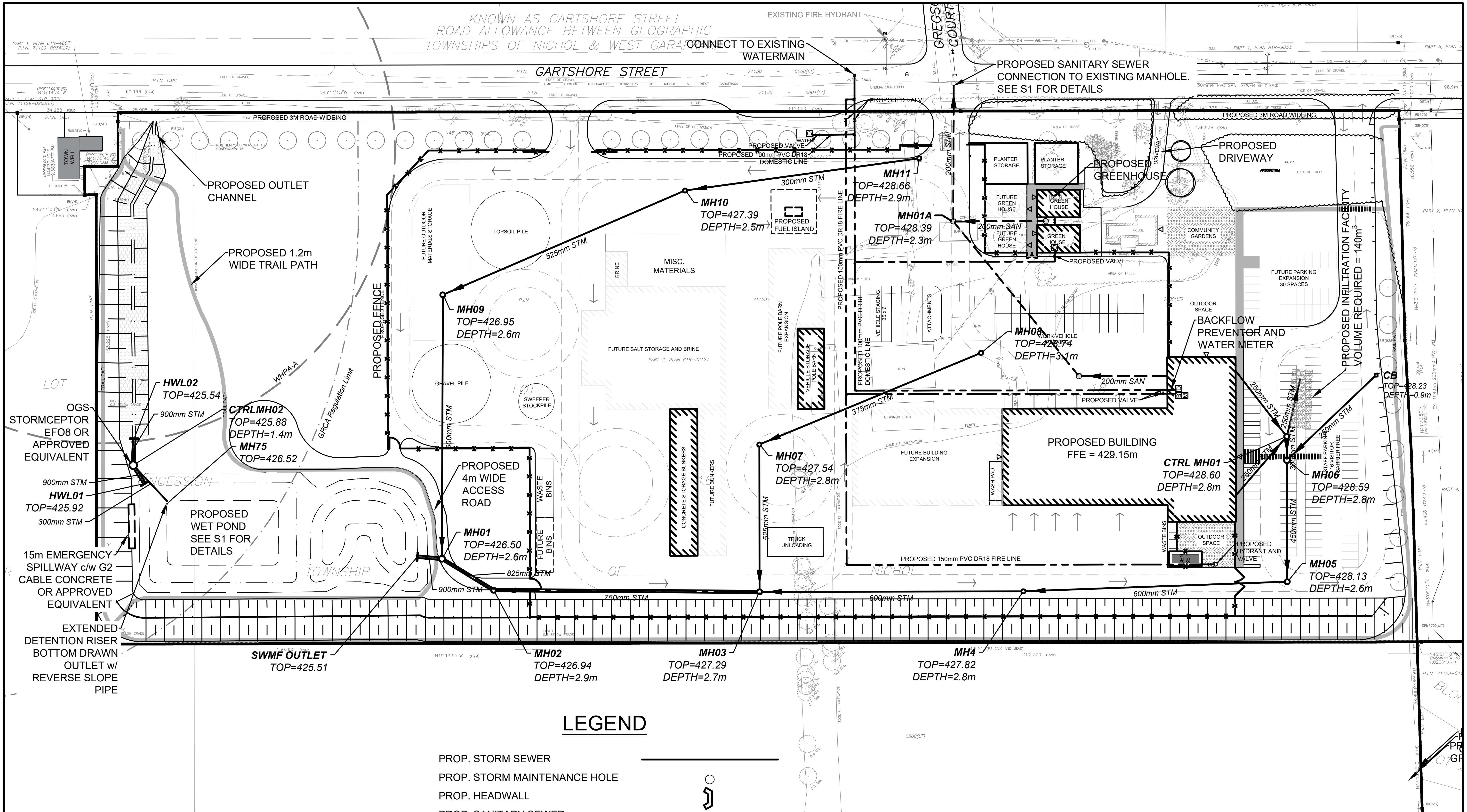
The following criteria were applied during the calculation of fire flows, and will be updated as necessary during detailed design:

- The proposed buildings will be classified as Type II - Noncombustible, with limited combustible contents, and a 15% occupancy reduction has been applied.
- The proposed buildings will be between 10.1m to 20 m from the existing house. A total separation charge of 15% has been applied.

Therefore, the overall combined peak water demand for the site was determined to be 137.51 L/s.

The use of brine on the proposed salt/sand storage building does not require additional calculations for the future water supply. Water connection is not anticipated to be necessary for brine operations in the future.

Refer to Appendix A for complete water demand calculations. Figure 3 displays the proposed servicing for the site.



LEGEND

PROP. STORM SEWER	
PROP. STORM MAINTENANCE HOLE	
PROP. HEADWALL	
PROP. SANITARY SEWER	
PROP. SANITARY MAINTENANCE HOLE	
PROP. WATERMAIN	
PROP. VALVE	
EX. SANITARY MAINTENANCE HOLE	
EX. SANITARY SEWER	
EX. WATERMAIN	
EX. VALVE	WV
EX. HYDRANT	

TRUE NORTH
PROJECT NORTH

0 25 50 75 100
Metres

BURNSIDE

Figure Title
CENTRE WELLINGTON OPERATIONS CENTRE
SERVICING PLAN

Client
TOWNSHIP OF CENTRE WELLINGTON

Drawn	Checked	Date	Figure No.
JR	AB	23/02/03	3
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2.4 Hydrant Coverage

There are 2 existing fire hydrants located within the development's proximity. Both are located along Gartshore Street's right of way. One additional hydrant is proposed to provide sufficient fire coverage within the site. The proposed hydrant will be complete with a valve and boot to satisfy Centre Wellington requirements.

3.0 Sanitary Servicing

3.1 Existing Sanitary Sewer Flow

Based on as-built drawings provided by the Township, there is an existing 250 mm dia. PVC sanitary sewer running within Gartshore Street that can be used to service the site. The sanitary sewer is a gravity system draining to the southwest. The existing sanitary sewer connection from the residence is proposed to remain.

3.2 Proposed Sanitary Servicing

3.2.1 New Connection

One new 200 mm sanitary connection is proposed at the location indicated on the Site Servicing drawing (Drawing S1 included with this report). The proposed connection is the existing sanitary manhole located at the intersection of Gregson Court and Gartshore Street. The private sanitary sewer connection will be provided in accordance with the Municipal Standards noted on the drawing.

The connection will have an inspection manhole located entirely within the site.

3.2.2 Proposed Sanitary Flows

Calculations have been made based on the proposed office and industrial applications of the building. The total peak sanitary flow for the existing site (including infiltration allowance) has been estimated to be 1.25 L/s. The total peak sanitary flow for the proposed development (including infiltration allowance) has been calculated at 5.27 L/s, which represents an increase of 4.02 L/s when compared with the existing peak sanitary flows.

Refer to Appendix B for calculations. Refer to Figure 3 for the proposed servicing layout.

4.0 Grading and Storm Drainage

4.1 Site Grading

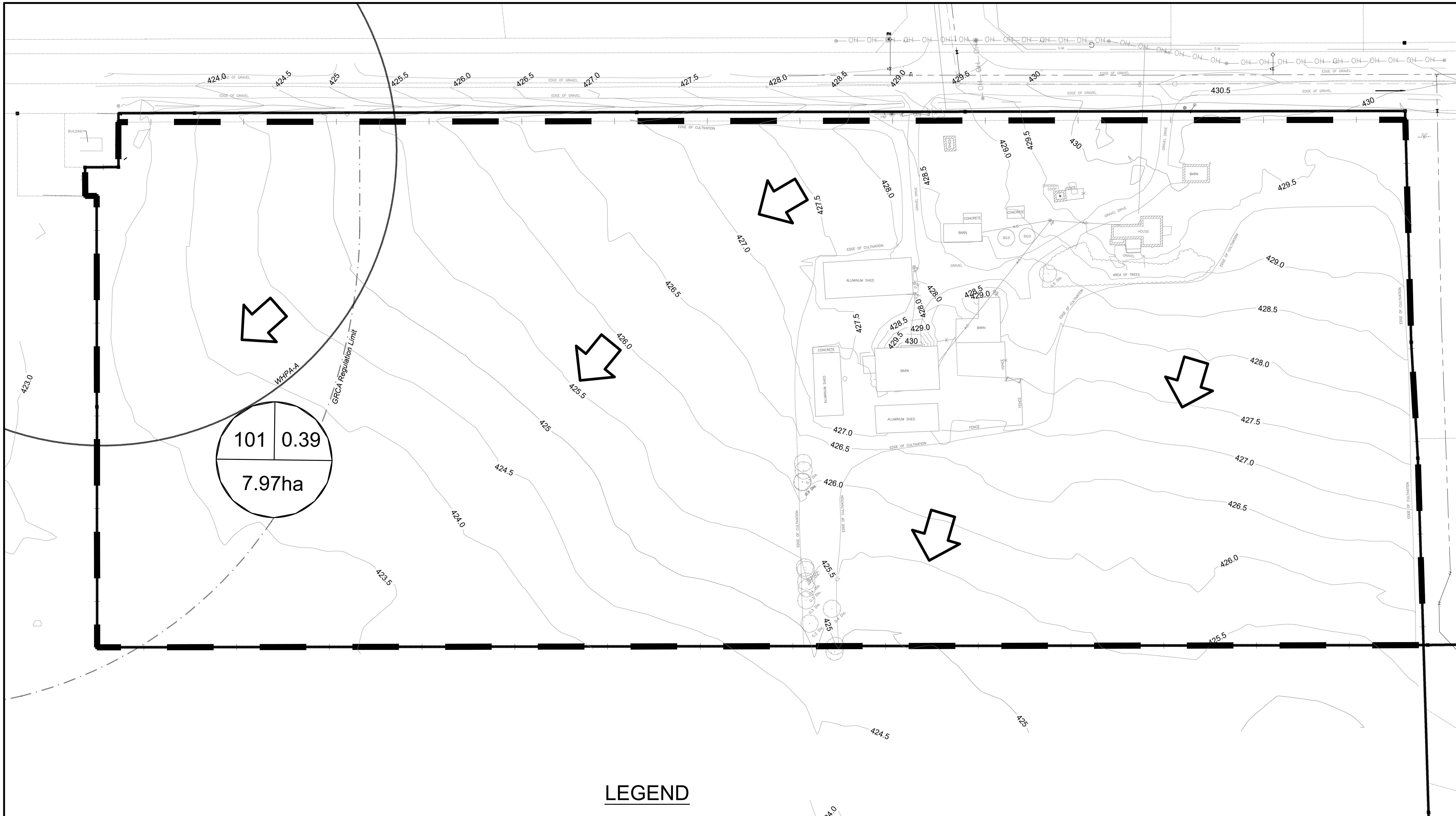
The grading design for this site has been completed in compliance with the following requirements and constraints:

- Matching existing grades along the development boundary as defined by the property boundary.
- Control and conveyance of stormwater within the site and minimization of external runoff.
- Providing major overland flow routes to convey runoff.

4.2 Existing Storm Drainage

The existing site has an overall high point near the northeast corner of the property. The result is that the entire site drains east to west via overland flow to the adjacent agricultural property. There is an overall elevation difference of approximately 3.9 m across the site. External drainage areas are negligible as the road runoff is conveyed by the municipal right of way and adjacent lots are directed away from the site.

The existing site consists of primarily agricultural lands, but also includes a single-family dwelling and several accessory structures that contribute a small amount of impervious area. The site was assumed as one large catchment with an area of 7.97 ha. The Preliminary Geotechnical Investigation completed by JLP Geotechnical and Environmental Consultants, dated December 19, 2022 indicates that the subsurface conditions generally consist of 200-250 mm thick topsoil, followed by discontinuous deposits of sandy silt till and silty sand. Based on Centre Wellington recommended stormwater runoff coefficients and Ontario Ministry of Transportation (MTO) Drainage Manual, design charts were used to calculate the site runoff coefficient of 0.34. The pre-development catchment can be seen within Figure 4**.**



LEGEND

- PROPERTY BOUNDARY
- DRAINAGE BOUNDARY
- OVERLAND FLOW DIRECTION

CATCHMENT No. — 101 | 0.50 — RUNOFF COEFFICIENT

AREA — 10.00ha

TRUE NORTH   PROJECT NORTH

0 25 50 75 100

Metres

BURNSIDE

Figure Title

CENTRE WELLINGTON OPERATIONS CENTRE

EXISTING SITE DRAINAGE CONDITIONS

Client

TOWNSHIP OF CENTRE WELLINGTON

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4.3 Proposed Storm Drainage

The proposed development has several different areas, including the main operations building, paved parking areas, as well as a paved works yard. To control runoff, the proposed development has been designed to collect all impervious and developed areas of the site into a SWM facility located near the west corner of the property. The design will utilize a combination of surface drainage and storm sewers to convey the runoff to the SWM facility.

Two outlet scenarios were explored with township staff: The first was outletting through the WHPA-A area and into the Gartshore roadside ditch with quality control measures in place such as a clay liner along the outlet channel and an oil grit separator (OGS) at the outlet structure. The second was to petition for a municipal drain or explore a mutual drain agreement (under the Drainage Act) with the neighbouring landowner. The second option proved to have more disadvantages than the first including but not limited to:

- The Drainage Act can be a timely process;
- The cost to direct flows across the neighboring lands via an open ditch or closed pipe system would likely all be borne by the Municipality;
- The neighbouring lands, although agricultural at the present time, are zoned for future development. At the time of development would likely require the outlet from the subject property to be re-routed, which would be solely paid for by the municipality.

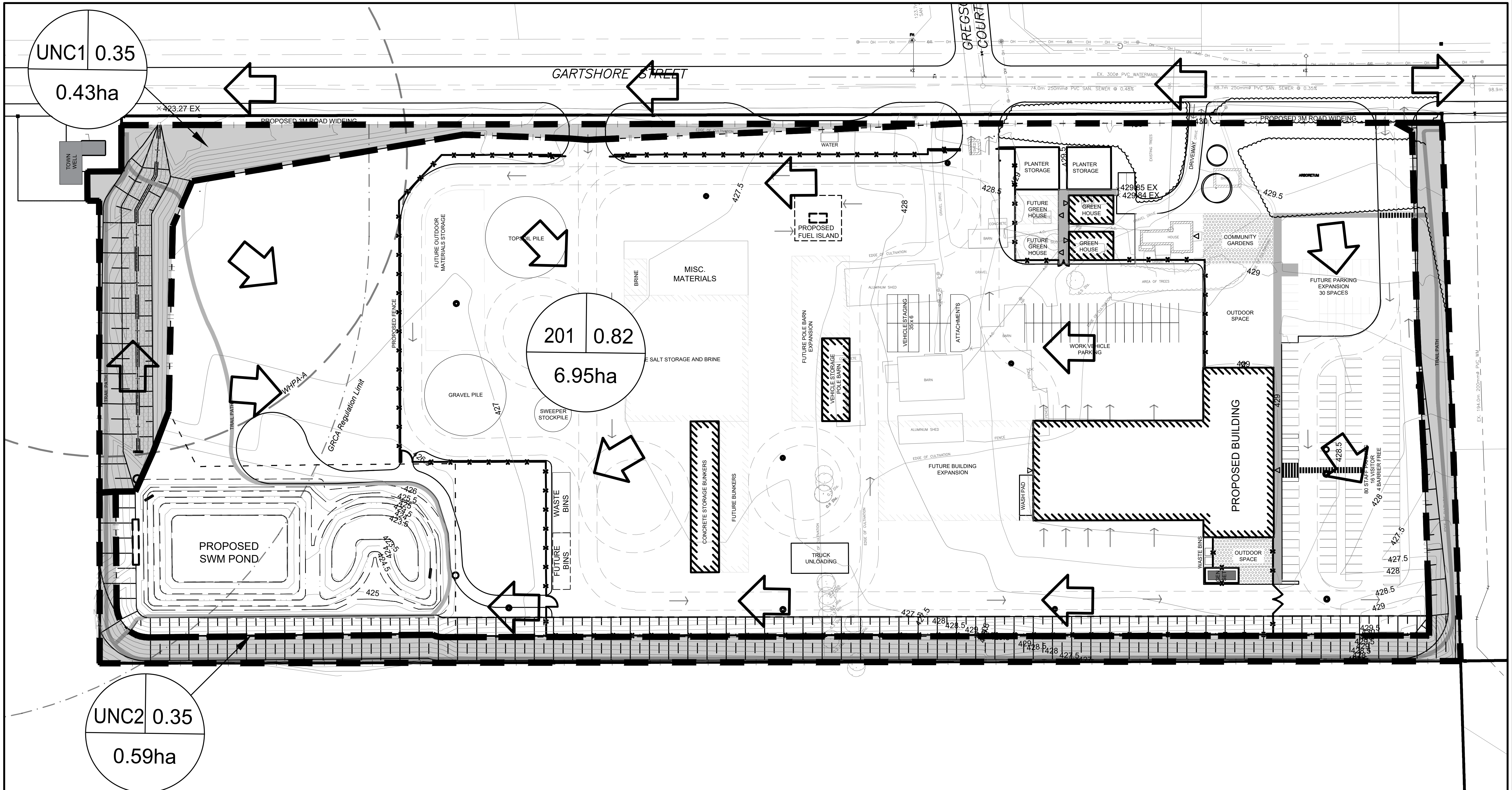
After further discussions with Township staff and the Risk Management Official for Wellington Source Water Protection, it was determined that the location of the SWM facility should be in the WHPA-B zone.

Considering the potential complications, unknown costs and unknown timelines required for petitioning for a Municipal Drain through the neighbour's property, it was decided to proceed with the option to outlet the flows toward the northeast, past the WHPA-A area.

Although the existing site flows to the neighbouring property, this proposed facility will control and release site flows to the existing Gartshore Street ROW. This will provide a suitable outlet without impacting the neighbouring property. A small portion of the site (UNC1 and UNC2) will be uncontrolled due to grading constraints. These areas will be solely landscaped. Catchment UNC1 will be directed to the Gartshore ditch, while UNC2 will discharge via overland flow to the adjacent agricultural property in a similar fashion to the existing site. Figure 5 displays the post development catchment plan and Table 2 provides a summary of the proposed drainage areas.

Table 2: Post Development Drainage Conditions

Catchment	Discharge Location	Area (ha)	Runoff Coefficient
201	Gartshore Street R.O.W.	6.95	0.78
UNC1	Gartshore Street R.O.W.	0.43	0.35
UNC2	Adjacent agricultural property	0.59	0.35
Total	-	7.97	



LEGEND

PROPERTY BOUNDARY

DRAINAGE BOUNDARY

OVERLAND FLOW DIRECTION

CATCHMENT No. — 101 | 0.50 — RUNOFF COEFFICIENT

AREA — 10.00ha

TRUE NORTH

PROJECT NORTH

0 25 50 75 100

Metres

BURNSIDE

Figure Title

CENTRE WELLINGTON OPERATIONS CENTRE

PROPOSED SITE DRAINAGE CONDITIONS

Client	Drawn	Checked	Date	Figure No.
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4.4 Minor System Conveyance

As per *Centre Wellington Development Manual (draft 2018),* the minor system flow will be conveyed within the site through a series of storm sewers sized in combination with catchbasins and catchbasin manholes. The conceptual storm servicing design for the development shown in Figure 3 and S1 displays the minor system. The minor system consists of 2 storm networks a North line and South line, joining at a control manhole to the southwest of the site before out letting to the SWM facility. One SWM facility is proposed to collect the storm discharge. Please refer to Appendix C for the storm sewer design sheet.

4.5 Major System Conveyance

The major system will convey the 100-year return period storm within the development site and direct the flow into the proposed SWM pond as overland flow.

5.0 Stormwater Management

5.1 Stormwater Management Criteria

The SWM criteria for this development are based on the Township of Centre Wellington's *Development Manual (draft 2018)* as well as the Ministry of the Environment, Conservation and Park' s(MECP) *Stormwater Management Planning and Design Manual (2003).* Climate change and severity of storm events was considered during the planning and design of the proposed SWM facility to ensure resiliency to climate change.

From these design criteria, the following SWM guidelines are to be applied:

Volume Control Maintain or improve infiltration to aquifer in Q1/Q2 Zones.

Water Quality: Level 1 - Enhanced protection corresponds to the end-of-pipe storage volumes required for the long-term removal of 80% of suspended solids.

Erosion Control: Extended detention of the 25 mm storm event

Water Quantity: Peak flow control for 2 year through 100 year storms

5.2 Existing Hydrologic Conditions

The rational method was used to calculate pre-development peak flows for existing catchments. The Intensity-Duration-Frequency (IDF) parameters used to calculate rainfall intensity were obtained from the MTO IDF Curve Lookup tool. Detailed calculations can be found in Appendix D and the pre-development peak flow rates for the site are summarized in Table 3.

Table 3: Pre-Development Peak Flows

Return Period	Peak Flow (cms)
2-year	0.613
5-year	0.807
10-year	0.936
25-year	1.209
50-year	1.464
100-year	1.673

5.3 Proposed Hydrological Conditions

5.3.1 Quantity Control

The proposed development will utilize SWMF1 with and an outlet to the Gartshore Street ROW. SWMF1 will operate as a wet pond complete with a forebay and extended detention for the first 25 mm and detain of the 100-year post development flows. There are 2 uncontrolled areas that drain from the site, which have been accommodated in the allowable release rate from SWMF1. The rational method was used to evaluate peak flow rates from the site. Table 4 shows post-development sub-catchment areas and peak flows, detailed calculations can be found in Appendix D.

Table 4: Post-Development Peak Flows

Catchment	201	UNC1	UNC2
Drainage Area (ha)	6.95	0.43	0.59
2-year cms	1.219	0.034	0.047
5-year cms	1.606	0.045	0.061
10-year cms	1.863	0.052	0.071
25-year cms	2.406	0.067	0.092
50-year cms	2.914	0.081	0.112
100-year cms	3.435	0.093	0.128

Table 5: Flow Rate Summary, summarizes the net storm flows leaving the development site under both pre- and post-development conditions.

Table 5: Flow Rate Summary

Storm Event	Flow Rates (m^3/s)	
	Development Site	
	Pre	Post
2-Year	0.613	0.244
5-Year	0.807	0.336
10-Year	0.936	0.444
25-Year	1.209	0.702
50-Year	1.464	0.836
100-Year	1.673	1.265

As shown in the tables above, the post-development flows for the subject property will be restricted to at or below pre-development flows for all storms 2-thourgh 100-year storm events. The final SWM modelling will be completed at detailed design.

5.3.2 Volume Control to Groundwater

Pre to post infiltration to groundwater is to be conserved by infiltrating the first 25 mm of roof runoff from the Operations Centre. An infiltration facility is proposed under the asphalt parking area sized for the 25 mm runoff from both the Phase 1 and Phase 2 portions of the operations building. See Drawing S1 for additional details. Water balance and drawdown calculations will be completed during detailed design.

5.3.3 Water Quality and Erosion Control

Based on requirements outlined in the MECP's *Stormwater Management Planning and Design Manual (2003)* and Centre Wellington's Development Manual (draft), stormwater quality control for this site is required to achieve an average of 80% long-term removal of total suspended solids (TSS) for the enhanced protection level. This is based on the annual loading of all runoffs leaving the site. The wet pond has been designed to meet the guidelines to achieve 80% TSS removal with an appropriately sized permanent pool and forebay. In addition to the engineered pond, for redundancy and for additional potential to overcontrol water quality, an oil grit separator will be utilized at the pond outlet to further reduce the sediment loading on the downstream lands. Table 6 shows ultimate TSS removal efficiencies.

Table 6: TSS Removal Efficiency Summary

Description	Area (ha)	Landscape[1]	Infiltration[2]	Wet Pond[2]	OGS	Total TSS Removal
Uncontrolled Landscape	1.02	80%	-	-		80%
Controlled Landscape	1.46	80%		80%	50%	92%
Parking, Yard and SWM Facility	4.92	-	-	80%	50%	90%
Roof	0.55	-	75%	80%	50%	90%
Site Total	7.97					**89.1%**

1 Removal efficiencies from STEP/TRCA LID Treatment Train Tool.
2 Removal efficiency from City of Toronto guidelines.

The proposed plan shows a TSS removal of 89.1% has been achieved and the Enhanced Protection Level target of 80% has been met. Incorporating these measures to the proposed site plan will provide the site with the necessary water quality treatment, erosion control, and water quantity attenuation prior to out letting to the existing ditch.

The township will incorporate best practices to prevent stockpiles of any potential hazardous materials from being stored on the site within the WHP-A limit. Organic materials such as wood chips, mulch, branches or rocks, are permitted to be stored in the WHPA-A. This will avoid having access roads and road salt within the WHPA-A, preventing possible fuel spills from equipment. During detailed design, low impact development opportunities will be explored including but not limited to installation of rainwater gardens, soakaway pits, pervious pipe systems and bioswales where groundwater levels and native conditions allow. A drinking water threat disclosure report is likely to be required at detailed design to further address water quality concerns regarding the development. There is no intention to accommodate township snow storage or snow disposal on the site. All snow storage is strictly limited to snow accumulated on site. There will not be a dump out pit for the hydrovac on site.

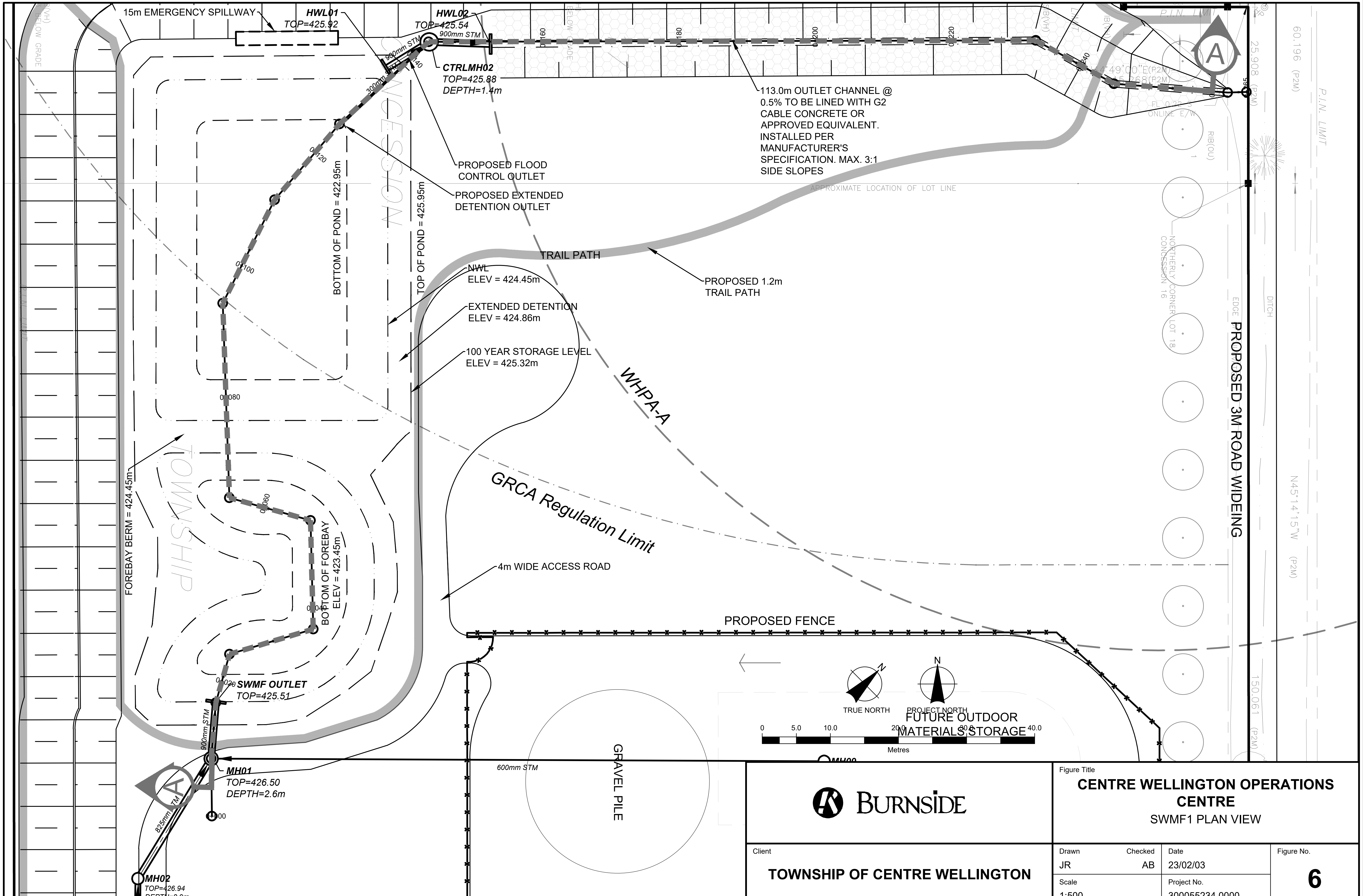
5.3.4 Stormwater Management Facility

SWMF1 is located along the western property boundary outside of the WHPA-A limits. The pond has been designed with 4:1 side slopes and a 4 m wide access road to provide access to forebay, inlet and outlet. The pond outlet will be directed to Gartshore Street ROW through a 113 m outlet channel. SWMF1 and the outlet channel is to be lined with a 0.5m impermeable clay liner to prevent infiltration within the WHPA-A zone. A cable concrete liner is proposed for energy dissipation and erosion control during peak events. Appendix E shows detailed calculations for SWMF1 and Table 7 summarizes the operating characteristics and storage volumes to meet the design criteria. Figure 6 and Figure 7 show the plan and section for SWMF1.

Table 7: Summary Table for SWMF1

Drainage Area	=	6.95 ha	% IMP= 65
Pond Block Area	=	0.45 ha	
Permanent Pool Required	=	173 m^3/ha x 6.95 ha = 1,204 m^3	
Permanent Pool Provided	=	2,140 m^3	
Max Depth	=	1.5 m	
Permanent Pool Elevation	=	424.45 m	
Erosion Control	=	25 mm x 4.5 ha 1123 m^3	
Release Rate	=	11.55 L/s	
ED Active Storage Provided	=	1155 m^3	
Depth	=	0.41 m at 424.86 m	

Return Event	Pond Out-Flow (m^3/s)	Storage Volume (m^3)	Water Elevation (m)
2-year	0.163	929	424.87
5-year	0.230	1182	424.88
10-year	0.321	1243	424.90
25-year	0.498	1445	424.96
50-year	0.643	1689	425.03
100-year	1.044	2736	425.32



BURNSIDE

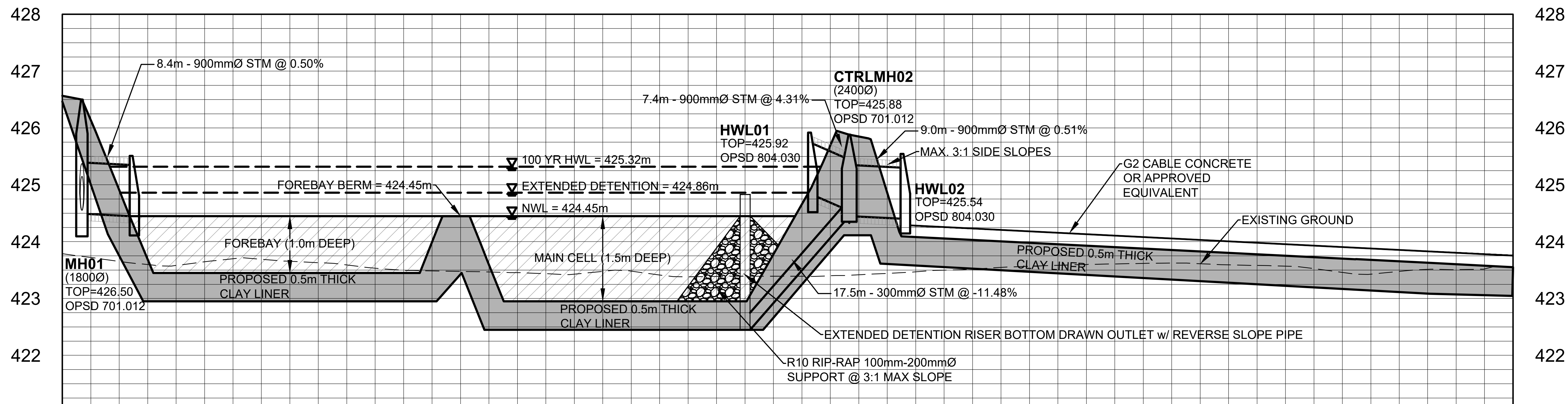
Figure Title
CENTRE WELLINGTON OPERATIONS CENTRE
SWMF1 PLAN VIEW

Client
TOWNSHIP OF CENTRE WELLINGTON

Drawn	Checked	Date	Figure No.
JR	AB	23/02/03	6
Scale		Project No.	
1:500		300055234.0000	

File: \\sherlock\shared work areas\055234 centre wellington operations ctr\07_Figures\055234 FIG6 SWM SECTIONS.dwg Date Plotted: April 17, 2023 - 9:30 AM

055234 SWM Section AA



CHAINAGE	EXIST ELEV	PROP ELEV
0+005	423.79	426.567
0+020	423.60	423.690
0+040	423.69	423.450
0+060	423.53	423.450
0+080	423.47	423.594
0+100	423.48	422.950
0+120	423.39	422.950
0+140	423.40	425.695
0+160	423.50	424.056
0+180	423.58	423.954
0+200	423.63	423.854
0+220	423.57	423.753
0+240	423.48	423.654
0+260	423.55	423.552

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Figure Title
CENTRE WELLINGTON OPERATIONS CENTRE
SWMF1 SECTION

Client
TOWNSHIP OF CENTRE WELLINGTON

Drawn	Checked	Date	Figure No.
JR	AB	23/02/03	**7**
Scale		Project No.	
H 1:750 V 1:7500		300055234.0000	

File: \\sherlock\shared work areas\055234 centre wellington operations ctr\07_Figures\055234 FIG6 SWM SECTIONS.dwg Date Plotted: April 17, 2023 - 9:30 AM

6.0 Erosion and Sediment Control

The erosion and sediment control plan for the site will be designed in conformance with the standards outlined by the Toronto and Region Conservation Authority (TRCA) in the *Erosion and Sediment Control Guide for Urban Construction (2019).* Details for erosion and sedimentation control during construction will be subject to the GRCA approval prior to the issuance of the building permit. Erosion and sediment control measures include but are not limited to a heavy-duty silt fence, rock check dams and a mud mat at the construction entrance. See ESC1 for details.

7.0 Utilities

Unless stated otherwise, utilities will be installed in a joint utility trench, and design will be provided by the individual utility companies. Existing gas, telecommunications, and overhead hydro available on Gartshore Street will be used to service the proposed site. Coordination with utility companies and sizing of connections will be completed during the detailed design stage of this project.

8.0 Conclusions and Recommendations

The preceding report provides an investigation of the existing servicing with a design for the proposed servicing and SWM of this development. The proposed Centre Wellington Operations Centre on Gartshore Street will be able to be serviced using existing water and sanitary services within the ROW. A new 150 mm watermain will be required to provide domestic and fire servicing, with a 200 mm sanitary sewer required to connect into the existing 250 mm sanitary line. The design also meets requirements for site grading and SWM with a proposed wet pond on the west property line to outlet to Gartshore Street. The existing municipal infrastructure is sufficient and capable of supporting the proposed development. As such, no external upgrades to the existing infrastructure will be required.

Accordingly, we propose that this Functional Servicing and SWM Report be accepted for review and approval to facilitate the rezoning application for the subject property.

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Appendix A

Water Calculations

CALCULATION SHEET

Project:
Centre Wellington Operations Centre

Fergus, Ontario

Water Demand Calculations

Prepared by:	JR
Checked by:	FG
Project No:	300055234.0000
Date:	April 14, 2023

I. Fire Flow Calculation

**Based on Fire Underwriters Survey*

1 F= 220 C $(A)^{1/2}$

Where F= Fire flow in Lpm
C = construction type coefficient
Type II - Noncombustible
= 0.8
A = total floor area in sq.m. excluding basements, includes garage*

Floor	Area (sq.m)		%
1st Floor	4856	m^2	100%
2nd Floor	1308	m^2	25%
N/A	0	m^2	25%

*Largest floor area + 25% of adjoining floor areas, assuming vertical opening are properly protected (one hour rating)

Largest Area = 5,183 sq.m.
F = 12,671.38 L/min

Round to nearest 1000 l/min
F = 13,000 L/min

2 Occupancy Contents Adjustment Factor
Type = Limited Combustible Contents **Office space*
Factor = -15%
Adjustment = -1,950 L/min
F = 11,050 L/min

3 Sprinkler Reduction
Sprinkler Design System = Automatc sprinkler protection in accorance with NFPA standards
Factor = 30%
Reduction = 3,315 L/min

4 Exposure Adjustment Charge

Use conservative method = YES

Face	Distance	Separation Charge
North	>30m	0%
West	>30m	0%
South	>30m	0%
East	>30m	0%

Total Separation Charge = 0%
MAX Separation Charge = 75%
Charge = 0 L/min

F = 8,000 L/min
133.33 L/s
F = 2,114 US GPM

Fire Flow Required = 133.33 L/s
Fire Flow Required = 8,000 L/min 2,114 US GPM

CALCULATION SHEET

Project:		Prepared by:	JR
Centre Wellington Operations Centre		Checked by:	FG
		Project No:	300055234.0000
Fergus, Ontario			
Water Demand Calculations		Date:	April 14, 2023

II. Domestic Flow Calculations - Office

GFA =	2616			**From Sanitary Design Sheet*
Average Day Demand =	75	L/day/9.3m2		
=	0.73	L/s		
=	12	US GPM		
Max. Daily Demand Peaking Factor =	1.1			
Max. Daily Demand =	0.80	L/s		
=	13	US GPM		
or				
Max. Hourly Demand Peaking Factor =	3.0			
Max. Hourly Demand =	2.19	L/s		
=	35	US GPM		
Office Domestic Flow =	**2.19**	**L/s**	**35**	**US GPM**

III. Domestic Flow Calculations - Industrial

	Quantity	Q / unit (L/day)	Q (L/day)	**From Sanitary Design Sheet*
per wash bay	1	400	400	
per water closet	2	950	1,900	
			2,300	

Average Day Demand =	0.08	L/s		
=	1	US GPM		
Max. Daily Demand Peaking Factor =	1.1			**From City of Toronto municipal standards*
Max. Daily Demand =	0.09	L/s		
=	1	US GPM		
or				
Max. Hourly Demand Peaking Factor =	3.0			**From Region of Waterloo standards*
Max. Hourly Demand =	0.24	L/s		
=	4	US GPM		
Industrial Domestic Flow =	**0.24**	**L/s**	**4**	**US GPM**

III. Flow Calculations - Greenhouse

Average Day Demand Greenhouse (4) =	6949	L/day		*From Past Project Experience*
=	0.08	L/s		
=	1.28	US GPM		
Maximum Day Demand Peaking Factor=	1.33			*From Past Project Experience*
Max. Daily Demand =	0.11	L/s		
=	1.70	US GPM		
or				
Peak Rate =	-			*From Past Project Experience*
Max. Hourly Demand =	1.75	L/s		
=	27.74	US GPM		
Greenhouse Irrigation Flow =	**1.75**	**L/s**	**63**	**US GPM**

Total Domestic Flow =	**4.18**	**L/s**
Fire Flow =	**133.33**	**L/s**
Peak Domestic + Fire Demand =	**137.51**	**L/s**
	8250.80	**L/min**

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Appendix B

Sanitary Calculations

BURNSIDE

CALCULATION SHEET

Project:	Prepared by: JR
Centre Wellington Operations Centre	Checked by: FG
Fergus, Ontario	Project No: 300055234.0000
Sanitary Servicing Calculations	Date: April 14, 2023

Existing Site Flows

$$Q = \frac{P \times Q \times M}{86400} + (A \times I)$$

Residential Flow

Building Address	Units	Building Area (m^2)	GFA (ha)	P/m^2	P/unit	Population
965 Gartshore Street	1	127			3	3
						0
						0
Total						**3**

Q= 350 L/cap/day

$$M = 1 + \frac{14}{4 + (P/1000)^{1/2}}$$

M= 4.45

$Q_{(residential)}$= 0.05 L/s

Site Area= 7.97 ha

Infiltration Allowance= 12960 L/day/ha **From Centre Wellington Design Guidelines*

= 0.15 L/s/ha

$Q_{infiltration}$= 1.20 L/s

$Q_{Existing\ Total}$= 1.25 L/s

CALCULATION SHEET

Project:	Prepared by:	JR
Centre Wellington Operations Centre	Checked by:	FG
Fergus, Ontario	Project No:	300055234.0000
Sanitary Servicing Calculations	Date:	April 14, 2023

Proposed Site Flows

Office

GFA Office = 2616 m2

	Quantity	Q / unit (L/day)	Q (L/day)	
per employee per 8hr shift, or per each 9.3m2 of floor space	281.3	75	21,101	**From OBC*
			21,101	

$Q_{(Office)}$= 0.73 L/s

Max. Hourly Demand Peaking Factor = 3.0

$Q_{(Office)}$= 2.19 L/s

Industrial (Warehouse)

GFA = 3548 m2

	Washes / Day	L / per	Q (L/day)
Per Wash Bay	1	400	400
Per Water Closet	2	950	1,900
			2,300

$Q_{(Industrial)}$= 0.08 L/s

Max. Hourly Demand Peaking Factor = N/A

$Q_{(Industrial)}$= 0.08 L/s

Greenhouse Activities

$Q_{(Peak)}$= 1.75 L/s **From Water Demand*

$Q_{(Greenhouses)}$= 1.75 L/s

Infiltration Allowance= 12960 L/day/ha

= 0.15 L/s/ha

A= 7.97 ha

$Q_{infiltration}$= 1.20 L/s

$Q_{proposed\ total}$= 5.27 L/s

$Q_{increase\ total}$= 4.02 L/s

Service Connection					
Diameter (mm)	Slope (%)	Full Flow Velocity (m/s)	Capacity (L/s)	Spare Capacity (L/s)	Percent Full (%)
200	1.00	1.04	32.80	28.78	16.07%

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Appendix C

Storm Sewer Design Sheet

Appendix C

STORM SEWER DESIGN SHEET: (5 Year Storm)

965 Gartshore street
Centre of Wellington Operations Centre , Centre of Welington

Project #: 300055234.0000
Date: 25-Jan-23
Designed: JR
Checked: FG

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 10 min
Factor of Safety = 10 %

Rainfall Intensity = $\frac{A}{(Tc+B)^c}$ ***where Tc is in hours***

A = 30.7
B = 0
C = 0.699
(5 Yr)

NOMINAL PIPE SIZE USED

DESCRIPTION	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
South Line	MH06	MH05	0.79	0.72	0.57	0.57	107.4	0.169			0.169	41.5	0.50	450	0.202	1.27	10.00	0.55	10.55	84%
	MH05	MH04	0.44	0.90	0.40	0.96	103.5	0.277			0.277	90.0	0.50	600	0.434	1.54	10.55	0.98	11.52	64%
	MH04	MH03	0.28	0.90	0.25	1.22	97.3	0.329			0.329	62.8	0.50	600	0.434	1.54	11.52	0.68	12.20	76%
Branch 'A'	MH08	MH07	0.56	0.75	0.42	0.42	107.4	0.126			0.126	90.0	1.00	375	0.175	1.59	10.00	0.94	10.94	72%
	MH07	MH03	0.56	0.90	0.50	0.93	100.8	0.259			0.259	34.0	0.50	525	0.304	1.40	10.94	0.40	11.35	85%
	MH03	MH02	0.50	0.90	0.45	2.59	93.5	0.673			0.673	90.0	0.50	750	0.787	1.78	12.20	0.84	13.05	85%
	MH02	MH01	0.69	0.90	0.62	3.21	89.2	0.796			0.796	20.6	0.50	825	1.015	1.90	13.05	0.18	13.23	78%
North Line	MH11	MH10	0.28	0.63	0.18	0.18	107.4	0.052			0.052	90.0	1.00	300	0.097	1.37	10.00	1.10	11.10	54%
	MH10	MH09	0.58	0.90	0.52	0.70	99.9	0.193			0.193	90.0	0.50	525	0.304	1.40	11.10	1.07	12.16	64%
	MH09	MH01	1.25	0.63	0.79	1.48	93.7	0.386			0.386	90.0	0.50	600	0.434	1.54	12.16	0.98	13.14	89%
Outlet	MH01	SWMF1		0.90		4.70	88.3	1.153			1.153	8.4	0.50	900	1.280	2.01	13.23	0.07	13.30	90%

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Appendix D

Modified Rational Method Calculations

Ontario IDF CURVE LOOKUP

Active coordinate

43° 43' 15" N, 80° 23' 15" W (43.720833,-80.387500)

Retrieved: Mon, 06 Feb 2023 13:29:20 GMT

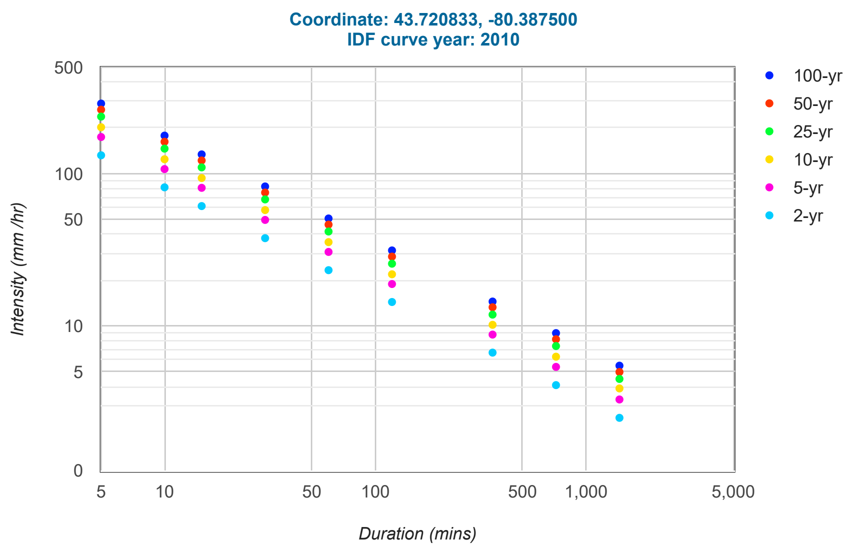
Location summary

These are the locations in the selection.

IDF Curve: 43° 43' 15" N, 80° 23' 15" W (43.720833,-80.387500)

Results

An IDF curve was found.



Coefficient summary

IDF Curve: 43° 43' 15" N, 80° 23' 15" W (43.720833,-80.387500)

Retrieved: Mon, 06 Feb 2023 13:29:20 GMT

Data year: 2010
IDF curve year: 2010

Return period	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
A	23.3	30.7	35.6	41.8	46.4	50.9
B	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699

Statistics

Rainfall intensity (mm hr^{-1})

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	132.3	81.5	61.4	37.8	23.3	14.4	6.7	4.1	2.5
5-yr	174.4	107.4	80.9	49.8	30.7	18.9	8.8	5.4	3.3
10-yr	202.2	124.6	93.8	57.8	35.6	21.9	10.2	6.3	3.9
25-yr	237.4	146.3	110.2	67.9	41.8	25.7	11.9	7.4	4.5
50-yr	263.6	162.3	122.3	75.3	46.4	28.6	13.3	8.2	5.0
100-yr	289.1	178.1	134.1	82.6	50.9	31.4	14.5	9.0	5.5

Rainfall depth (mm)

Duration	5-min	10-min	15-min	30-min	1-hr	2-hr	6-hr	12-hr	24-hr
2-yr	11.0	13.6	15.4	18.9	23.3	28.7	40.0	49.2	60.6
5-yr	14.5	17.9	20.2	24.9	30.7	37.8	52.6	64.9	79.9
10-yr	16.9	20.8	23.5	28.9	35.6	43.9	61.0	75.2	92.7
25-yr	19.8	24.4	27.5	33.9	41.8	51.5	71.7	88.3	108.8
50-yr	22.0	27.1	30.6	37.7	46.4	57.2	79.6	98.0	120.8
100-yr	24.1	29.7	33.5	41.3	50.9	62.7	87.3	107.5	132.5

Terms of Use

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CALCULATION SHEET

Project: **Centre Wellington Operations Centre**

Prepared by:	J. Rooke
Checked by:	F.Goulding
Project No:	300055234.0000
Date:	6-Feb-2023

C101

Existing/Allowable Flows

Runoff Equation Q = 2.78CIA (L/s)

where,
C = runoff coefficient
I = rainfall intensity (mm/hr)
A = area (ha)
2.78= conversion factor

Definition	Area		C	
Asphalt/Concrete/Rooftops	0.17	ha	0.90	**From Centre Wellington Design Standards*
Grass Short / Mowed	0.98	ha	0.35	**From Centre Wellington Design Standards*
Gravel	0.24	ha	0.70	**From Centre Wellington Design Standards*
Agricultural	6.58	ha	0.31	**From MTO Design Chart*
Totals	7.97	ha	0.34	

$$I = AT^B$$

I= Rainfall Intensity (mm/hr)
T= Time of concentration (hour)
(use T=10 min or 0.1666667hr)

Return Period	A	B	T		I		C	Q	
2 year	23.3	-0.699	0.167	hr	81.52	mm/hr	0.34	612.74	L/s
5 year	30.7	-0.699	0.167	hr	107.42	mm/hr	0.34	807.35	L/s
10 year	35.6	-0.699	0.167	hr	124.56	mm/hr	0.34	936.21	L/s
25 year	41.8	-0.699	0.167	hr	146.25	mm/hr	0.34	1099.26	L/s
50 year	46.4	-0.699	0.167	hr	162.35	mm/hr	0.34	1220.23	L/s
100 year	50.9	-0.699	0.167	hr	178.09	mm/hr	0.34	1338.57	L/s

Allowable release rate from the site is 1338.57 L/s

IDF Curve Data taken from the MTO IDF Curve Lookup database for the site location

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CALCULATION SHEET

Project: **Centre Wellington Operations Centre**

C201
Post Development Controlled Flows

Prepared by:	J. Rooke
Checked by:	F.Goulding
Project No:	300055234
Date:	6-Feb-2023

Runoff Equation Q = 2.78CIA (L/s)

where,
C = runoff coefficient
I = rainfall intensity (mm/hr)
A = area (ha)
2.78= conversion factor

Definition	Area	C	
Asphalt/Concrete/Rooftops	4.62 ha	0.90	**From Centre Wellington Design Standards*
Grass Short / Mowed	1.69 ha	0.35	**From Centre Wellington Design Standards*
SWM Facility	0.64 ha	1.00	
Totals	6.95 ha	0.78	

$$I = AT^B$$

I= Rainfall Intensity (mm/hr)
T= Time of concentration (hour)
(use T=10 min or 0.1666667hr)

Return Period	A	B	T	I	C	Q
2 year	23.3	-0.699	0.167 hr	81.52 mm/hr	0.78	1219.56 L/s
5 year	30.7	-0.699	0.167 hr	107.42 mm/hr	0.78	1606.88 L/s
10 year	35.6	-0.699	0.167 hr	124.56 mm/hr	0.78	1863.36 L/s
25 year	41.8	-0.699	0.167 hr	146.25 mm/hr	0.85	2406.66 L/s
50 year	46.4	-0.699	0.167 hr	162.35 mm/hr	0.93	2914.37 L/s
100 year	50.9	-0.699	0.167 hr	178.09 mm/hr	1.00	3435.98 L/s

IDF Curve Data taken from the MTO IDF Curve Lookup database for the site location

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CALCULATION SHEET

Project: **Centre Wellington Operations Centre**

UNC1
Post Development Uncontrolled Flows

Prepared by:	J. Rooke
Checked by:	F.Goulding
Project No:	300055234
Date:	6-Feb-2023

Runoff Equation Q = 2.78CIA (L/s)

where,
C = runoff coefficient
I = rainfall intensity (mm/hr)
A = area (ha)
2.78= conversion factor

Definition	Area	C	
Asphalt/Concrete/Rooftops	0.00 ha	0.90	**From Centre Wellington Design Standards*
Grass Short / Mowed	0.43 ha	0.35	**From Centre Wellington Design Standards*
SWM Facility	0.00 ha	1.00	
Totals	0.43 ha	0.35	

$I = AT^{B}$

I= Rainfall Intensity (mm/hr)
T= Time of concentration (hour)
(use T=10 min or 0.1666667hr)

Return Period	A	B	T	I	C	Q
2 year	23.3	-0.70	0.167 hr	81.52 mm/hr	0.35	34.08 L/s
5 year	30.7	-0.70	0.167 hr	107.42 mm/hr	0.35	44.91 L/s
10 year	35.6	-0.70	0.167 hr	124.56 mm/hr	0.35	52.08 L/s
25 year	41.8	-0.70	0.167 hr	146.25 mm/hr	0.39	67.26 L/s
50 year	46.4	-0.70	0.167 hr	162.35 mm/hr	0.42	81.45 L/s
100 year	50.9	-0.70	0.167 hr	178.09 mm/hr	0.44	93.07 L/s

IDF Curve Data taken from the MTO IDF Curve Lookup database for the site location

BURNSIDE

CALCULATION SHEET

Project: **Centre Wellington Operations Centre**

UNC2
Post Development Uncontrolled Flows

Prepared by:	J. Rooke
Checked by:	F.Goulding
Project No:	300055234
Date:	6-Feb-2023

Runoff Equation Q = 2.78CIA (L/s)

where,
C = runoff coefficient
I = rainfall intensity (mm/hr)
A = area (ha)
2.78= conversion factor

Definition	Area	C	
Asphalt/Concrete/Rooftops	0.00 ha	0.90	**From Centre Wellington Design Standards*
Grass Short / Mowed	0.59 ha	0.35	**From Centre Wellington Design Standards*
SWM Facility	0.00 ha	1.00	
Totals	0.59 ha	0.35	

I = AT^{B}
I= Rainfall Intensity (mm/hr)
T= Time of concentration (hour)
(use T=10 min or 0.1666667hr)

Return Period	A	B	T	I	C	Q
2 year	23.3	-0.70	0.167 hr	81.52 mm/hr	0.35	46.77 L/s
5 year	30.7	-0.70	0.167 hr	107.42 mm/hr	0.35	61.62 L/s
10 year	35.6	-0.70	0.167 hr	124.56 mm/hr	0.35	71.45 L/s
25 year	41.8	-0.70	0.167 hr	146.25 mm/hr	0.39	92.29 L/s
50 year	46.4	-0.70	0.167 hr	162.35 mm/hr	0.42	111.76 L/s
100 year	50.9	-0.70	0.167 hr	178.09 mm/hr	0.44	127.70 L/s

IDF Curve Data taken from the MTO IDF Curve Lookup database for the site location

Project:	Centre Wellington Operations Centre
Project No.:	300055234
Modelled By:	J. Rooke
Date:	6-Feb-2023

MODIFIED RATIONAL METHOD
POST-DEVELOPMENT CONTROLLED FLOWS

Rainfall IDF Coefficients 100 -year

A =	50.4	A =	
C =	-0.699	B =	
		C =	

Rational Method Calculation

Area =	6.95	ha	
Runoff Coefficient, C =	1.00		
C*A =	6.95		
Time of Concentration, t_c =	10.0	min	
Storm Duration Increment =	5.0	min	
Target Release Rate =	1339	L/s	
Constant Inflow =	0	L/s	
Uncontrolled Outflow =	221	L/s	Max. Allowable Outflow (L/s) = 1339
Outflow =	1044	L/s	*From SWM Design Sheet Total Ofice Flow*

Storm Duration (min)	Rainfall Intensity (mm/hr)	Max. Runoff Flow (L/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Volume Required (m^3)
10.0	176.34	3401.95	2041	626	1415	
15.0	132.82	2562.36	2306	783	1523	
20.0	108.63	2095.60	2515	940	1575	
25.0	92.94	1792.95	2689	1096	1593	2748
30.0	81.82	1578.41	2841	1253	1588	
35.0	73.46	1417.18	2976	1409	1567	
40.0	66.91	1290.89	3098	1566	1532	
45.0	61.63	1188.86	3210	1723	1487	
50.0	57.25	1104.45	3313	1879	1434	
55.0	53.56	1033.27	3410	2036	1374	
60.0	50.40	972.30	3500	2192	1308	
65.0	47.66	919.39	3586	2349	1237	
70.0	45.25	872.98	3667	2506	1161	
75.0	43.12	831.88	3743	2662	1081	
80.0	41.22	795.18	3817	2819	998	
85.0	39.51	762.19	3887	2975	912	

MODIFIED RATIONAL METHOD
POST-DEVELOPMENT CONTROLLED FLOWS

Rainfall IDF Coefficients 50 -year

A =	46.4	A =	
C =	-0.699	B =	
		C =	

Rational Method Calculation

Area =	6.95	ha		
Runoff Coefficient, C =	0.93			
C*A =	6.46			
Time of Concentration, t_c =	10.0	min		
Storm Duration Increment =	5.0	min		
Target Release Rate =	1220	L/s		
Constant Inflow =	0	L/s		
Uncontrolled Outflow =	193	L/s	Max. Allowable Outflow (L/s) =	1220
Outflow =	643	L/s	*From SWM Design Sheet Total Orifice Flow	

Storm Duration (min)	Rainfall Intensity (mm/hr)	Max. Runoff Flow (L/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Volume Required (m^3)
10.0	162.35	2914.14	1748	386	1363	
15.0	122.28	2194.94	1975	482	1493	
20.0	100.01	1795.11	2154	579	1575	
25.0	85.56	1535.85	2304	675	1629	
30.0	75.32	1352.08	2434	772	1662	
35.0	67.63	1213.97	2549	868	1681	
40.0	61.60	1105.78	2654	965	1689	1689
45.0	56.73	1018.39	2750	1061	1689	
50.0	52.71	946.08	2838	1157	1681	
55.0	49.31	885.11	2921	1254	1667	
60.0	46.40	832.88	2998	1350	1648	
65.0	43.88	787.56	3071	1447	1625	
70.0	41.66	747.80	3141	1543	1598	
75.0	39.70	712.59	3207	1640	1567	
80.0	37.95	681.16	3270	1736	1533	
85.0	36.37	652.90	3330	1833	1497	

BURNSIDE

Project: Centre Wellington Operations Centre
Project No.: 300055234
Modelled By: J. Rooke
Date: 6-Feb-2023

MODIFIED RATIONAL METHOD
POST-DEVELOPMENT CONTROLLED FLOWS

Rainfall IDF Coefficients 25 -year

A =	41.8	A =	
C =	-0.699	B =	
		C =	

Rational Method Calculation

Area =	6.95	ha		
Runoff Coefficient, C =	0.85			
C*A =	5.92			
Time of Concentration, t_c =	10.0	min		
Storm Duration Increment =	15.0	min		
Target Release Rate =	1099	L/s		
Constant Inflow =	0	L/s		
Uncontrolled Outflow =	160	L/s	Max. Allowable Outflow (L/s) =	1099
Outflow =	498	L/s	*From SWM Design Sheet Total Orfice Flow	

Storm Duration (min)	Rainfall Intensity (mm/hr)	Max. Runoff Flow (L/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Volume Required (m^3)
10.0	146.25	2406.47	1444	299	1145	
25.0	77.08	1268.29	1902	523	1380	
40.0	55.50	913.15	2192	747	1445	1445
55.0	44.42	730.91	2412	971	1441	
70.0	37.53	617.53	2594	1195	1398	
85.0	32.77	539.16	2750	1419	1330	
100.0	29.25	481.26	2888	1643	1244	
115.0	26.53	436.47	3012	1868	1144	
130.0	24.35	400.62	3125	2092	1033	
145.0	22.56	371.18	3229	2316	914	
160.0	21.06	346.50	3326	2540	787	
175.0	19.78	325.46	3417	2764	653	
190.0	18.67	307.28	3503	2988	515	
205.0	17.71	291.38	3584	3212	372	
220.0	16.86	277.35	3661	3436	225	
235.0	16.10	264.85	3734	3660	74	

MODIFIED RATIONAL METHOD
POST-DEVELOPMENT CONTROLLED FLOWS

Rainfall IDF Coefficients	10	-year		
A =	35.6		A =	
C =	-0.699		B =	
			C =	

Rational Method Calculation

Area =	6.95	ha		
Runoff Coefficient, C =	0.78			
C*A =	5.39			
Time of Concentration, t_c =	10.0	min		
Storm Duration Increment =	5.0	min		
Target Release Rate =	936	L/s		
Constant Inflow =	0	L/s		
Uncontrolled Outflow =	124	L/s	Max. Allowable Outflow (L/s) =	936
Outflow =	321	L/s	**From SWM Design Sheet Total Orfice Flow*	

Storm Duration (min)	Rainfall Intensity (mm/hr)	Max. Runoff Flow (L/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Volume Required (m^3)
10.0	124.56	1863.21	1118	193	925	
15.0	93.82	1403.37	1263	241	1022	
20.0	76.73	1147.73	1377	289	1088	
25.0	65.65	981.98	1473	337	1136	
30.0	57.79	864.48	1556	385	1171	
35.0	51.89	776.17	1630	433	1197	
40.0	47.26	707.00	1697	482	1215	
45.0	43.53	651.13	1758	530	1228	
50.0	40.44	604.90	1815	578	1237	
55.0	37.83	565.91	1868	626	1242	
60.0	35.60	532.52	1917	674	1243	1243
65.0	33.66	503.54	1964	722	1242	
70.0	31.96	478.12	2008	770	1238	
75.0	30.46	455.61	2050	819	1232	
80.0	29.12	435.51	2090	867	1224	
85.0	27.91	417.44	2129	915	1214	

Project: Centre Wellington Operations Centre
Project No.: 300055234
Modelled By: J. Rooke
Date: 6-Feb-2023

MODIFIED RATIONAL METHOD
POST-DEVELOPMENT CONTROLLED FLOWS

Rainfall IDF Coefficients	5	-year		
A =	30.7		A =	
C =	-0.699		B =	
			C =	

Rational Method Calculation

Area =	6.95	ha		
Runoff Coefficient, C =	0.78			
C*A =	5.39			
Time of Concentration, t_c =	10.0	min		
Storm Duration Increment =	10.0	min		
Target Release Rate =	807	L/s		
Constant Inflow =	0	L/s		
Uncontrolled Outflow =	107	L/s	Max. Allowable Outflow (L/s) =	807
Outflow =	230	L/s	**From SWM Design Sheet Total Orfice Flow*	

Storm Duration (min)	Rainfall Intensity (mm/hr)	Max. Runoff Flow (L/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Volume Required (m^3)
10.0	107.42	1606.75	964	138	826	
20.0	66.17	989.76	1188	207	981	
30.0	49.84	745.49	1342	276	1066	
40.0	40.76	609.69	1463	345	1118	
50.0	34.87	521.64	1565	414	1151	
60.0	30.70	459.22	1653	483	1170	
70.0	27.56	412.31	1732	552	1180	
80.0	25.11	375.57	1803	621	1182	1182
90.0	23.12	345.89	1868	690	1178	
100.0	21.48	321.33	1928	759	1169	
110.0	20.10	300.62	1984	828	1156	
120.0	18.91	282.88	2037	897	1140	
130.0	17.88	267.49	2086	966	1120	
140.0	16.98	253.98	2133	1035	1098	
150.0	16.18	242.03	2178	1104	1074	
160.0	15.47	231.35	2221	1173	1048	

Project: Centre Wellington Operations Centre
Project No.: 300055234
Modelled By: J. Rooke
Date: 6-Feb-2023

MODIFIED RATIONAL METHOD
POST-DEVELOPMENT CONTROLLED FLOWS

Rainfall IDF Coefficients 2 -year

A =	23.3	A =	
C =	-0.699	B =	
		C =	

Rational Method Calculation

Area =	6.95	ha		
Runoff Coefficient, C =	0.78			
C*A =	5.39			
Time of Concentration, t_c =	10.0	min		
Storm Duration Increment =	10.0	min		
Target Release Rate =	613	L/s		
Constant Inflow =	0	L/s		
Uncontrolled Outflow =	81	L/s	Max. Allowable Outflow (L/s) =	613
Outflow =	163	L/s	*From SWM Design Sheet Total Orfice Flow*	

Storm Duration (min)	Rainfall Intensity (mm/hr)	Max. Runoff Flow (L/s)	Runoff Volume (m^3)	Released Volume (m^3)	Storage Volume (m^3)	Max. Storage Volume Required (m^3)
10.0	81.52	1219.46	732	98	634	
20.0	50.22	751.18	901	147	755	
30.0	37.82	565.79	1018	196	823	
40.0	30.93	462.73	1111	245	866	
50.0	26.47	395.90	1188	293	894	
60.0	23.30	348.53	1255	342	912	
70.0	20.92	312.93	1314	391	923	
80.0	19.06	285.04	1368	440	928	
90.0	17.55	262.51	1418	489	929	929
100.0	16.30	243.87	1463	538	925	
110.0	15.25	228.16	1506	587	919	
120.0	14.35	214.69	1546	636	910	
130.0	13.57	203.01	1583	685	899	
140.0	12.89	192.76	1619	734	886	
150.0	12.28	183.69	1653	782	871	
160.0	11.74	175.58	1686	831	854	

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[THE DIFFERENCE IS OUR PEOPLE]

Appendix E

SWM Pond Calculations

EXTENDED DETENTION CALCULATIONS

Project:	Centre Wellington Operations Centre
File:	300055234
Designed by:	J. Rooke
Checked by:	F. Goulding
Date:	6-Feb-23

BURNSIDE

Extended Detention Storage Required

Requirements as per MOE

Storage =	25 mm / impervious ha
TIMP =	65.0 %
Area to Pond =	6.95 ha
Impervious Area =	4.5 ha
Storage Required =	**1123 cu.m**
Drawdown Required	**24 hrs**

Orifice Sizing per MOE 2003 SWM Manual - Falling Head Equation

t = 2*Ap*(h^0.5)/(C*Ao*(g*2)^0.5)

t =	drawdown time		**86400**	seconds	
Ao =	cross sectional area of orifice			sq.m	*to be calculated
h =	maximum water elevation above orifice (depth of ED)		**0.41**	m	*depth of ED
C =	discharge coefficient		0.62		
Ap =	average pond surface area for extended detention		**4118**	sq.m	*based on pond design
	Ao = 0.0222 sq.m	d =	168	mm	
	Actual Diameter	d =	**160**	mm	Ao = 0.020
	Actual Drawdown Time		26.5	hrs	

SEDIMENT FOREBAY SIZING

Project:	Centre Wellington Operations Centre
File:	300055234
Designed by:	J. Rooke
Checked by:	F. Goulding
Date:	6-Feb-23

Forebay Length: Two Calculations (per MOE SWMP Manual, 2003)

1) Settling Calculations **Dist = SQRT(r * Qp / Vs)**
(Equation 4.5, MOE 2003)

where:
- Dist = Forebay length (m)
- r = Length to width ratio of forebay
- Qp = Peak flowrate from the pond during quality design storm (cms)
- Vs = Settling velocity (m/s)

given:
- r = 3.5
- Qp = 0.02351 cms *see below
- Vs = 0.0003 m/s

therefore:
- Dist = 16.6 metres
- Width= 4.7 metres

Peak quality flowrate (Qp) from pond based on release rate and volume of extended detention multiplied by a factor of 2.0 for peaking

- Extended Detention Vol 1123 cu.m (extended det. volume)
- Release Rate 26.5 hrs
- Qp 0.02351 cms

2) Dispersion Length **Dist = (8 * Q) / (d * Vf)**
(Equation 4.6,MOE 2003)

where:
- Dist = Forebay length (m)
- Q = inlet flowrate (cms)
- d = depth of permanent pool in forebay (m)
- Vf = desired forebay velocity (m/s)

given:
- Q = 1.28 cms *see below
- d = 1 m
- Vf = 0.5 m/s

therefore:
- Dist = 20.5 metres
- Width= 10.2 metres
- Min Bottom Width= 2.6 metres *MOE equation 4.6
- Pond Side Slopes: 4
- Calc. Top Width= 10.56 metres
- Calc. Top Length= 36.96 meters

Peak inflow rate calculated based on STORM SEWER DESIGN FLOW per rational method sewer calculation.

Minimum Forebay Dimension:

- Length= 37.0 meters
- Width= 10.6 meters

Actual Forebay Design:

- Length= 56.0 meters
- Width= 16.0 meters

Check Average velocity in forebay <= 0.15 m/s
Pond Side Slopes: 4 H : 1 V
Q = V x A   Q = 1.28   A = 12 sq.metres

therefore: V = 0.1067 m/s
Design: **OK**

STAGE STORAGE DISCHARGE CURVE CALCULATIONS

BURNSIDE

Project:	Centre Wellington Operations Centre
File:	300055234
Designed by:	J. Rooke
Checked by:	F. Goulding
Date:	2/6/2023

Storage - Outflow Relationship for SWM Pond

Permanent Pool Elevation:	424.45	m	Storm outflow controlled by a single outlet pipe
Extended Detention Elevation:	424.86	m	Extended detention outflow controlled by a reverse sloped pipe
Extended Detention Orifice Size:	160	mm	
Orifice Area	0.02	m2	
Computational Increment	0.05	m	

Orifice Outlets:

	Orifice #1	
Flood Control Orifice Diameter	0.825	m
Flood Control Inlet	0.00	m above pp (ED Elev)
Flood Control Orifice Area	0.53	m2
Flood Control Inlet Elevation	424.45	
Flood Control Orifice Elevation	424.45	m
Flood Control Orifice Coeff	0.62	

Weir Outlets:

	Weir #1	
Flood Control Weir Width	15	m
Flood Control Weir Coeff	1.7	LSRCA Guidelines
Flood Control Weir Rectangular	n	(Y or N)
Flood Control Weir Crest Height	0.3	m
Flood Control Weir Crest EL	425.85	m
Flood Control Weir Side Slope X:1	4	(X:1, USE 0:1 FOR RECTANGULAR)

	Water Surface Elevation m	Depth above PP m	Depth of ED Orifice m	Depth of Flood Orifice m	Pond Storage Volume cum	ED Orifice Outflow cms	Flood Control Orifice #1 cms	Total Orifice Flow cms	Flood Control Weir #1 cms	Total Weir Flow cms	Total Pond Outflow cms	Pond Storage Volume ha m
NWL	424.45	0.00	0.00	0.00	0	0.0000		0.000		0.000	0.000	0.000
	424.50	0.05	0.05	0.05	132.0	0.0021	0.000	0.002		0.000	0.002	0.013
	424.55	0.10	0.10	0.10	263.0	0.0175	0.000	0.017		0.000	0.017	0.026
	424.60	0.15	0.15	0.15	402.0	0.0214	0.000	0.021		0.000	0.021	0.040
	424.65	0.20	0.20	0.20	540.0	0.0247	0.000	0.025		0.000	0.025	0.054
	424.70	0.25	0.25	0.25	685.0	0.0276	0.000	0.028		0.000	0.028	0.069
	424.75	0.30	0.30	0.30	829.0	0.0302	0.000	0.030		0.000	0.030	0.083
	424.80	0.35	0.35	0.35	992.0	0.0327	0.000	0.033		0.000	0.033	0.099
ED	424.86	0.41	0.41	0.41	1155.0	0.0354	0.000	0.035		0.000	0.035	0.116
2- year	424.87	0.42	0.42	0.42	929.0	0.0358	0.127	0.163		0.000	0.163	0.093
5- year	424.88	0.43	0.43	0.43	1182.0	0.0362	0.194	0.230		0.000	0.230	0.118
10-year	424.90	0.45	0.45	0.45	1243.0	0.0370	0.284	0.321		0.000	0.321	0.124
25- year	424.96	0.51	0.51	0.51	1445.0	0.0394	0.458	0.498		0.000	0.498	0.145
50- year	425.03	0.58	0.58	0.58	1689.0	0.0421	0.601	0.643		0.000	0.643	0.169
	425.05	0.60	0.60	0.60	1776.0	0.0428	0.636	0.678		0.000	0.678	0.178
	425.10	0.65	0.65	0.65	1950.0	0.0445	0.715	0.760		0.000	0.760	0.195
	425.15	0.70	0.70	0.70	2124.0	0.0462	0.787	0.833		0.000	0.833	0.212
	425.25	0.80	0.80	0.80	2484.0	0.0494	0.914	0.963		0.000	0.963	0.248
100- year	425.32	0.87	0.87	0.87	2736.0	0.0515	0.993	1.044		0.000	1.044	0.274
	425.35	0.90	0.90	0.90	2855.0	0.0524	1.025	1.077		0.000	1.077	0.286