



**400 Millennium Boulevard
Waterloo, ON
Functional Servicing and
Stormwater Management Report**

November 2024

Prepared for:
Activa Holdings Inc.
Columbia Corporate Centre
55 Columbia Street East, Suite 1
Waterloo, ON N2J 4N7

Prepared by:
Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4
Tel: (519) 579-4410

Project Number: 1603-10788

Sign-off Sheet

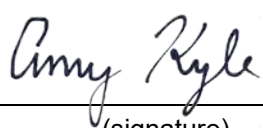
This document entitled 400 Millennium Boulevard Waterloo, ON Functional Servicing and Stormwater Management Report was prepared by Stantec Consulting International Ltd. ("Stantec") for the account of Activa Holdings Inc. (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by: 
(signature)

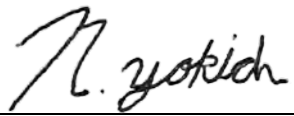
Sergio Zaga. M.Eng.
Project Manager

Reviewed by: 
(signature)

Hitesh Lad, P.Eng.
Project Manager

Stormwater
Management
Prepared by: 
(signature)

Amy Kyle
Water Resources Engineering Graduate

Reviewed by: 
(signature)

Nathan Yokich, P.Eng.
Water Resources Engineer



**400 MILLENNIUM BOULEVARD WATERLOO, ON
FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT**

Table of Contents

1.0	INTRODUCTION.....	1.1
1.1	BACKGROUND REPORTS AND DOCUMENTATION.....	1.1
2.0	OVERALL GRADING AND DRAINAGE	2.1
2.1	EXISTING SITE TOPOGRAPHY AND LAND USE.....	2.1
2.2	AREA GRADING AND ROAD PROFILE DESIGN CONSTRAINTS.....	2.1
2.3	PROPOSED SITE GRADING	2.2
3.0	SANITARY SERVICING	3.1
4.0	WATER DISTRIBUTION SYSTEM ANALYSIS.....	4.1
4.1	WATER SERVICING BACKGROUND.....	4.1
4.2	METHODOLOGY	4.1
4.2.1	OVERVIEW	4.1
4.2.2	MODEL DEVELOPMENT AND DESIGN CRITERIA	4.1
4.2.3	REGION OF WATERLOO MUNICIPAL DESIGN GUIDELINES.....	4.2
4.2.4	BOUNDARY CONDITIONS.....	4.2
4.2.5	PEAKING FACTORS	4.3
4.2.6	SYSTEM DEMANDS.....	4.3
4.2.7	PRESSURE REQUIREMENTS.....	4.3
4.2.8	FIRE FLOW REQUIREMENTS.....	4.4
4.2.9	VELOCITY REQUIREMENTS.....	4.4
4.2.10	FRICTION FACTOR.....	4.4
4.3	RESULTS.....	4.4
4.4	SUMMARY	4.5
5.0	STORM DRAINAGE	5.1
6.0	GEOTECHNICAL.....	6.1
7.0	HYDROGEOLOGY	7.1
8.0	STORMWATER MANAGEMENT.....	8.1
8.1	INTRODUCTION.....	8.1
8.2	OVERVIEW	8.1
8.3	STUDY APPROACH.....	8.2
8.4	STORMWATER MANAGEMENT DESIGN.....	8.2
8.5	EXISTING CONDITIONS	8.2
8.5.1	TOPOGRAPHY AND SURFACE DRAINAGE.....	8.2
8.5.2	GEOTECHNICAL/HYDROGEOLOGICAL INFORMATION	8.3
8.6	STORMWATER MANAGEMENT DESIGN.....	8.4
8.6.1	HYDROLOGIC MODELLING	8.4
8.6.2	EXISTING CONDITONS HYDROLOGIC MODEL	8.4
8.6.3	PROPOSED CONDITIONS HYDROLOGIC MODEL.....	8.5



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

8.7	STORMWATER MANAGEMENT STRATEGY	8.6
8.7.1	STORMWATER MANAGEMENT FACILITY DESIGN	8.6
8.7.2	MAJOR STORM CONVEYANCE DISCUSSION	8.9
8.7.3	ADDITIONAL DESIGN CONSIDERATIONS	8.9
8.8	WATER BALANCE ANALYSIS	8.10
8.9	MONITORING AND MAINTENANCE	8.11
9.0	EROSION AND SEDIMENT CONTROL PLAN	9.1
10.0	UTILITIES	10.1
10.1	ENOVA POWER	10.1
10.2	ENBRIDGE GAS	10.1
10.3	BELL CANADA	10.1
10.4	ROGERS CABLE	10.1
11.0	NOISE	11.1
12.0	CONCLUSIONS AND RECOMMENDATIONS	12.1

LIST OF TABLES

Table 1: Hydraulic Grade Lines (Node JCT_20511)	4.2
Table 2: Peaking Factors	4.3
Table 3: Region of Waterloo Pressure Requirements	4.3
Table 4: Hazen-Williams C-Factors	4.4
Table 5: Modeling Results – Fire Flow ¹	4.5
Table 6: Modeling Results – Pressures ¹	4.5
Table 7: Rainfall Events – City of Waterloo IDF Parameters	8.4
Table 8: SWMF Design Characteristics	8.7
Table 9: Onsite SWMF Operating Characteristics	8.8
Table 10: Existing and Proposed Peak Flows	8.9
Table 11: Wetland and Site Water Balance	8.11

LIST OF FIGURES AND DRAWINGS

Figure 1.0: Draft Plan of Subdivision	1.2
Figure 2.0: Existing Conditions Area Plan	8.12
Figure 3.0: Proposed Conditions Area Plan	8.13

LIST OF APPENDICES

APPENDIX A

DRAWINGS:

Existing Conditions & Removals Plan (C-050)
 General Servicing Plan (C-100)
 Storm Sewer Catchment Area (C-110)
 Sanitary Sewer Catchment Area (C-120)
 Plan and Profiles (C-200, C-201, C-202, C-203, C-204, C-205)
 General Grading Plan (C-400)



**400 MILLENNIUM BOULEVARD WATERLOO, ON
FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT**

APPENDIX B	SANITARY AND STORM DESIGN: Sanitary Sewer Design Calculations Storm Sewer Design Calculations
APPENDIX C	STORMWATER MANAGEMENT: Groundwater Level Data Stormwater Management Calculations Water Balance Calculations SWMHYMO Modelling Files Carriage Crossing Subdivision Final Stormwater Management Report
APPENDIX D	WATER DISTRIBUTION SYSTEM: Region of Waterloo Correspondence Water Demand Calculations Proposed Watermain Layout Detailed Modeling Results



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Introduction
November 2024

1.0 INTRODUCTION

Stantec Consulting Ltd. (Stantec) has been retained by Activa Holdings Inc. (Activa) to prepare a Functional Servicing Report (FSR) for lands associated with municipal address 400 Millennium Boulevard, Waterloo, Ontario and legally described as Block 320 Registered Plan 58M-506 (Geographic Township of Waterloo), City of Waterloo in the Regional Municipality of Waterloo (herein referred to as the “site”). The site encompasses 15.2 hectares (ha) of undeveloped land which are currently established with an active agricultural field fronting Millennium Boulevard and Country Squire Road.

The Draft Plan of Subdivision (prepared by MHBC dated September 3, 2024 includes seven (7) single residential blocks, seven (7) street town residential blocks, six (6) multiple residential blocks, one (1) commercial block, one (1) Stormwater Management Pond, one (1) park block, three (3) internal roads, three (3) open space blocks and one (1) walkway block on the Subject Lands. Refer to Figure 1.0 for the Draft Plan of Subdivision.

The Development is proposed to be constructed in four (4) Stages. Please to the Draft Plan for Stage boundaries.

The purpose of this FSR is to outline how the subject lands can be developed with adequate municipal services including sanitary, domestic water, stormwater management (SWM) and utilities in support of the Zoning By-Law Amendment (ZBA), Official Plan Amendment (OPA), and Draft Plan application for the subject lands.

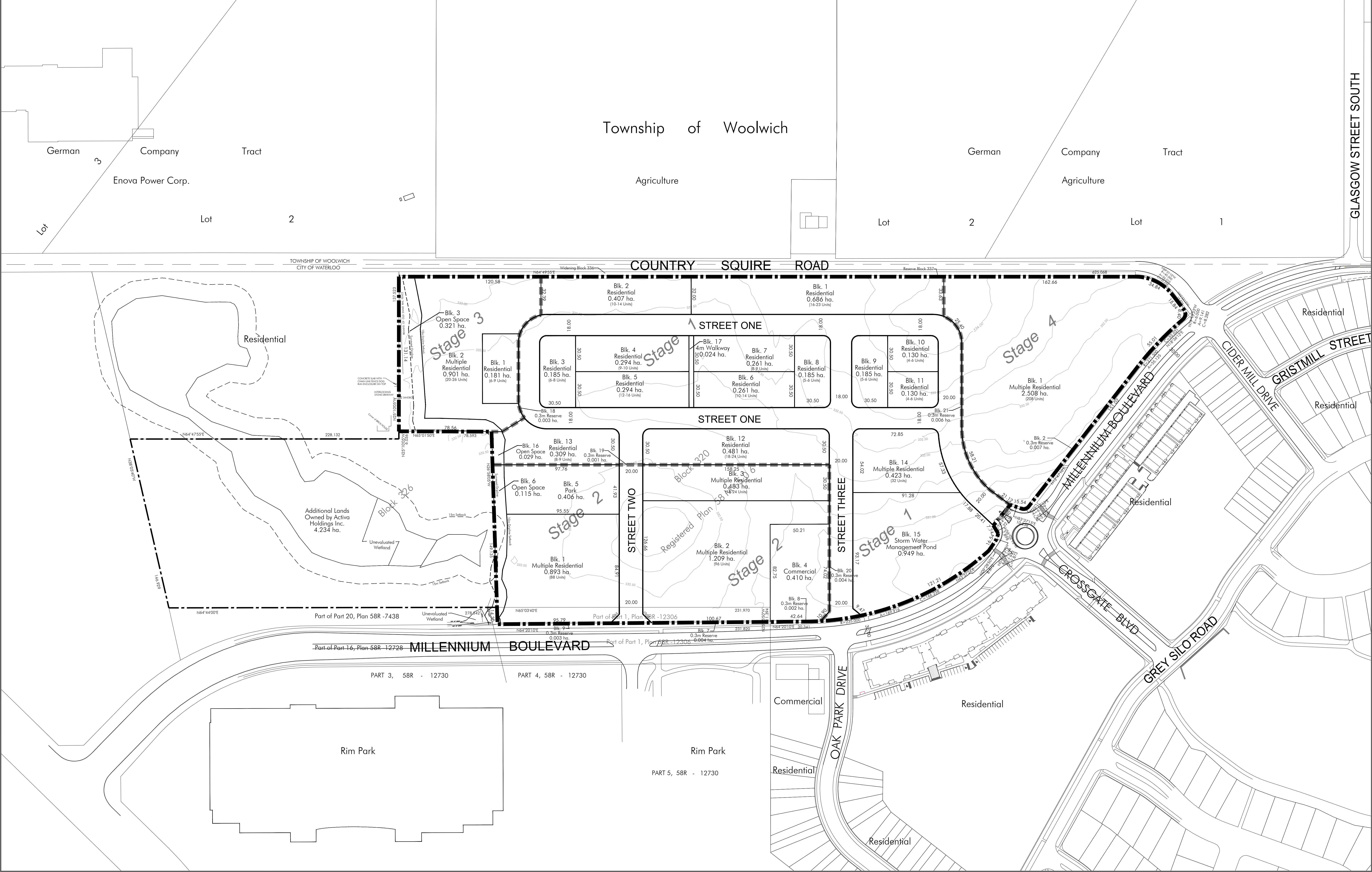
1.1 BACKGROUND REPORTS AND DOCUMENTATION

Supplementary reports that should be read in conjunction with this report include:

- Hydrogeological and Geotechnical Study, Activa Waterloo East Lands, Naylor Engineering Associates Ltd., February 2006.
- Proposed Millennium Lands – Block 320, Plan 58M-506 331 – City of Waterloo, ON.
- Noise Impact Study, Proposed Millennium Lands, Stantec Consulting Ltd., November 2023
- Hydrogeological Technical Memorandum, Carriage Crossing Subdivision (Millennium Boulevard), Stantec Consulting Ltd., November 2024
- Environmental Impact Statement (EIS) Update, 400 Millennium Boulevard Stantec Consulting Ltd., November 2024
- FSR/SWM for Carriage Crossing Subdivision, July 2008.

The drawings included in this report illustrate concept plans for review of grading and servicing within the development and are based on the latest Draft Plan prepared by MHBC, dated September 3, 2024. The servicing strategies presented in the report are conceptual. Detailed engineering drawings and a final SWM Report will be submitted to address draft plan conditions and as part of the engineering detailed design process, once the proposed subdivision has received Draft Plan Approval.





Legal Description
BLOCK 320, PLAN 58M-506,
(GEOGRAPHIC TOWNSHIP OF WATERLOO),
CITY OF WATERLOO,
REGIONAL MUNICIPALITY OF WATERLOO

Owner's Certificate
I AUTHORIZE MACNAUGHTON HERMSEN BRITTON CLARKSON PLANNING LIMITED TO SUBMIT
THIS PLAN FOR APPROVAL.

DATE: _____
Peter Ambruster - Vice President
Community Development
Activa Holdings Inc.

DATE: _____
Justin McFadden
Executive Director of Economic Development
City of Waterloo

Surveyor's Certificate
I HEREBY CERTIFY THAT THE BOUNDARIES OF THE LAND TO BE SUBDIVIDED ON THIS PLAN AND
THEIR RELATIONSHIP TO THE ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE: _____
Humair Malik, O.L.S.
Stantec Geomatics Ltd., Ontario Land Surveyors

Key Plan

Active Holdings Inc. Lands
City of Waterloo Lands
Additional Lands Owned
by Activa Holdings Inc.

North
Not to Scale

Area Schedule

Description	STAGE 1			STAGE 2		
	Lots/Blks	Area	Units	Lots/Blks	Area	Units
Single Family Residential	1,2,4,7-9,13	2.327	61-77			
Street Town Residential	3,5,6,10-12	1.481	54-74			
Multiple Residential	14	0.423	32	1-3	2.585	202-208
Commercial				4	0.410	
Storm Water Mgmt	15	0.949				
Park				5	0.406	
Open Space	16	0.029		6	0.115	
Walkway	17	0.024				
0.3m Reserve	18-21	0.014		7-9	0.009	
Roads		2.224			0.273	
TOTAL	21	7.471	147-183	9	3.798	202-208

Description	STAGE 3			STAGE 4		
	Lots/Blks	Area	Units	Lots/Blks	Area	Units
Street Town Residential	1	0.181	6-9			
Multiple Residential	2	0.901	20-26	1	2.508	208
Open Space	3	0.321				
0.3m Reserve				2	0.007	
Roads						
TOTAL	3	1.403	26-35	2	2.515	208

TOTAL			
Description	Lots/Blks	Area	Units
Single Family Residential	7	2.327	61-77
Street Town Residential	7	1.662	60-83
Multiple Residential	6	6.417	462-474
Commercial	1	0.410	
Storm Water Mgmt	1	0.949	
Park	1	0.406	
Open Space	3	0.465	
Walkway	1	0.024	
0.3m Reserve	8	0.030	
Roads		2.498	
TOTAL	35	15.187	583-634

2 September 3, 2024 For Client Review PL
1 July 11, 2024 Unit Yield Increase to Block 1, Stage 2, Revise Area Schedule. LHB
No Date Issued / Revision By

Notes:
• Topographic information prepared by MTE Engineering, March 23, 2016 & Stantec Consulting, October 2023.
• Contour interval 0.5m
• Parcel Fabric, Region of Waterloo, 2020

**PLANNING
URBAN DESIGN
& LANDSCAPE
ARCHITECTURE**
200-540 BINGEMANS CENTRE DR. KITCHENER, ON, N2B 3X9 | P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

Approval Stamp	Date
	September 3, 2024

File No.	8784CX

Plan Scale	1:1,250

Drawn By	L.H.B. / P.L.

Checked By	P.B. / T.H.

Project	Activa Holdings Inc. Millennium Boulevard Waterloo, Ontario

File Name	DRAFT PLAN OF SUBDIVISION

K:\8784CX-ACTIVA-MILLENNIUM BLVD\DRIFT PLAN\DRIFT PLAN - SEPTEMBER 3 2024.DWG

400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Overall Grading and Drainage
November 2024

2.0 OVERALL GRADING AND DRAINAGE

2.1 EXISTING SITE TOPOGRAPHY AND LAND USE

The site is located on the north side of Millennium Boulevard opposite to the Carriage Crossing community and adjacent to the northern City boundary shared with the Township of Woolwich. The lands were originally intended to be developed as part of the Carriage Crossing community and therefore are a registered Block within the Carriage Crossing Plan of Subdivision. As such, there has already been extensive studies and reports completed as part of that Registration.

The property has historically been used for agricultural purposes and has continued to be cultivated with soy and corn crops in recent years by a local farmer. The site is generally flat with very few trees or other natural vegetation with bounding elevations of approximately 331.0 m above mean sea level (ASL) at Millennium Boulevard and 333.0 mASL at Country Squire Road. The site slopes gently from Country Squire Road towards Millennium Boulevard to an internal low-lying area. During major rainfall events, drainage reaches the Millennium Road right-of-way (ROW), ultimately draining to SWM Facility B (SWMF B) located in the Carriage Crossing Subdivision.

The Existing Conditions and Removals Plan (Drawing C-050) is provided in Appendix A.

2.2 AREA GRADING AND ROAD PROFILE DESIGN CONSTRAINTS

Based on the proposed Concept Plan, the following design constraints and criteria were used in the preliminary grading design:

- Match existing road elevations (i.e., Millennium Boulevard and Country Squire Road)
- Match existing boundary grades around the perimeter of site
- Match existing grades, where possible, to minimize grading and cut/fill quantities and minimize changes to the surface hydrology and hydrogeology of the area
- Satisfy the City of Waterloo's requirements for minimum and maximum road grades
- Ensure 0.5 m separation from high groundwater to proposed basement floors
- Maintain adequate cover over storm and sanitary sewers, and watermains, where possible
- Meet AODA standards for site accessibility
- Provide a major overland flow route for emergency overflow runoff to the existing Carriage Crossing Subdivision (i.e., greater than the 100-year rainfall event)



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Overall Grading and Drainage
November 2024

2.3 PROPOSED SITE GRADING

The proposed preliminary site grading has been completed in accordance with the design constraints outlined in Section 2.2. Where blending to adjacent properties could not be achieved via transition slopes, retaining walls have been proposed. Retaining walls are located along a portion of the northwest property line abutting Country Squire Road. The site is generally built-up from the adjacent roadways, sloping upwards to a central high point located on the northwest side of the site. Retaining walls will be eliminated where possible through detailed design.

In general, the site is proposed to be raised an average of approximately 1 m to provide sufficient cover for municipal servicing. Due to the high groundwater onsite, infiltration is not feasible as the minimum 1.0 m separation distance between the seasonal high groundwater level and infiltration structures cannot be reasonably achieved without raising the site significantly.

The proposed site and lot grading generally ranges from 2.0% to 5.0% slopes. The road profiles are relatively smooth with grades ranging from a minimum of 0.6% to a maximum of 5.0%. Transition slopes are proposed where necessary to blend proposed to existing elevations and proposed roadways. This proposed grading allows for the majority of runoff to be picked up onsite and directed via storm sewers to a proposed SWM facility (SWMF) on site. The major overland flow route is located within the roadway and spills to the existing road, Millennium Boulevard.

The Grading Plan is illustrated on Drawing C-400 located in Appendix A.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Sanitary Servicing
November 2024

3.0 SANITARY SERVICING

Sanitary servicing for the site will be provided from the existing 300 mm diameter sanitary sewer located on Millennium Boulevard. The site will be serviced by a 200 mm diameter internal sanitary sewer main connecting to the existing main along Millennium Boulevard at Crossgate Boulevard complete with a proposed manhole (MH 400A). The main will be extended into site through the proposed internal roads to service the proposed subdivision.

Connection to the existing sanitary sewer will be completed by placing proposed maintenance hole (MH 400A) west of the intersection of Street One and Millennium Boulevard. The internal sewer system services the entire site via 200 mm diameter sanitary sewers conveying flows from Street One, Street Two and Street Three to the site entrance at Millennium Boulevard. Per the preliminary sanitary sewer calculations, the peak flow draining to the Millennium Boulevard sanitary sewer system equals approximately 17.71 L/s.

The existing sanitary plug connection on Millennium Boulevard, servicing the site, has an invert elevation of 328.80 mASL. As mentioned on Section 2.1, the site is generally flat with bounding elevations of approximately 331.0 mASL at Millennium Boulevard and 333.0 mASL at Country Squire Road. In order to achieve the 2.8 m minimum cover requirement on sanitary services, the proposed grading on site has been raised by an average approximately 1 m to meet DGSSM requirements.

The proposed sanitary sewers within the development will generally be constructed at depths ranging from 2.8 m to 4.0 m ensuring sanitary service connections maintain a 2% slope to the buildings per Region of Waterloo Design Guidelines. Please refer to the enclosed Conceptual Servicing Plans (Drawing C-100) and Conceptual Road Profile Plans (Drawings C-200, C-201, C-202, C-203, C-204 and C-205) located in Appendix A for an illustration of the sanitary servicing strategy. The sanitary sewer design calculations completed for the proposed development are provided in Appendix B. The Sanitary Sewer Drainage Area Plan (C-120) is located in Appendix A.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Water Distribution System Analysis
November 2024

4.0 WATER DISTRIBUTION SYSTEM ANALYSIS

4.1 WATER SERVICING BACKGROUND

A water distribution system analysis for the adjacent Carriage Crossing Subdivision was previously completed in July 2008, and a report titled “Rural East District Subdivision Water Distribution Analysis Report” was prepared by Stantec. The report analyzed the proposed water distribution network for the entire Carriage Crossing Subdivision including the subject Millennium Lands and presented the output results of the WaterCAD analysis. The subject Millennium Lands were modeled as future employment lands in the report and assigned Node J-3 located at Millennium Boulevard and Cross Gate Boulevard in the water distribution analysis. Watermains within the Carriage Crossing subdivision were designed such that a 150 L/s fire flow could be provided at Node J-3.

Subsequently, the servicing and roadworks were completed in the Carriage Crossing Subdivision, including installation of watermains on Millennium Boulevard as recommended in the afore-mentioned report dated July 2008. Accordingly, a 300 mm diameter watermain was installed on Millennium Boulevard fronting the subject site and from this watermain, a 300 mm diameter watermain stub was installed for future water servicing of the subject Millennium Boulevard lands.

4.2 METHODOLOGY

4.2.1 OVERVIEW

A Water Distribution Analysis has been carried out for the subject lands based on the Draft Plan Concept presented in Figure 1.0, and the Preliminary Servicing and Grading Plans included in Appendix A.

The intent of the analysis is to determine the appropriate watermain sizes that will adequately distribute projected domestic and fire water demands, and to confirm that the required fire flow can be provided through the proposed fire hydrants under various domestic and fire demand scenarios recommended in the Ministry of the Environment, Conservation and Parks (MECP), Region of Waterloo, and City of Waterloo pressure and distribution guidelines.

The water servicing strategy for the subject lands will include a connection to the existing 300 mm diameter watermain stub on Millennium Boulevard at Oak Park Drive.

4.2.2 MODEL DEVELOPMENT AND DESIGN CRITERIA

The water distribution system analysis was performed using the Haestad Methods Hydraulic Modeling WaterCAD Software. The distribution network was created by assigning physical parameters to each node and pipe. The model was run under various demand scenarios, and each was checked against the relevant guidelines for operating and residual pressures as well as fire flow availability. The parameters and criteria are outlined in the following sections.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Water Distribution System Analysis
November 2024

The proposed development is currently located within the pressure zone referred to as “Wat 4”. The water for the proposed distribution network will be drawn from a connection to the existing 300mm diameter watermain stub on Millennium Boulevard at Oak Park Drive. The Region of Waterloo has provided Hydraulic grade line (HGL) data pertaining to node ‘JCT_20511’ which is located at this connection point. Please refer to the Region’s correspondence dated August 9, 2023 provided in Appendix D. Results under various demand conditions were provided in the Region’s letter to establish the HGL at node ‘JCT_20511’.

From the connection point, a 300 mm diameter watermain will be extended along proposed Street Three within the subdivision as shown the Site Servicing Drawing C-100, included in Appendix A. As shown, 200 mm diameter watermain will be constructed within proposed Street One and Street Two within the subdivision. The proposed hydrants within the subdivision will provide fire coverage for the proposed development. The proposed water distribution network is shown schematically in Appendix D.

4.2.3 REGION OF WATERLOO MUNICIPAL DESIGN GUIDELINES

The Region of Waterloo document entitled *Region of Waterloo and Area Municipal Design Guidelines and Supplemental Specifications for Municipal Services (DGSSMS)*, intended to provide a common regional and area-wide standardization for municipal water distribution and wastewater designs and installation was used to guide the analysis. The general guidelines have been published to provide direction for water distribution system analysis and design, including:

- Pressure, demand, and velocity criteria
- Hydraulic modeling parameters (i.e. friction factors)
- Hydrant spacing and location
- Minimum watermain sizing criteria

The recommendations of the DGSSMS have been followed in completing this analysis.

4.2.4 BOUNDARY CONDITIONS

Hydraulic grade line (HGL) information for the subject subdivision is based on the modeling results provided by the Region of Waterloo. The HGLs were obtained for the average day and maximum day demands as well as data pertaining to a range of fire flow scenarios. A reservoir was assigned the hydraulic grade line determined from the Region’s model for each demand scenario. The following Table 1 provides a summary of the hydraulic grade lines used in the analysis.

Table 1: Hydraulic Grade Lines (Node JCT_20511)

Demand Scenario	Hydraulic Grade Line (m)
Average Day	379.53
Maximum Day	378.48
Minimum Hour	383.08
Peak Hour	375.59
Max. Day + 100 L/s Fire*	372.10
Max. Day + 133 L/s Fire*	368.11

*HGL interpolated from a curve generated from the fire flow analysis



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Water Distribution System Analysis
November 2024

4.2.5 PEAKING FACTORS

The peaking factors used in the model are based on the Region of Waterloo's DGSSMS document and Table 3-1 of the 2008 MECP Design Guidelines for Drinking-Water Systems, as outlined in Table 2.

Table 2: Peaking Factors

Demand Scenario	Factor
Average Day	1.00
Maximum Day	2.00
Peak Hour	3.00
Minimum Hour	0.50

4.2.6 SYSTEM DEMANDS

Population projections were used in conjunction with per capita rates and demand factors to calculate future water demands for the proposed subdivision. A residential per capita rate of 225 L/cap/day was used based on the rate recommended in Region of Waterloo Water Supply and Distribution Master Plan dated May 2015. Using the Draft Plan and population estimates, demand allocation was completed by assigning the demand from contributory areas to each applicable node. Detailed water demand calculations have been provided in Appendix D.

4.2.7 PRESSURE REQUIREMENTS

The Region of Waterloo Pressure Guidelines are to be maintained for all demand scenarios and are consistent with the MECP requirements. The guidelines are shown in Table 3 below.

Table 3: Region of Waterloo Pressure Requirements

Demand Scenario	Pressure Guidelines (kPa)	
	Min.	Max.
Average Day	350	550
Maximum Day	350	550
Peak Hour	275	700
Minimum Hour	275	700
Max. Day + Fire	140	550

The Region of Waterloo requires the use of individual pressure-reducing valves (PRV) on each water service where pressures exceed 550 kPa (80 psi) under any demand scenario.

400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Water Distribution System Analysis
November 2024

4.2.8 FIRE FLOW REQUIREMENTS

Per the City of Waterloo design criteria, the fire flow requirements for any development shall be determined in accordance with the Fire Underwriters Survey (FUS) methodology. Accordingly, the fire flow demand for the proposed development is determined using the *Water Supply for Public Fire Protection, A Guide to Recommended Practice (1999), Fire Underwriter's Survey (FUS)*. Based on the FUS manual, the required fire flows are as follows:

- Modern semi and detached home > 3 m separation – 4,000 L/min (67 L/s)
- Modern semi and detached home < 3 m separation – 6,000 L/min (100 L/s)
- High-density, contiguous multi-block homes – 8,000 L/min (133 L/s)

Assuming a worst-case scenario where the majority of the proposed units may be within a 3 m separation of each other, the larger 100 L/s fire flow was used in the modeling of semi- detached or detached residential areas. The multi-residential blocks were modeled using the 133 L/s criterion.

4.2.9 VELOCITY REQUIREMENTS

The Region of Waterloo and the MECP recommend that velocities throughout the distribution system not exceed a maximum of 5 m/s for non-regional watermain and 1.5 m/s for regional watermain during any demand scenario. Areas of concern are typically at long cul-de-sacs or dead-end stubs of smaller diameter (150mm diameter). Large fire flow loads may cause the velocity in these mains to exceed 5 m/s.

4.2.10 FRICTION FACTOR

The following Hazen-Williams C-factors are commonly used to estimate frictional losses through the distribution system based on material type, as outlined in Table 4.

Table 4: Hazen-Williams C-Factors

Pipe Material	C
PVC	150
Ductile Iron (D.I.)	130
Concrete Pressure Pipe (CPP)	140
High-Density Polyethylene (HDPE)	140

All pipes were assumed to be PVC and a C value of 150 was applied.

4.3 RESULTS

The water distribution analysis was performed using the boundary conditions and demand criteria outlined in the above sections. Based on the analysis, the proposed network sufficiently services the proposed development. Appendix D provides a series of tables summarizing the output results of the WaterCAD analysis. Tables 5 and 6 present a summary of the modeling results at select nodes within the proposed development.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Water Distribution System Analysis
November 2024

Table 5: Modeling Results – Fire Flow¹

Node	Node Elevation (m)	Required Fire Flow (L/s)	Available Fire Flow (L/s)	Required System Pressure (kPa)	Fire Node Pressure (kPa)	Residual System Pressure (kPa)
J-2	333.30	133	>138	140	320	299
J-7	334.10	133	>138	140	268	272
J-8	334.80	133	>138	140	235	240
J-10	335.40	133	>133	140	219	233
J-11	334.80	100	>105	140	310	312
J-13	334.20	133	>138	140	140	179

1. Representative nodes shown. See Appendix D for remaining nodes and all pipe results

The available fire flows shown in Table 5 and Appendix D demonstrate that a fire flow of 100 L/s can be provided at each semi and single detached residential nodes, and 133 L/s to each multi-residential node with the MECF minimum system pressure of 140 kPa as per the DGSSMS. Overall, the required fire flows can be achieved for the proposed land uses.

Table 6: Modeling Results – Pressures¹

Node	Node Elevation (m)	Pressure (kPa)			
		Average Day	Maximum Day	Peak Hour	Minimum Hour
J-2	333.30	452	442	414	487
J-7	334.10	445	434	406	479
J-8	334.80	438	427	399	473
J-10	335.40	432	421	393	467
J-11	334.80	438	427	399	473
J-13	334.20	444	433	405	478

1. Representative nodes shown. See Appendix D for remaining nodes.

Based on the results shown in Table 6 and Appendix D, under the Pressure Zone Wat 4 operating conditions, the pressures during average day, maximum day, peak hour, and minimum hour demands are within the recommended MECF water distribution system operating pressures for the proposed water distribution system within the site; and that individual PRVs will not be required.

4.4 SUMMARY

From the analysis presented in the above sections, the main findings can be summarized as follows:

- The proposed water distribution network will consist of:
 - 300 mm watermain on Street Three
 - 200 mm dia. watermain on Street One and Two
- Velocities in all watermain are generally less than 5 m/s under fire flow conditions
- Individual PRVs will not be required within the proposed development



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Water Distribution System Analysis
November 2024

- All fire flow requirements are met including:
 - 100 L/S provided at all single detached residential buildings
 - 133 L/s provided at all multi-residential and townhome blocks

Given the proposed water distribution network, the proposed subdivision can be serviced, in compliance with all requirements of the City of Waterloo, Region of Waterloo and the Ministry of the Environment, with sufficient water supply available to the proposed development.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Storm Drainage
November 2024

5.0 STORM DRAINAGE

The proposed grading strategy for the site generally conveys runoff to a proposed storm water management facility (SWMF) located at the southeast corner of the site via storm sewers and overland flow strategies. Details of the SWM strategy are discussed in Section 8 of this report. Overflows from the SWMF spillway occur during storms greater than the 100-year storm and will then be conveyed overland through the existing road right-of-way to the existing constructed wetland (SWMF B) approximately 700 m to the east of the site as described in the Carriage Crossing Subdivision Final Stormwater Management Report (CCFSWM), (Stantec, 2010).

Flows from the external agricultural lands north of the site drain into the north limit of the site and are conveyed through the development, to the SWMF. A portion of the proposed road right-of-way area drains uncontrolled offsite in a westerly direction along the Millennium Blvd. The remaining site area directs runoff to the wetland west of the site. Overflow from the proposed SWMF will be conveyed overland to the existing SWMF, noted as SWMF B in CCFSWM (Stantec, 2010), approximately 700m east of the site.

The preliminary storm servicing plan is illustrated in the Conceptual Servicing Plans located in Appendix A.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Geotechnical
November 2024

6.0 GEOTECHNICAL

Naylor Engineering and Associates Ltd. (Naylor) completed a geotechnical investigation to explore the geotechnical characteristics of the site and provide any recommendations in accordance with the conceptual servicing and grading plans prepared for the neighbouring Carriage Crossing subdivision. The complete Geotechnical Investigation (Naylor, February 13, 2006) was reviewed and approved by the City during the approval of the Carriage Crossing subdivision.

In January 2006, an initial field program was conducted, and thirty-six (36) boreholes (thirty complete with monitoring wells) were advanced at regular 0.75 and 1.50 m depth intervals. Of the thirty-six boreholes constructed on this investigation, seven (7) boreholes were constructed within the site (400 Millennium Boulevard). Borehole logs completed as part of the investigation depict the soil stratigraphy to comprise of silty topsoil which overlays silt till in the western portions of the site, and overlays minor deposits of silt/silt till and major deposits of sand and clay till in the eastern portions.

It is recommended that further investigations be carried out throughout the Site Plan Approval process for the design of the various residential and commercial Block(s). Additional assessments may also be required in detailed design where the groundwater table is expected to be close to building footings and/or finished grades. The recommended pavement structure is provided in the Geotechnical Report (Naylor, 2006).



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Hydrogeology
November 2024

7.0 HYDROGEOLOGY

Naylor completed a hydrogeology investigation to assess the baseline groundwater conditions onsite and evaluate how the proposed development may impact the existing hydrogeological regime of the development area. The complete Hydrogeological Investigation (Naylor, February 13, 2006) was part of the approval of the Carriage Crossing subdivision.

As noted on section 6.0, of the thirty-six boreholes constructed on this investigation, seven (7) boreholes were constructed within the site (400 Millennium Boulevard) and six (6) measured groundwater levels. The groundwater levels measured from these boreholes in November 2005 found the water level to vary between approximately 0.75 and 2.5 m below ground surface (BGS). Overall, groundwater throughout the Site was found to be located between 330 and 332 m AMSL.

Stantec completed a supplementary groundwater monitoring and wetland assessment for the subject lands (Block 320) and adjacent wetland (Block 326). The findings were presented in a hydrogeological technical memorandum. Stantec data measured groundwater levels in eight monitoring wells on site since March 2022 and found groundwater levels to vary between approximately 0.0 and 3.2 m BGS. Overall, groundwater throughout the site was found to be located between 329 and 333.1 m AMSL. As expected, higher water levels were observed during the late winter to spring periods. Groundwater elevations observed at the drive-point piezometers in the wetland ranged between 331.8 and 332.9 m AMSL. Due to the observation of neutral to downward vertical gradient occurring beneath the wetland, the results indicate the wetland is likely a groundwater recharge feature.

Groundwater flow direction is from the northwest to the southeast away from the wetland towards Millennium Boulevard. The direction of groundwater flow at this site indicates that development of the site is not expected to have an impact on pre-existing groundwater flow that may sustain the wetland. These results indicate that the future development of the site will not have an impact on existing groundwater flows that may sustain the wetland, given that these potential groundwater inputs originate from the lands to the northeast of the site.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

8.0 STORMWATER MANAGEMENT

8.1 INTRODUCTION

The stormwater management (SWM) design for the proposed development (site) is being completed with a preliminary level of detail in support of the overall Draft Plan of Subdivision application. The purpose of the preliminary SWM design is to demonstrate that the proposed SWM strategy is functional, and that the SWM criteria will be achieved. The SWM design components will be further investigated and refined at the detailed design stage.

Within the completion of this drainage assessment and SWM design, the following sources have been referenced:

- *Stormwater Management Planning and Design Manual (SWMPD Manual)*, Ontario Ministry of the Environment, March 2003.
- *Hydrogeological and Geotechnical Study, Activa Waterloo East Lands*, Naylor Engineering Associates Ltd., February 2006.
- *Carriage Crossing Subdivision Final Stormwater Management Report (CCFSWM)*, Stantec Consulting Ltd., May 2010 (Appended).
- *Erosion and Sediment Control Guide for Urban Construction*, Toronto and Region Conservation Authority (TRCA), 2019.
- *Hydrogeological Technical Memorandum, Supplementary Groundwater Monitoring and Wetland Assessment, Carriage Crossing Subdivision (Millennium Boulevard), Blocks 320 and 326 (Registered Plan 58M-506), Waterloo Ontario (Hydrogeological Technical Memorandum)*, Stantec Consulting Ltd., October 2023.
- *Grand River Conservation Authority (GRCA) "Map Your Property" tool*, 2023.
- *Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) "AgMaps" tool*, 2023.
- *City of Waterloo Comprehensive Engineering and Landscape Manual (CELM)*, City of Waterloo, May 2024.

8.2 OVERVIEW

The subject property is approximately 14.89 ha in area and was originally included as a parcel within the previous Carriage Crossing Draft Plan of Subdivision submission. The site is bordered by Millennium Blvd. to the east and southeast, Country Squire Rd. to the northwest, and forested lands and wetland to the west/southwest. The site is within the Upper Grand River watershed and the southwest corner of the site is within the GRCA regulation limit due to the wetland located southwest of the site. The wetland is not considered to be a Provincially Significant Wetland. The site is not located in any mapped Wellhead Protection Areas (WHPA) or Areas of Natural and Scientific Interest (ANSI) (GRCA, 2023).



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

8.3 STUDY APPROACH

The objective of the SWM plan is to ensure that the proposed development includes the necessary controls to mitigate the impacts to the existing hydrologic functions of the receiving systems. The study approach includes the following components:

- Complete hydrologic models for the existing and proposed development conditions to determine hydrologic response to downstream receivers.
- Complete preliminary design of SWMF as required to control the site runoff in accordance with SWMPD (2003), and CELM (2024) requirements.
- Assess the existing site and offsite wetland water balance and evaluate site runoff potential to maintain or enhance runoff rates to the wetland.
- Develop a preliminary erosion and sediment control (ESC) strategy to be implemented during construction.
- Summarize the study and present recommendations for the proposed development.

8.4 STORMWATER MANAGEMENT DESIGN

Stormwater management criteria were established through review of technical guidelines, site-specific requirements and the *Carriage Crossing Subdivision Final SWM Report (Stantec, 2010)*. The stormwater management criteria applicable to the proposed development is as follows:

Water Quantity / Erosion:	Control 2-year through to the 5-year post-development peak flow rates to existing conditions rates. Return periods greater than the 5-year storm will be controlled by Stormwater Management Facility B (SWMF B) per CCFSWM report and discussed in Section 8.7 below. • Provide sufficient extended detention with the SWMF.
Water Quality:	Provide sufficient permanent pool and extended detention volume to meet MOE Enhanced (Level 1) criteria as identified in Table 3.2 of the MOE Manual.
Water Balance:	Evaluate the infiltration potential onsite as it relates to the existing water budget and recommend measures to meet the goal of maintaining water supply to the adjacent wetland.

8.5 EXISTING CONDITIONS

8.5.1 TOPOGRAPHY AND SURFACE DRAINAGE

The existing land use of the study area is primarily agricultural, with woodlots and a wetland located west of the site. The topography of the site is moderately rolling with two high points around 334 m above mean sea level (AMSL) and a low point of 330.5 m AMSL. The site predominately slopes to the southeast, with the low-point located just south of the intersection at Crossgate Blvd. and Millennium Blvd. The majority of the site



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

runoff outlets at this point, either through infiltration or draining overland to the Millennium Blvd right-of way. These flows are then directed approximately 700 m east to the previously constructed SWMF B. A portion of the runoff outlets at the south end of the site, draining overland to the Millennium Blvd. right-of-way and is subsequently conveyed in a westerly direction. The west portion of the site area drains in a westerly direction, feeding into the adjacent wetland.

8.5.2 GEOTECHNICAL/HYDROGEOLOGICAL INFORMATION

The Hydrogeological Technical Memorandum (Stantec, 2023) describes the site as being within the Oxford Till Plain, an area characterized by drumlinized till plains consisting of sands and silts. Borehole investigations characterize the stratigraphic conditions beneath the site as predominantly surficial topsoil overlying native deposits of sandy silt and/or clayey silt till. The central and eastern portions of the site also have areas of sand in the glacial till deposits (Stantec, 2023). The Hydrogeological and Geotechnical Study conducted by Naylor Engineering Associates in 2006 generally supports these findings. The OMAFRA “AgMaps” soil mapping tool was also used to confirm these results (OMAFRA, 2023). Based on this tool, the majority of the site falls within Tavistock Loam soil type. Tavistock Loam is classified as a hydrologic soil type ‘C’. Soils in the C group generally have slow infiltration rates and moderate to high runoff potential.

Based on the previous geotechnical investigation (Naylor, 2006), groundwater appears to occur in the shallow overburden soil deposits, flowing laterally towards the intermittent stream just east of the intersection of Grey Silo Road and Crossgate Blvd. (approximately 200 m east of the site boundary). In locations where surficial sands are present, some shallow groundwater flows vertically into the regional aquifer system, overall flowing east and south to the Grand River. Recent Stantec investigations confirm these conclusions, with August 2022 and April 2023 data showing groundwater flow from northwest to southeast across the Site toward Millennium Blvd (Stantec, 2023). See Appendix C for groundwater monitoring data.

Of the seven boreholes constructed on site in the Naylor investigation (2006), six measured groundwater levels. The groundwater levels measured from these boreholes in November 2005 found the water level to vary between approximately 0.75 and 2.5 m below ground surface (BGS). Overall, groundwater throughout the site was found to be located between 330 and 332 m AMSL. Recent Stantec investigations measured groundwater levels in eight monitoring wells on site between March 2022 and May 2023 and found groundwater levels to vary between approximately 0.0 and 3.2 m BGS. Overall, groundwater throughout the site was found to be located between 329.0 and 333.1 m AMSL. As expected, higher water levels were observed during the spring freshet (Stantec, 2023).

Previous investigations and reporting of the site location stated that infiltration would likely not be feasible on the site due to the high groundwater levels, but that this should be confirmed with future testing (Stantec, 2010). The Hydrogeological Technical Memorandum (Stantec, 2023) confirms this conclusion.



8.6 STORMWATER MANAGEMENT DESIGN

8.6.1 HYDROLOGIC MODELLING

A hydrologic model was prepared using the Stormwater Management Hydrologic Model (SWMHYMO) software to simulate existing and proposed drainage conditions for the subject development and design of the SWMF. The following return periods and rainfall distributions were used for the hydrologic models:

- 25 mm, 4-hour Chicago Storm
- City of Waterloo 2- to 100-year, 3-hour Chicago Storm distributions

Table 7 includes the IDF parameters and resulting rainfall depth for each storm event.

Table 7: Rainfall Events – City of Waterloo IDF Parameters

Storm Event	IDF Parameters			Event Depth (mm)
	A	B	C	
25mm	-	-	-	25.0
2-yr	1101	9.258	0.882	32.4
5-yr	1755	12.347	0.895	47.5
25-yr	3261	16.193	0.938	69.2
100-yr	4692	17.437	0.956	89.9

8.6.2 EXISTING CONDITIONS HYDROLOGIC MODEL

An existing conditions hydrologic model was developed using SWMHYMO to simulate drainage from the site and determine pre-development target release rates. Flows from the 25mm event and the 2- to 100-year storm events were modelled. Under existing conditions, most runoff from the site drains in a southeasterly direction toward Millennium Blvd. right-of-way near the Millennium Blvd. and Crossgate Blvd. roundabout. Most of this flow is conveyed to a ditch inlet catch basin (DICB) northwest of the roundabout which ultimately discharges through a storm sewer system to the intermittent stream / wetland area at the intersection of Crossgate Blvd. and Grey Silo Rd. via an outfall. A portion of the site drains to Millennium Blvd. and is subsequently conveyed east to the existing SWMF B. Another small portion of the site flows drain south and are conveyed west along Millennium Blvd. The western portion of the site generally drains west to the existing wetland. Existing conditions catchment delineations, including external areas which drain onto the site, are provided on Figure 2 and are summarized as follows:

- **Catchment 100:** 9.64 ha of existing agricultural lands northwest of Millennium Blvd., draining southeast to Millennium Blvd. south of the roundabout.
- **Catchment 101:** 0.82 ha of existing agricultural lands north of Millennium Blvd., draining to Millennium Blvd. right-of-way and being conveyed east toward SWMF B.
- **Catchment 102:** 2.03 ha of existing agricultural lands north of Millennium Blvd., draining west to the wetland.
- **Catchment 103:** 2.25 ha of existing agricultural lands northwest of Millennium Blvd., draining south to Millennium Blvd., north of the existing roundabout.

400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

- **Catchment 104:** 4.50 ha of external agricultural lands draining into the north limit of the site, over Country Squire Rd.
- **Catchment 105:** 0.13 ha of existing agricultural lands north of Millennium Blvd., draining to Millennium Blvd. right-of-way and being conveyed west.

Schematics of the SWMHYMO model output files and parameter calculations are provided in Appendix C. Soil Conservation Service (SCS) Curve Numbers and catchment parameters were calculated for each catchment based on land use and soil type and are provided in Appendix C.

8.6.3 PROPOSED CONDITIONS HYDROLOGIC MODEL

Proposed conditions catchments were delineated as shown on Figure 3. The proposed development consists mainly of a mixed-residential area, including single-family homes, townhomes, low-rise residential units, and parking areas. The proposed development includes a SWMF wet pond in the southeast corner of the site and a park in the west. Most of the site runoff drains to the proposed SWMF. Flows from the external agricultural lands north of the site drain into the north limit of the site and are conveyed through the development to the SWMF. A small portion of the street facing landscaped area drains uncontrolled offsite in a westerly direction along the Millennium Blvd. A portion of the rear lots and road right-of-way also drains uncontrolled to Millennium Blvd and subsequently the existing SWMF, noted as SWMF B in CCFSWM (Stantec, 2010), approximately 700 m east of the site. The remaining site area directs parkland and rear yard runoff to the wetland west of the site. Overflow from the proposed SWMF will be conveyed overland to the existing SWMFB. Minor storm events include all storm events up to and including the 5-year storm. Major storm events include all storm events above the 5-year storm including the regional storm event. The proposed catchments are summarized as follows:

- **Catchment 200:** 12.30 ha of the proposed development, containing a large mixed residential block consisting of single-family homes, low-rise residential units, townhomes, a roundabout, parking lots, and the SWMF. Minor flows from the catchment drain to the SWMF forebay via storm sewers. Major flows will flow overland through the internal roadways' rights-of-way, entering the SWMF forebay at the low point of Street Three.
- **Catchment 201:** 1.50 ha of the proposed development, containing a park, rear yards and rooftops that are conveyed south or west to the wetland.
- **Catchment 202:** 0.17 ha of the proposed development, containing a small area of the road right-of-way and landscaped areas draining uncontrolled to Millennium Blvd. and being conveyed in an easterly direction. Minor and major flows ultimately drain to the existing SWMF B.
- **Catchment 203:** 0.05 ha of the proposed development, containing a small area of the road right-of-way draining uncontrolled to Millennium Blvd. Minor and major flows ultimately drain to the existing SWMF B.
- **Catchment 204:** 0.82 ha of the proposed development, containing rear lots in the northeast corner of the property and a small part of road right-of-way, sheet flowing uncontrolled to Millennium Blvd. Minor and major flows ultimately drain to the existing SWMF B.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

- **Catchment 205:** 4.50 ha of existing agricultural lands and part of Country Squire Road. Minor and major flows drain over Country Squire Road into the development (catchment 200). Minor flows from the catchment ultimately drain to the SWMF forebay via storm sewers. Major flows will be conveyed overland through the internal roadways' rights-of-way, entering the SWMF forebay at the low point of Street Three in catchment 200.
- **Catchment 206:** 0.03 ha of the proposed development, containing landscaped area draining uncontrolled to Millennium Blvd. and being conveyed in a westerly direction.

Schematics of the SWMHYMO model, output files and parameter calculations are provided in Appendix C. Soil Conservation Service (SCS) Curve Numbers and catchment parameters were calculated for each catchment based on land use and soil type and are provided in Appendix C.

8.7 STORMWATER MANAGEMENT STRATEGY

Water quantity and water quality control for the majority of the site drainage area will be provided by an end-of-pipe wet pond SWMF. The proposed SWMF is designed to provide enhanced (formerly Level 1) level of water quality control (80% TSS removal efficiency) through the inclusion of permanent pool and extended detention storage as well as a single sediment forebay, sized per the requirements of the SWMPD Manual (MOE, 2003). The onsite SWMF is designed to control all storm events up to and including the 100-year from the contributing area. As a provision, overflows from the SWMF spillway will be conveyed overland through the existing road right-of-way to the existing constructed wetland (SWMF B) approximately 700m to the east of the site as described in the CCFSWM (Stantec, 2010).

A portion of the site drainage is directed uncontrolled to the wetland. The contributing area consists of pervious or "clean" sources (rear yards, rooftops, green spaces, etc.) and thus do not require water quality control. It was determined through the environmental and hydrogeological investigations that the wetland southwest of the site is primarily supplied with surface water rather than groundwater. As a result, the area draining to the wetland has been sized accordingly to convey a similar amount of runoff to the wetland as in existing conditions. Peak flow attenuation is inherently provided for the wetland with the reduction of the contributing drainage area.

An erosion and sediment control (ESC) strategy will be in place throughout construction to mitigate erosion and the transport of sediment into downstream waterbodies. Refer to Section 9.0 for more details related to a preliminary ESC strategy. A monitoring and maintenance program will be developed during detailed design to ensure continued SWMF functionality.

8.7.1 STORMWATER MANAGEMENT FACILITY DESIGN

The preferred SWM plan for the site includes an onsite wet pond SWMF that accepts drainage from and provides treatment for 16.80 ha of contributing land with a weighted impervious percentage of 45%, including the external catchment north of Country Squire Road. Active storage volume will be discharged to the existing storm sewer system on Crossgate Boulevard. via a reverse slope pipe and vertical circular orifice within the outlet structure manifold. Flows from this storm sewer will ultimately discharge to the intermittent



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

stream / wetland at the intersection of Crossgate Boulevard and Grey Silo Road via an outfall, as originally described in the CCFSWM (Stantec, 2010). Storm events up to and including the 100-year are contained within the proposed SWMF. An emergency overflow weir is provided as a provision to drain the pond in the event of outlet failure or infrequent storm events. The overflow weir is designed as a rip-rap spillway to the Millennium Blvd. right-of way and flow subsequently drains overland to the existing SWMF B downstream.

The onsite SWMF is located in the south-east corner of the site, bordering Millennium Boulevard between Oak Park Drive and Crossgate Boulevard on the southeast, internal development roads on the north and southwest, and a Multi-Residential Block to the northwest. The total depth of the pond is 3.8 m and the permanent pool depth is 1.2 m. Based on the MOE volume requirements for enhanced quality control, the required permanent pool volume is 2,112 m³. The current design of the pond includes 2,210 m³ of permanent pool volume. In addition, the SWMF provides sufficient extended detention storage and outlets via a 190 mm water quality extended detention orifice, resulting in a 28.2-hour drawdown of the 4-hr Chicago – 25 mm event.

The sediment storage capacity of the forebay is 140 m³, which corresponds to a cleanout frequency of 8.2 years. The forebay length required to provide appropriate dispersion and settling length for the 5-year inlet flow is 36.3 m and 25.4 m, respectively. The design length of the forebay is 53 m. Forebay design calculations are provided in Appendix C.

The offsite SWMF B has been designed to control the overflow from the proposed onsite wet pond SWMF for events greater than the 5-year storm event, in addition to a portion of the original Carriage Crossing development lands. SWMF B provides sufficient extended detention storage to achieve a 26-hour drawdown of the MOE water quality control volumes from all contributing areas. For more information on the design of this facility, see the CCFSWM (Stantec, 2010) in Appendix C.

Design characteristics for the proposed onsite SWMF are summarized in Table 8, with design calculations provided in Appendix C.

Table 8: SWMF Design Characteristics

Parameter	Basin Characteristics
Total Contributing Drainage Area	16.80 ha
Bottom Elevation of Pond	328.50 m
Permanent Pool Elevation	329.70 m
Pond Top Elevation	332.30 m
High Water Level (100-year Storm Event)	331.87 m
Freeboard Provided Above High-Water Level	0.43 m
Water Quality Control (Enhanced/Level 1)	
Contributing Area req. Quality Control	16.80 ha
Impervious Coverage	45 %
Unit Area Storage Requirement	166 m ³ /ha
Total Volume Required	2784 m ³
Permanent Pool Volume Required	2112 m ³



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

Permanent Pool Volume Provided	2210 m ³
Permanent Pool Depth in Forebay	1.20 m
Extended Detention Volume Required (40 m ³ /ha)	672 m ³
25 mm Event Extended Detention Drawdown Time	28.2 hours
100 – Year Event Extended Detention Drawdown Time	55.3 hours
Forebay Parameters	
Length Required	36.3 m
Length Provided	53.0 m
Maximum Sediment Accumulation Depth	0.35 m
Cleanout Frequency	8.2 yrs
Outlet Structure Details	
Orifice Diameter	190 mm
Orifice Invert Elevation	329.70 m
Emergency Spillway Elevation	332.00 m
Emergency Spillway Invert Width	2.00 m

The SWMF operating characteristics for the onsite SWMF are provided in Table 9.

Table 9: Onsite SWMF Operating Characteristics

Parameters	25 mm	2-Yr	5-Yr	25-Yr	100-Yr
Proposed Peak Facility Inflow (m ³ /s)	0.928	1.332	1.929	2.986	4.187
Proposed Peak Facility Outflow (m ³ /s)	0.048	0.059	0.075	0.094	0.109
Maximum Storage Volume (m ³)	0.159	0.237	0.402	0.670	0.949
Maximum Ponding Elevation (m)	330.21	330.42	330.80	331.36	331.87
Maximum Ponding Depth (m)	0.51	0.72	1.10	1.66	2.17
Drawdown Time (hours)	28.2	32.1	38.9	47.7	55.3

The SWMF design meets the desired drawdown requirements as per the SWMPD (MOE, 2003). The resulting peak flow rates to the site outlets have been compared to the existing target rates for each return period and are presented in Table 10.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

Table 10: Existing and Proposed Peak Flows

Storm Event	Peak Flow to Wetland (m ³ /s)		Peak Flow to Millennium Blvd., draining to existing SWMF B (m ³ /s)		Peak Flow to Millennium Blvd., draining east to intermittent stream (m ³ /s)		Peak Flow to Millennium Blvd., draining west (m ³ /s)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
25 mm Event	0.034	0.026	0.015	0.037	0.186	0.048	0.002	0.001
2-year	0.057	0.044	0.025	0.057	0.310	0.059	0.003	0.001
5-year	0.108	0.084	0.047	0.101	0.585	0.075	0.006	0.002
25-year	0.197	0.158	0.087	0.182	1.064	0.094	0.011	0.005
100-year	0.294	0.242	0.130	0.275	1.577	0.109	0.017	0.007

As shown in Table 10, the proposed peak flow rates are controlled to below existing condition levels for all storm events to the Wetland west of the site, intermittent stream, and west of Millenium Blvd. Proposed peak flows are greater than existing conditions to the existing SWMF B for all storm events. The existing SWMF B was designed with capacity to attenuate major flows from the site. Stormwater management design calculations are provided in Appendix C. Output for both the existing and proposed hydrologic models are provided in Appendix C.

8.7.2 MAJOR STORM CONVEYANCE DISCUSSION

The General Grading Plan (Drawing C-400) provided in Appendix A displays the major overland flow routes throughout the subdivision. Generally, the major flows from the Residential and Commercial Blocks will drain to the internal roads' rights-of-way which are subsequently conveyed to the SWM Block through the low point on Street Three.

Major flows from a portion of the 2.5 ha Multiple Residential block 1 in the northeast corner of the site are conveyed through the parking lot of the 0.47 ha Multiple Residential block 14 to Street Three, where they enter the SWMF. Similarly, major flows from the 0.97 ha Multiple Residential block 1 west of Street Two are conveyed through the parking lot of the 1.69 ha Multiple Residential block 2 before entering the SWMF through the low point on Street Three. Additionally, 4.50 ha of existing agricultural lands (catchment 205) drains over Country Squire Road into the development (catchment 200) and major flows will be conveyed overland through the internal roadways' rights-of-way, entering the SWMF forebay at the low point of Street Three in catchment 200.

The regulatory storm event will be modelled during detailed design to determine the major flow capacity at certain locations.

8.7.3 ADDITIONAL DESIGN CONSIDERATIONS

Due to the high groundwater observed throughout the site (Stantec, 2023, Naylor, 2006) several additional considerations must be made and are as follows:



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

8.7.3.1 INFILTRATION

As the development of the site will result in an increase of impervious surface, Low-Impact-Development options were considered to increase the volume infiltration to the subsurface. A constraint of infiltration augmentation measures is the positioning of the seasonally high groundwater table. The SWMPD suggests that infiltration facilities be a minimum 1.0 m above the groundwater table. It was determined based on recent hydrogeological studies that underground infiltration measures were not feasible on the site due to the elevation of the water table. This was noted in *Carriage Crossing Subdivision Final Stormwater Management Report* (Stantec, 2010) and confirmed with recent testing (Stantec, 2023). In the absence of formal infiltration measures, distributive infiltration measures have been incorporated into the site design in order to provide additional opportunity for retention of site runoff prior to discharging to the storm sewer. These passive measures include:

- Minimizing site slopes.
- Increased topsoil thickness to increase retention potential.
- Directing rooftop runoff to pervious surfaces prior to collection in the Storm Sewers.

8.7.3.2 SWMF CONSIDERATIONS

It is anticipated that a liner will be required on the SWMF due to the high water table and the layer of sand and silt near the base of the SWMF, as identified from borehole logs in the *Naylor, 2006* investigation. During detailed design, the geotechnical engineer should review and assess conditions at the base of the facility to confirm if a liner will be required.

Seasonal groundwater fluctuations may require the need for slope drains or weepers installed within the SWMF to effectively lower the water table and reduce the hydrostatic pressure acting on the embankments. The application of slope drains or weepers should be investigated by a geotechnical engineer during detailed design.

8.8 WATER BALANCE ANALYSIS

Based on recent hydrogeological investigations (Stantec, 2023), it was determined that the wetland west of the site is primarily surface water fed and acts as a groundwater recharge feature. Groundwater within the site flows from northwest to southeast, away from the wetland; thus, infiltration from the proposed development area does not enter the wetland. As a result, the purpose of the water balance analysis is to ensure the surface runoff volumes directed to the wetland from the development lands are within 10% of the existing annual runoff rates, in order to ensure continued wetland function.

A monthly water balance analysis was conducted using the Thornthwaite and Mather method, for both the overall site and for the offsite wetland. The soils across the site are not anticipated to change from the existing to the proposed condition, therefore, the area, land use and vegetation cover are the only changing parameters in the calculations. The runoff from the existing conditions wetland-contributing catchment corresponds to catchment 102 in the existing conditions and catchment 201 in the proposed conditions. Site-wide conditions refer to flows from the entire proposed development area.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Stormwater Management
November 2024

Table 11 provides an annual summary of runoff estimates for the wetland and overall site. The detailed monthly calculations are included in Appendix C.

Table 11: Wetland and Site Water Balance

Analysis	Area (ha)	Water Supply	
		Groundwater Recharge (m ³ /yr)	Runoff (m ³ /yr)
Existing Conditions Wetland-Contributing Catchment	2.03	2,216	2,216
Proposed Conditions Wetland-Contributing Catchment	1.50	1,299	2,368
Difference		-917	152
Existing Conditions Site-Wide	19.37	22,688	22,124
Proposed Conditions Site-Wide	19.37	11,156	68,493
Difference		-11,532	46,368

Although the wetland-contributing catchment area is decreased by 26% from existing to proposed conditions, the addition of impervious rooftop runoff area from the proposed development generates a slight runoff surplus (152 m³/yr) to the wetland. This corresponds to an increase in runoff volume directed to the wetland of approximately 7% from existing conditions. The infiltration deficit in the wetland-contributing catchment is not anticipated to impact the wetland function because the ground water from catchment 201 is flowing southeast, away from the wetland. The proposed wetland-contributing catchment will be graded towards the wetland to supplement the surface water supply. The site-wide water balance is deemed acceptable as runoff will be controlled by the SWMF.

8.9 MONITORING AND MAINTENANCE

Monitoring and maintenance activities are an important part of a SWM Plan to ensure that the designed features continue to operate as intended. Volume 2 of the City of Waterloo Comprehensive Engineering and Landscape Manual, (City of Waterloo, 2023) identifies three stages of monitoring: pre-construction (Stage I), during-construction (Stage II) and post-construction (Stage III) analysis. The objectives of these stages are to establish baseline environmental conditions, monitor the effectiveness of the erosion and sedimentation control measures during construction and to evaluate the operation of the facilities, respectively. A detailed monitoring and maintenance plan has been outlined within the *Carriage Crossing Subdivision Final Stormwater Management Report* (Stantec, 2010). A detailed Stage II and Stage III monitoring plan will be prepared for the proposed SWMF during detailed design.



V:\01403\active\160310788\design\drawing\C3D\sheet_files\2023 Millennium
Sheets\160310788_C-SD-PE.dwg
10/30/2024 2:46:30 PM BY:MAST-VJL



Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4
Tel: (519) 579-4410
www.stantec.com

Legend

-  AREA I.D.
CATCHMENT AREA
-  MAJOR OVERLAND FLOOD ROUTE
-  DRAINAGE BOUNDARY

Notes

TOTAL AREA = 19.37 ha
IMPERVIOUS AREA = 0.47 ha (2.4%)
PERVIOUS AREA = 18.90 ha (97.6%)

Client/Project

ACTIVA HOLDINGS INC.
MILLENNIUM BOULEVARD

Project No.

160310788

Title

STORM DRAINAGE AREA
PLAN PRE-DEVELOPMENT

Revision

Reference Sheet

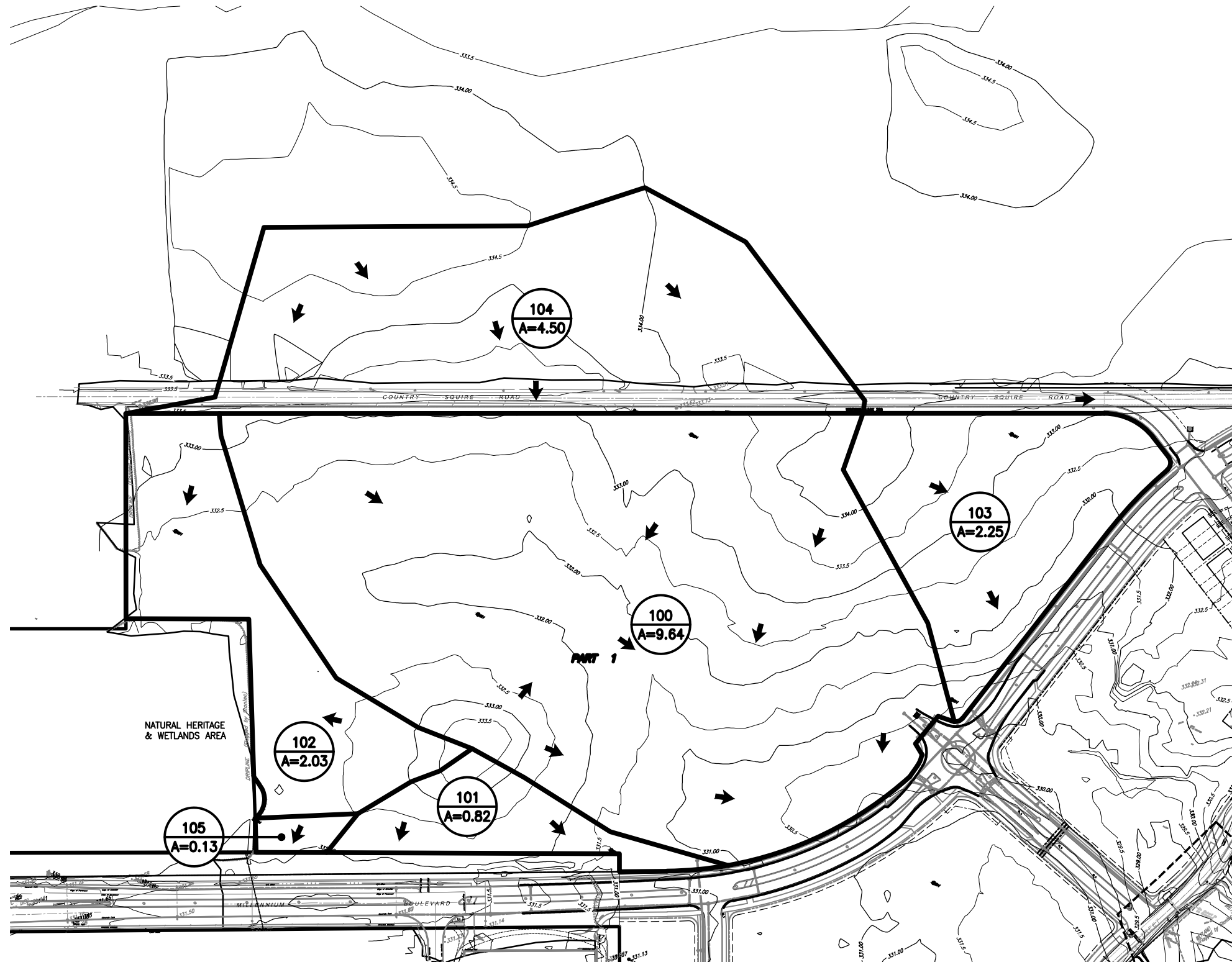
Date

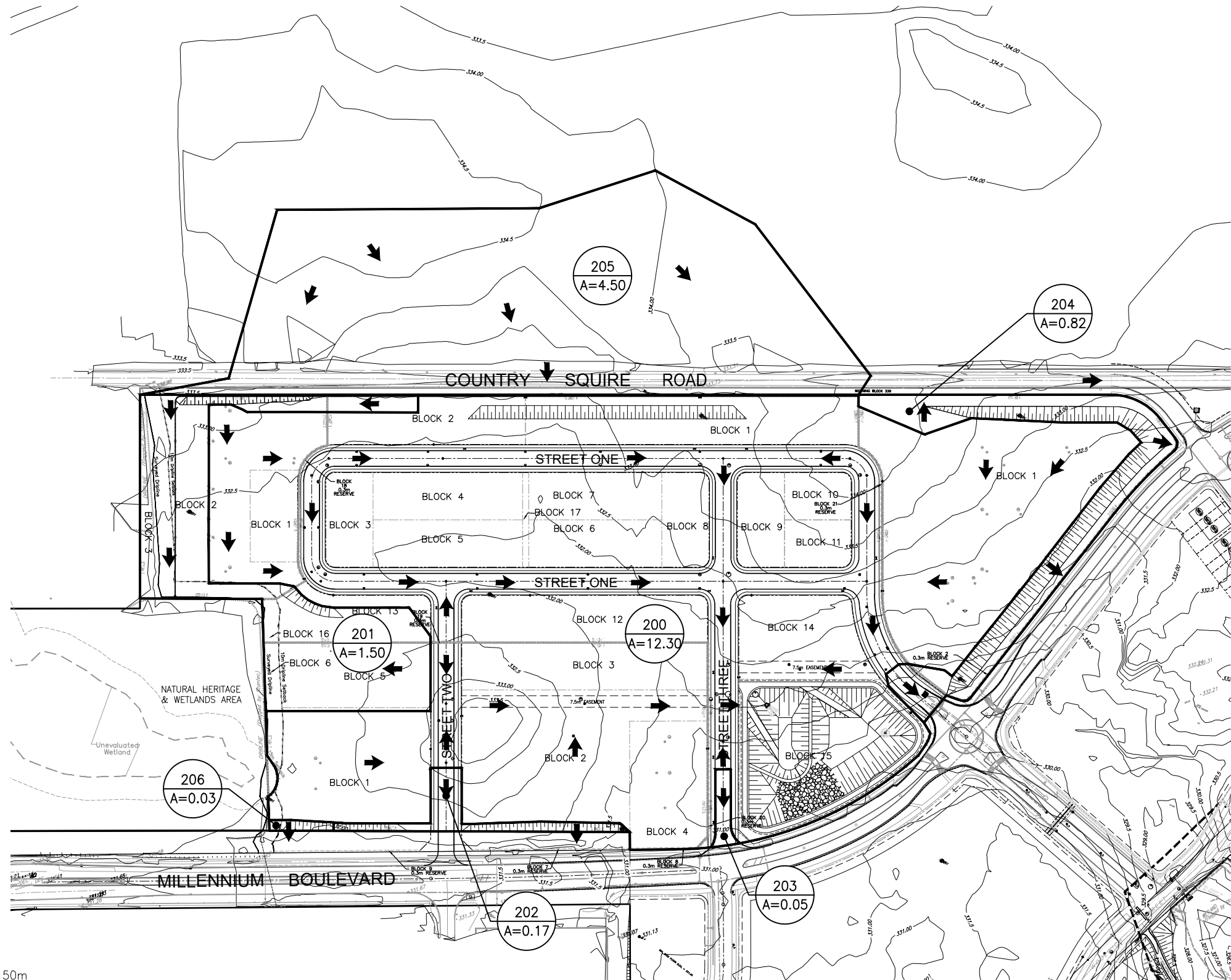
2024.10.30

Figure No.

2

1:3000
0 30 90 150m





Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo ON N2L 0A4
Tel: (519) 579-4410
www.stantec.com

Legend

-  AREA I.D.
CATCHMENT AREA
-  MAJOR OVERLAND FLOOD ROUTE
-  DRAINAGE BOUNDARY

Notes

TOTAL AREA = 19.37 ha
IMPERVIOUS AREA = 8.06 ha (41.6%)
PERVIOUS AREA = 11.31 ha (58.4%)

Client/Project
ACTIVA HOLDINGS INC.
MILLENNIUM BOULEVARD

Project No.
160310788

Title
STORM DRAINAGE AREA
PLAN POST-DEVELOPMENT

Revision	Date
	2024.10.30
Reference Sheet	Figure No.
	3

V:\01403\active\160310788\design\drawing\C3D\sheet_files\2023 Millennium
Sheets\160310788_C3D-POST.dwg
10/30/2024 2:45:02 PM Bv.Mast1.Wll

400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Erosion and Sediment Control Plan
November 2024

9.0 EROSION AND SEDIMENT CONTROL PLAN

An erosion and sediment control strategy will be developed during detailed design and implemented during the construction process in order to minimize the potential for offsite discharge of sediment and the associated negative environmental impacts.

Though subject to refinement in conjunction with final design activities, the following preliminary strategy has been developed to outline the anticipated approach. Most of the various construction activities will result in the disturbance of at-surface soils to various extents, ranging from construction traffic to topsoil stripping and/or grading activities involving cutting or filling, all of which expose the underlying earth to potential erosion and sediment transport to offsite locations. In all instances where the potential for erosion is identified, a series of control measures should be implemented that may include:

- Erect silt fence before grading begins around the perimeter of site to protect the downstream lands from potential sediment transport that may be entrained in overland flows.
- Install erosion control matting on all steep (>3:1) slopes.
- Provide a construction entrance feature ("mud mat") at all site entrances to minimize the transport of sediment on construction vehicle tires.
- Direct runoff via swales and erosion control berms (where necessary) to sediment control measures to ensure that no untreated runoff is discharged from the site.
- Install temporary rock check dams in swales where appropriate to help attenuate flows, reduce erosive velocities, and encourage sediment deposition.
- During construction, all catchbasins are to be sealed until roads are paved to prevent sediment deposition in the catchbasin sumps and conveyance of silt to the infiltration galleries.
- Immediately stabilize all disturbed areas not subject to construction activities within 30 days, according to OPSS 572.



10.0 UTILITIES

Utility Groups were contacted by Stantec Consulting Ltd. early in July 2023 requesting information outlining servicing capabilities for the site. There is significant existing overhead and underground utility infrastructure on Millennium Boulevard. The following information has been obtained from the various utility companies. Coordination with the companies will continue throughout the design process to determine distribution systems for the site.

10.1 ENOVA POWER

Correspondence is ongoing with Enova Power Corp. to confirm existing hydro infrastructure surrounding the site and capacity to service the development. However, based on previous correspondence with Enova (formerly Waterloo North Hydro) regarding neighbouring development, Carriage Crossings, Enova confirmed they have existing infrastructure on Country Squire Road and Millennium Boulevard.

10.2 ENBRIDGE GAS

Correspondence is ongoing with Enbridge to confirm existing gas infrastructure surrounding the site and capacity to service the development. However, based on previous correspondence with Enbridge (formerly Union Gas) regarding neighbouring development, Carriage Crossings, Enbridge confirmed they have existing infrastructure on Country Squire Road and Millennium Boulevard, near University Avenue.

10.3 BELL CANADA

Bell Canada has indicated that fibre servicing can be extended to the site from existing infrastructure on Millennium Boulevard. Relocation of bell pedestals on Millennium Boulevard may be required. Relocations can be completed by Bell at the developers cost.

10.4 ROGERS CABLE

Correspondence is ongoing with Rogers to confirm existing infrastructure surrounding the site and capacity to service the development. However, based on previous correspondence with Rogers regarding neighbouring development, Carriage Crossings, Rogers confirmed they have existing infrastructure on Millennium Boulevard.

11.0 NOISE

A noise study prepared by Stantec Consulting Ltd. (November 9, 2023) was conducted to determine the noise impact from Millennium Boulevard vehicle traffic (road traffic noise) and nearby commercial facility operations (stationary noise) on the site and recommend noise control measures if required in accordance with the Ministry of the Environment, Conservation and Parks (MECP) and City of Waterloo guidelines. Road traffic and stationary noise were measured at all proposed residential blocks and park block.

The road traffic noise levels at the points of reception (PORs) were predicted according to the MECP and RMOW guidelines using STAMSON v4.1 noise modelling software which implements the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT) (MECP, 1989). ORNAMENT is the MECP recommended road traffic noise prediction method. Based on the road traffic noise level predictions at the representative receptors within the Development, units within Block A and Block B require Type C noise warning clauses and compliance with the Ontario Building Code as specified in the MECP/RMOW Guidelines and detailed in the Noise Impact Study (Stantec, November 9, 2023).

A site review of the property determined that there are potential sources of stationary noise in the surrounding area. In particular, the Enova Power Corporation Facility to the northwest of the site and the RIM park athletic center to the southwest of the site were identified as potentially impactful stationary noise sources. As no rail lines exist within 500 m of the proposed site and the site is beyond the NEF 25 noise contours for local airport, an assessment of rail and aircraft traffic noise impacts to the site was not warranted.

Modelled sound levels from stationary noise are predicted to be at or below applicable MECP criteria, no *mitigation or warning* clauses are required to mitigate the impact of stationary noise on the Development. Based on the road traffic noise level predictions at modelled receptors within the Development, noise warning clauses are required in addition to compliance with Ontario Building Code as specified in the applicable MECP and RMOW guidelines.

Refer to the Noise Impact Study prepared by Stantec dated November 9, 2023 for full details of the study.



400 MILLENNIUM BOULEVARD WATERLOO, ON FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Conclusions and Recommendations
November 2024

12.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of this report, it is concluded that:

- The proposed Millennium Boulevard development can be adequately serviced with municipal sewers, water services and utilities.
- Municipal servicing and roadworks can be provided in accordance with the City of Waterloo standards.
- A stormwater management facility wet pond provides water quality and quantity control for the site.
- Feature water balance is achieved through conveying 'clean' surface water runoff to the wetland with the goal of maintaining annual existing condition runoff rates.
- Groundwater monitoring is continuing onsite to confirm the seasonal high groundwater levels.
- The subdivision can be serviced with Hydro, Gas, and Telecommunications extended from existing facilities surrounding the site.
- Noise warning clauses are required at some locations within the proposed site development.

It is further recommended that:

- A detailed dewatering assessment be conducted throughout detailed engineering design to assess construction groundwater dewatering volumes anticipated and attain any required water taking permits.
- The report be circulated to the municipalities and various approval agencies in support of the Zoning By-Law Amendment and Draft Plan of subdivision application.
- Detailed grading and servicing design drawings be prepared, and a Final Stormwater Management Report and Erosion and Sediment Control Plan be completed as part of the Draft Plan conditions following approval of the ZBA/OPA/DP submission.
- The preliminary engineering design be approved to support the Zoning Bylaw Amendment, Official Plan Amendment, and Draft Plan application.

