Functional Servicing Report

108, 116, 122 Harvie Road
ASA Development Inc
City of Barrie
County of Simcoe

PEARSON ENGINEERING
PEARSONENG.COM

September 2021
21092

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Functional Servicing Report
108, 116, 122 Harvie Road

1. Introduction

PEARSON Engineering Ltd. has been retained by ASA Development Inc. (Client) to prepare a Functional Servicing Report in support of the proposed Residential Subdivision (Project) located at 108, 116, and 122 Harvie Road in the City of Barrie (City). The subject lands can be seen on Figure 1.

The subject property is approximately 2.48 ha in size and is currently three separate residential lots, each occupied by a detached home fronting onto Harvie Road. The Project is located north of Harvie Road, east of Kemp Street Extension, south of Montserrand Street and west of Beacon Road. The Project site is bound by residential homes to the north and west, the future Beacon Road right-of-way (ROW) to the East and Harvie Road to the south.

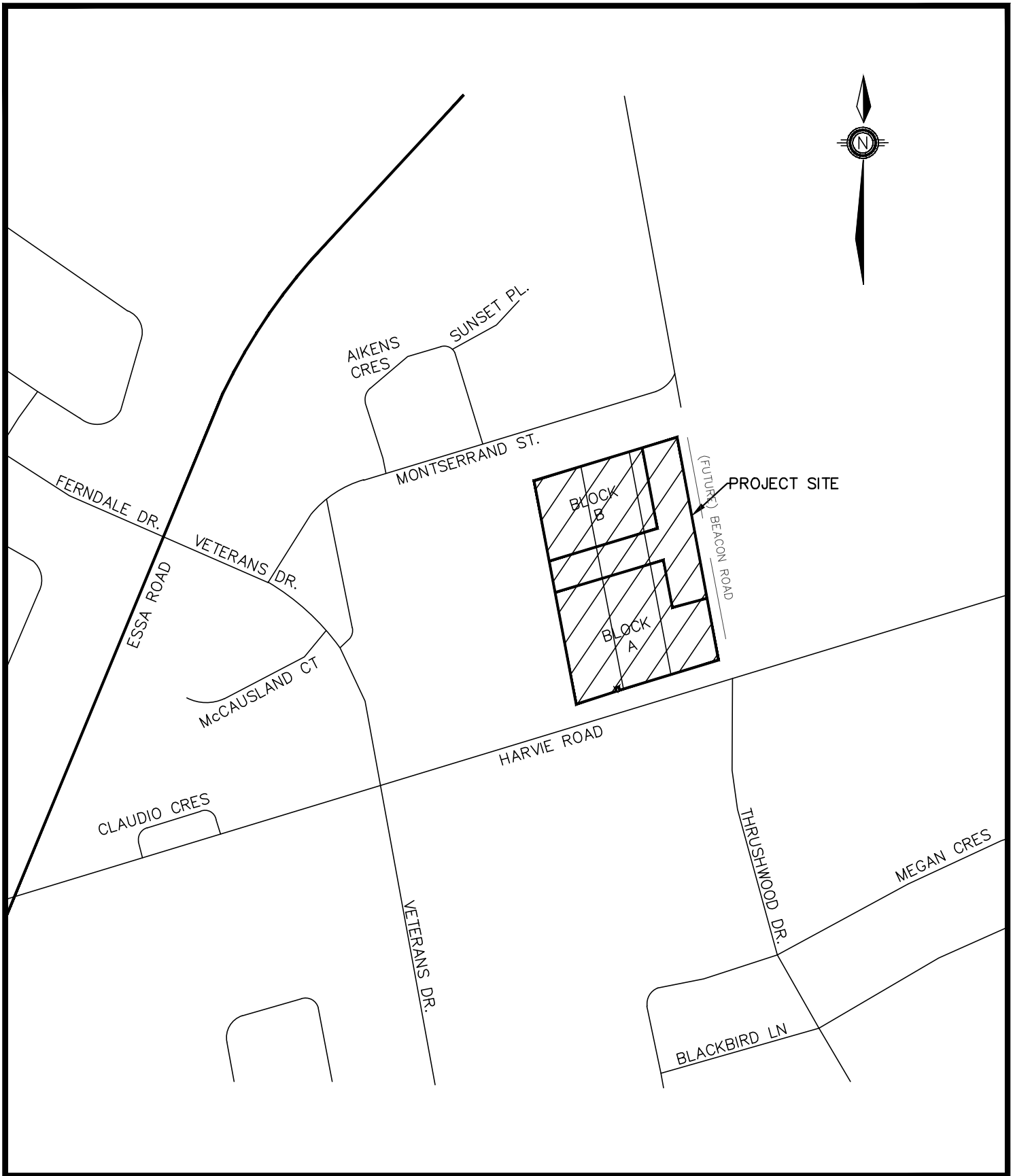
The Project proposes a Residential Subdivision consisting of a municipal road (Street A), Beacon Road extension, two Medium Density Residential Blocks (Block A and B) and single-family homes fronting on Beacon Road. Street A is proposed to be an 18-meter-wide local road cross section and Beacon Road extension will be 24 m to 25 m wide road cross section. Block A and B will be developed as site plans consisting of townhouses and an apartment building in Block B. The Subdivision servicing will provide connection stubs for both Block A and B.

This FSR assesses the required municipal services, existing municipal infrastructure in the vicinity of the Project, the onsite Stormwater Management (SWM) facilities and internal services required to service the proposed Project. The report also includes preliminary design calculations and a brief outline of the proposed internal services, as well as comments regarding the ability of the various secondary utilities to service the site.

2. Supporting Documents

The following documents have been referenced in the preparation of this report:

- Ministry of the Environment, Design Guidelines for Sewage Works - 2008
- Ministry of the Environment, Design Guidelines for Drinking-Water Systems - 2008
- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- City of Barrie, Sanitary Sewage Collection System Policies and Design Guidelines - October 2017
- City of Barrie Water Distribution Specification – December 2017
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines – December 2017
- Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Submissions, September 2016



ASA DEVELOPMENT INC.
108, 116, 122 HARVIE ROAD
BARRIE, ONTARIO

SITE LOCATION PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	MWD/PG	HORIZ SCALE	N.T.S	PROJECT #	21092
DRAWN BY	PG	VERT SCALE	VERT	DRAWING #	FIG–1
CHECKED BY	GMP	DATE	DATE	REVISION #	0

3. Design Population

The proposed development is to consist of twelve (12) single family homes, sixty-five (65) townhouse units and a fifty-one (51) unit apartment building. Utilizing the City of Barrie design standards, a design population of 291 persons is estimated for the project with the breakdown found in Table 1 below.

Table 1: Design Population

Density	# of Units	Residential PPU	People
Single Family Homes (Low)	12	3.25	39
Townhouses (Medium)	65	2.57	167
Apartment (High)	51	1.67	85
		TOTAL	**291**

4. Water Supply and Distribution

4.1. Water Servicing Design Criteria

The site is to have a design population of 291 persons. Utilizing the City of Barrie Engineering Design Criteria for residential water demand of 225 L/capita/day, an Average Day Demand (ADD) of 0.76 L/s was calculated. A max day factor of 3.60 was utilized which resulted in a Max Day Demand (MDD) of 2.73 L/s and a Peak Rate factor of 5.40 was used in calculating a Peak Hour Demand of 4.10 L/s for the proposed development. Calculations for the domestic water requirements for the site can be found in Appendix A.

4.2. Internal Water Distribution System

The Project site will be serviced by connecting into the existing 300 mm diameter watermain on the east side of Beacon Road with a 250 mm diameter watermain on Street A and including a connection for future development to the west of the Project site. The single-family homes fronting onto Beacon Road will be serviced by separate 25 mm water services off the existing Beacon Road watermain. Block A and Block B will be serviced with a proposed 200 mm diameter watermain connecting to Street A in two locations, creating a looped system. The proposed watermain will extend through the project site and connect to the proposed townhouse units and apartment building to meet domestic requirements. Check valve chambers will be added at each property line as per City Standards. Internal and municipal fire hydrants are proposed to provide adequate firefighting coverage as per City Standards. Refer to Drawing SS-1 in Appendix G for the water servicing layout.

A water pressure test was performed by Vipond Inc. on August 31, 2021, on an existing fire hydrant located adjacent to 108 Harvie Road indicating that a static pressure of 57 psi was available. This flow test also identified that a flow of approximately 1,350 gallons per minute (GPM) with a residual pressure of 54 psi can be provided to the Project site. Therefore, the existing watermain's flow availability and residual pressures appear sufficient to service the proposed development. The results from this flow test are included in Appendix A.

The water model uses the peak domestic demand flows of 0.05 L/s for each detached home, 0.18 L/s for the 5-unit Townhouse blocks, 0.25 L/s for the 7-unit townhouse blocks, and 1.20 L/s for the apartment building. This results in a minimum pressure of 56.4 psi occurring at Junction J-23. The pressures for the proposed detached homes, townhouse units, and apartment range from 56.9 psi to 63.8 psi. Therefore, the proposed water servicing layout meets the domestic needs of the development. Model details can be found in Appendix A.

4.3. Fire Flow Requirements

Fire flow calculations included in Appendix A were completed based on the Fire Underwriters Survey (FUS) guide for the determination of required fire flow. As per City of Barrie Standards, if the minimum required fire flow in the FUS calculations is below the City of Barrie minimum required fire flow, the City standards minimum shall govern. Table 2 below outlines the City of Barrie, FUS and selected fire flow requirement.

Table 2: Require Fire Flow

Density	Fire Flow Requirements (L/s)		
	City of Barrie	FUS	Proposed
Single Family Homes (Low)	100	117	117
Townhouses (Medium)	155	200	200
Apartment (High)	200	150	200

The water model uses the above required fire flows for the proposed development. This resulted in a minimum fire flow that can be supplied to the Project site with a flow of 212 L/s at a residual pressure of 20 psi through the 200 mm diameter watermain from Beacon Road to the proposed hydrant (H-3). As the proposed water infrastructure can supply the required flows as per the City of Barrie requirements, the watermain design is sufficient. Provided fire flow information from the water model can be found in Appendix A.

5. Sanitary Servicing

5.1. Sanitary Design Criteria

The site is to have a design population of 291 persons. Utilizing the City of Barrie Engineering Design Criteria's sanitary flow rate per capita of 225 L/capita/day, an Average Daily Flow (ADF) of 0.76 L/s was calculated. Using a Peaking Factor of 4.00 for this project and an infiltration allowance of 0.25 L/s/ha, a peak flow of 3.28 L/s was calculated for the proposed development. The existing 300 mm diameter sanitary sewer on Beacon Road has a capacity of 85.85 L/s at a slope of 0.78%. Therefore, the proposed peak flow is approximately 3.8% of the existing sanitary sewer's capacity and the sanitary design flows are expected to have no adverse effects on the existing sanitary sewer system

5.2. Internal Sanitary Sewer System

It is proposed that the sanitary sewers be constructed in accordance with the City of Barrie and the Ministry of the Environment, Conservation, and Parks (MECP) guidelines to service the Project and will meet minimum design grades and the required minimum and maximum velocities under proposed flow conditions.

The Project's sanitary sewer system will convey flow via a 200 mm gravity sanitary sewer from the site and connect to the existing manhole MV#3009 on Beacon Road. New municipal sanitary sewers will be installed on Street A and along the Beacon Road extension to the proposed single family home south of Street A. Blocks A and B will connect to the Street A sanitary sewer and the sewer system will extend internally on so that each townhouse unit will be provided with a separate service connection and. Refer to drawing SS-1 in Appendix G for the sanitary servicing layout.

6. Stormwater Management

A key component of the development is the need to address environmental and related SWM issues. These are examined in a framework aimed at meeting the City, and the Lake Simcoe Regional Conservation Authority (LSRCA) and MECP requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems. This FSR focuses on the necessary measures to satisfy the MECP's SWM requirements.

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

- Protect life and property from flooding and erosion
- Maintain water quality for ecological integrity, recreational opportunities etc.
- Protect and maintain groundwater flow regime(s).
- Protect aquatic and fishery communities and habitats.
- Maintain and protect significant natural features.

6.1. Analysis Methodology

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

- The Ministry of the Environment Stormwater Management Planning and Design Manual, March 2003
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines – December 2017
- Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Submissions – September 2016

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

6.2. Existing Drainage Conditions

The Project site currently consists of 3 residential properties each with a single-family home and large areas of trees. The majority of the flow on site drains northeast via overland flow at approximately 2% towards the Beacon Road ROW. Stormwater is then conveyed via a storm sewer system on the Beacon Road ROW towards Whiskey Creek. Details of the existing storm drainage conditions are shown on drawing STM-1 in Appendix G.

According to the Geotechnical Investigation by Peto MacCallum Ltd., dated February 2021 and the Hydrogeological Study prepared by R.J. Burnside & Associates Limited, dated June 2021, the project site is comprised of highly calcareous till with drumlinized sheets of glacial till (Newmarket till), stratified glaciolacustrine deposits of sand and gravel, littoral-foreshore deposits and massive-well laminated deposits of sand and gravel. Local silty layers were present below the topsoil and the material was very loose to loose. The infiltration rate was estimated to be approximately 75 to 150 mm/hr. Groundwater was found to by typically below the depth of exploration being approximately 8.6m below the existing ground surface in January 2021.

The newly updated City of Barrie Drainage Master Plan in 2020 identifies a SWM pond to be installed on the east side of the Beacon Road ROW. However, it is our understanding that the schedule for the construction of this pond will not align with this development and therefore onsite controls will be required.

Allowable peak flows for the site were calculated using the site's current conditions and can be seen in Table 3 below

Table 3: Pre-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Project Site (m^3)	0.149	0.196	0.227	0.293	0.354	0.405

6.3. Proposed Storm Drainage System

Post-development drainage patterns for the site will generally follow pre-development drainage conditions. The Project site is proposed to drain via catchbasin and storm sewer, which was sized for the 5-year storm event. The rooftop area of the apartment building, townhouse blocks, and single detached homes will be conveyed to proposed underground infiltration galleries sized for the 25 mm storm. In the event of a storm greater than the 25 mm storm, an overflow system will be provided allowing stormwater to drain to the site's storm sewer system. The majority of the site's paved and landscaped areas have been graded to direct stormwater towards permeable pavers. In the event of a storm greater than the filtration capacity of the pavers, a catchbasin will be provided conveying stormwater to the storm sewer system. The peak flows released from the site are controlled through an orifice tube on each Block which will cause stormwater to back up into underground storage tanks in order to release stormwater at allowable rates providing quantity control for the site.

Blocks A and B will be overcontrolled to allow for the uncontrolled release of the single-family home lots and Street A. The proposed drainage south of the apartment building in Block A will continue to drain uncontrolled to Harvie Road. Block A has been graded to provide an emergency overflow weir through the driveway to Street A. Block B will be graded with an emergency overland flow route north of townhouse block B-5 and single-family lot number 12 to Beacon Road. The single-family homes lots and Street A will drain uncontrolled to Beacon Road. Details of the proposed storm drainage conditions are shown on drawing STM-2 in Appendix G.

6.4. External Drainage Areas

External drainage areas both west and north of the Project site drain through the site based on pre-development conditions. The site is located within the Beacon Road Subdivision storm sewer catchment area which can be seen on drawing G-4 by RG Robinson in Appendix H.

The western external area 1, shown on drawings STM-1 and STM-2 is 2.49 ha is size and is slated for future development including the extension of Street A and an extension of Kemp Street. The Street A storm sewer will be sized to allow for the future 5-year pre-development peak flows from the future development.

The northern external area 2, shown on drawings STM-1 and STM-2 is 0.38 ha in size and contains existing single family residential homes that are assumed to remain in the current development state. This area drains south towards the site and will be captured in a drainage channel as it flows towards the site and conveyed to Beacon Road to match the existing conditions.

6.5. Stormwater Quantity Control

The proposed development will increase the imperviousness of the site and as such the post-development peak flows will increase. It is important to quantify the increase in stormwater runoff rates and attenuate these increases. The calculated post-development runoff coefficient of 0.66 is greater than the pre-development runoff coefficient of 0.22. Runoff coefficient calculations can be found in Appendix C.

Considerations were taken to reduce post-development peak flows to pre-development values. Given the size of the site, the Modified Rational Method will be used to determine the SWM release rates. The City of Barrie IDF curve parameters were used for determining the storm intensity values.

Blocks A and B will be overcontrolled to allow Street A and the single-family homes to drain uncontrolled. Quantity control will be provided by an orifice tube at Block A and Block B to reduce post development peak flows to the allowable flow rates with 82% of the allowable flow allocated to Block A and 18% of the allowable flow to Block B.

Calculations in Appendix C demonstrate approximately 775 m^3 of total storage is required to reduce the 100-year storm peak flow. It is proposed to provide the quantity control storage through the use of underground StormTech chambers in Block A and Block B amenity areas. The underground storage tanks will be designed as an off-line system.

By comparing Table 3 and 4, it can be seen that the post development peak flows for the site are smaller than the pre-development for all storm events. Detailed quantity control calculations can be seen in Appendix C.

Table 4: Post-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Uncontrolled Flows (m^3/s)	0.074	0.097	0.113	0.146	0.176	0.201
Block A Controlled Flows (m^3/s)	0.040	0.052	0.061	0.078	0.095	0.108
Block B Controlled Flows (m^3/s)	0.009	0.011	0.013	0.017	0.021	0.024
Total Project Site (m^3/s)	**0.123**	**0.161**	**0.187**	**0.241**	**0.292**	**0.333**

6.6. Volume Control

Since the project site meets the definition of Major Development as per LSRCA Guidelines, considerations were taken to meet the volume control criteria detailed in Section 2.2.2. The LSRCA guidelines state that for a new development that creates 500 m^2 or more of impervious surfaces, 25 mm of runoff over the total impervious area of the site is to be retained and treated on site, with flexible alternatives if this criterion cannot be met.

The proposed drainage from the rooftop area of all buildings will be conveyed through roof leaders to separate infiltration galleries for each building, resulting in a storage volume of 171 m^3.

The majority of the site's paved areas have been graded to direct stormwater towards permeable pavers. The pavers will provide treatment via filtration and are wrapped in an impermeable liner and include a perforated underdrain which is connected to the storm sewer system and have a total combined storage volume of 225 m^3.

Due to site geometry and available space for LID, the full 25 mm storage cannot be achieved. The Flexible Treatment Alternative #1 of the 12.5 mm storm results in a total required volume of 223 m³. The rooftop infiltration galleries and permeable pavers provide a total of 396 m³ for the site which is equivalent to the 22 mm storm across the impervious surfaces, therefore meeting Volume Control requirements.

6.7. Stormwater Quality Control

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

6.7.1. *Permanent Quality Control*

The development's active parking facilities pose a risk to stormwater quality through the collection of grit, salt, sand, and oils on the paved surfaces. The MECP standard stipulates a Total Suspended Solids (TSS) removal of at least 80% for the enhanced protection level according to Table 3.2 in the MECP SWM Planning & Design Manual. A treatment train approach to maximize TSS removal has been proposed. Stormwater from the parking lot areas will drain to permeable pavers which will allow stormwater to filter through the stone reservoir and into the site's storm sewer system via a perforated pipe. The catch basins include sumps which will settle larger sediment particles. Underground storage tanks will be designed with an isolator row which will capture the majority of the sediment, and will ultimately drain through an oil/grit separator (OGS) unit prior to connecting to the existing infrastructure in Beacon Road.

Three OGS units are proposed, one each for Block A and B and one at Beacon Road before the existing MH. The proposed treatment train approach will provide a total TSS removal rate of at least 80% as per MECP standards.

6.7.2. *During Construction Activities*

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

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

- Installation of filter strips, silt fences and rock check dams or other similar facilities throughout the site, and specifically during all construction activities, in order to reduce stormwater drainage velocities and trap sediment on-site; and,
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit; the duration in which surfaces are disturbed/exposed shall not exceed 30 days.
- Provision of a mud-mat where applicable at the construction entrances in order to control the tracking of sediment and debris onto municipal streets.
- Reduce stormwater drainage velocities where possible.
- Minimize the amount of existing vegetation removed.

7. Phosphorus Budget

Local conservation authorities have determined the importance of reducing phosphorus levels in water courses in this area. Best efforts are to be employed in order to reduce phosphorus levels being contributed from the site.

The existing site consists of forest lands and low intensity residential with single family homes, garages and driveways and generates approximately 0.28 kg of phosphorus annually. The development of the project will increase the amount of phosphorus contributed from the site to 3.17 kg if uncontrolled.

To minimize the site's phosphorous discharge, a treatment train approach will be implemented. The rooftop area of all of the project's buildings will be conveyed to underground storage sized for the 25mm storm event.

Permeable pavers have been provided in the project's parking areas and have been designed with a stone reservoir of 0.50 m. As the pavers will be receiving primarily storm runoff from the site's paved areas, they have been designed with an impermeable liner and perforated underdrain to provide phosphorous reduction through filtration rather than infiltration. The perforated underdrain will connect to the stie's storm sewer.

According to the LSRCA Phosphorus Loading Development Tool, the typical phosphorus reduction is 60% for underground infiltration and 45% for permeable pavers. The following Table 5 details the anticipated phosphorous loadings for the pre and post-development conditions.

Table 5: Phosphorus Loadings

	Total P (kg)
Pre-Development	0.23
Uncontrolled Post-Development	3.17
Controlled Post-Development	2.21

Detailed calculations can be found in Appendix E.

8. Water Balance

Since the post development state will increase the imperviousness of the site, considerations were taken in regard to groundwater recharge. Under pre-development conditions, the project site consists of three single family homes and garages and associated driveways, which infiltrates approximately 6,883 m^3 annually over the entire site. With the increased imperviousness of the site, this recharge will be reduced to 2,651 m^3, resulting in a deficit volume of 6,883 m^3.

In order to infiltrate the deficit volume of 6,883 m^3 annually, it is proposed to infiltrate the first 12 mm from the rooftop drainage areas in underground storage chambers and infiltration galleries. The 12 mm storm is equivalent to 624.0 mm annually, which will infiltrate 6,883 m^3 per year, meeting the pre-development recharge. However, City of Barrie minimum criteria is 5 mm across the total development area resulting in a minimum volume of 120 m^3. The rooftop infiltration galleries and chambers have been designed to infiltrate the 25 mm storm event over the rooftop areas in order to meet the LSRCA's volume control criteria as well as maximize infiltration for quality control and phosphorous removal purposes resulting in a storage volume of 171 m^3, therefore exceeding the City's criteria. Infiltration rates will be confirmed with in-situ tests at the detailed design stage. Detailed calculations can be seen in Appendix D.

9. Grading

A preliminary grading design has been completed for the project to confirm drainage of the site. The majority of the site will drain easterly towards the proposed Beacon Road extension. Block A area will be directed towards Street A and Block B will be directed to the northern outlet channel which has been designed to flow toward Beacon Road. The single-family homes and area between the apartment building and Harvie Road will flow uncontrolled to Beacon Road. Refer to drawing SG-1 in Appendix G for details of the preliminary grading design.

10. Servicing for Adjacent Development

The adjacent lands to the west of our project site are expected to be developed in the future. Water, sanitary and storm services have been proposed to run through our Street A to service the adjacent lands. These services connections are located at the west end of Street A and capped for future development.

11. Secondary Utilities

Given the location of the subject site is within the municipal area of Barrie, it is anticipated that secondary utilities (hydro, cable, and phone) will be readily available to service the site. Letters have been sent to all secondary utilities to notify them of the proposed development, gain information on the availability of their services for the site and ensure they are able to adequately support the proposed development. Copies of these letters have been included in Appendix F.

12. Conclusions

The proposed development will require the connection of sanitary and watermain services to the existing municipal services on Beacon Road. Storm services for the development will be conveyed to underground storage tanks, ultimately outletting to Beacon Road.

A treatment train approach including three proposed OGS units will provide the required quality control to satisfy the MECP Enhanced level requirements, as well as reduce the phosphorous loading for the site

Rooftop infiltration will promote groundwater recharge meeting water balance requirements.

Quantity control for the development is provided in the StormTech underground storage units allowing post-development peak flows to be released at the allowable values through an orifice tube.

The analysis and conceptual design outlined in this report demonstrates that the servicing is feasible.

All of which is respectfully submitted,

Pearson Engineering Ltd.

Taylor Arkell, P.Eng.
Senior Project Manager

Mike Dejean, P.Eng.
Manager of Engineering Services

Appendix A

Water Servicing and Fire Flow Calculations

PEARSON ENGINEERING

108, 116, 122 Harvie Road, Barrie
Water Flow Calculations

Design Criteria

Demand per capita (Q):	225	L/cap/day
Peak Rate Factor (Max. Hour)	5.40	(Table 3-3: Peaking Factors, MOE Design Guidelines for Drinking-Water Systems)
Max. Day Factor	3.60	(Table 3-3: Peaking Factors, MOE Design Guidelines for Drinking-Water Systems)

Site Data

Description	Density		Units		Flow Rate		Peaking Factors	
Single Detached Home	3.25	people/unit	12	units	225	L/cap/d		
Townhouses	2.57	people/unit	65	units	225	L/cap/d	MAX DAY FACTOR*	3.60
Apartment	1.67	people/unit	51	units	225	L/cap/d	PEAK RATE FACTOR*	5.40

*From MOE Manual based on Population of fewer than 500 People

Calculate Population

Pop. Single Family Home	=	3.25	x	12	=	39
Pop. Townhouse	=	2.57	x	65	=	167
Pop. Apartments	=	1.67	x	51	=	85
Pop. Total	=	291	people			

Calculate Average Day Demand (ADD)

ADD	=	225	x	291
ADD	=	65,525	L/day	
ADD	=	0.76	L/s	

Calculate Max Day Flow

MDF	=	0.76	x	3.60
MDF	=	2.73	L/s	

Calculate Peak Hour Demand

PHD	=	0.76	x	5.40
PHD	=	4.10	L/s	

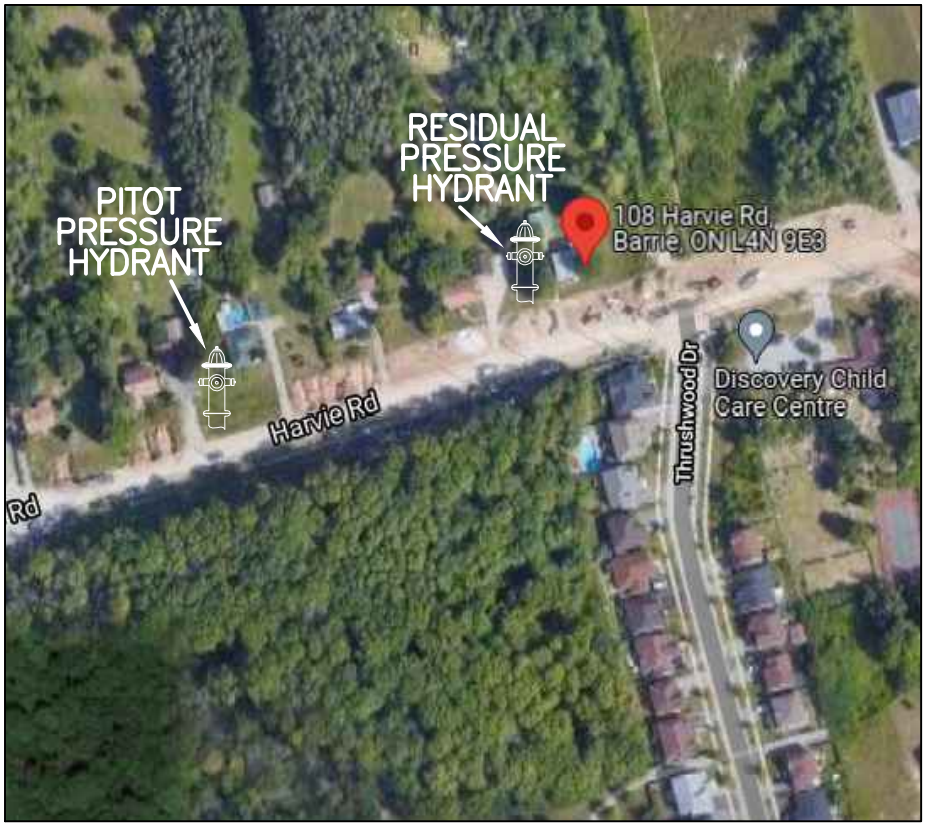
FLOW TEST RESULTS

FIRST FOR FIRE, LIFE SAFETY & SECURITY
VIPOND INC
est. 1945

DATE : AUG 31, 2021 TIME : 2:00

LOCATION : 108 HARVIE RD
CITY OF BARRIE
ONTARIO

TEST BY : VIPOND FIRE PROTECTION AND LOCAL PUC



STATIC PRESSURE : 57 PSI

TEST NO.	NO. OF NOZZLES	NOZZLE DIAMETER (INCHES)	DISCHARGE CO-EFFICIENT	RESIDUAL PRESSURE (PSI)	PITOT PRESSURE (PSI)	DISCHARGE (U.S.GPM)
1	1	1-3/4	0.995	56	40	563
2	1	2-1/2	0.90	56	20	754
3	2	2-1/2	0.90	54	16	1350

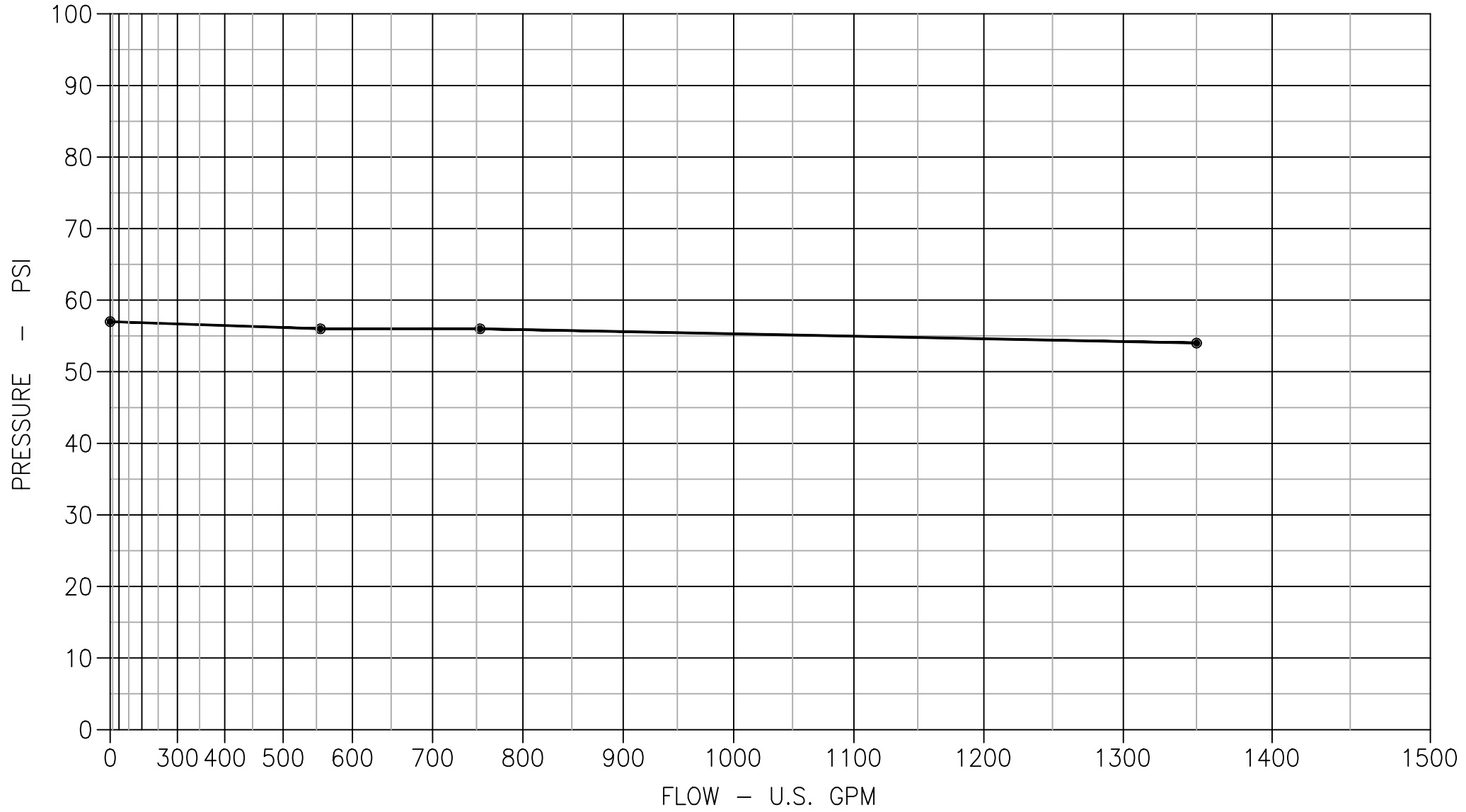
FIRST FOR FIRE, LIFE SAFETY & SECURITY

VIPOND INC est. 1945

108 HARVIE DR.	BY : LEN K./KRYSTIAN. K
CITY OF BARRIE	OFFICE : BARRIE
ONTARIO	TEST BY : VIPOND & PUC
	DATE : AUG 31, 2021

STATIC: 57 PSI

RESIDUAL:			FLOW:	
TEST#1	56 PSI	@	563	GPM
TEST#2	56 PSI	@	754	GPM
TEST#3	54 PSI	@	1350	GPM



PEARSON ENGINEERING

108, 116, 122 Harvie Road, Barrie
Fire Flow Calculations - Detached Homes

Location:	108, 116, 122 Harvie Road, Barrie
OBC Occupancy:	Residential Occupancies - Class C
Building Foot Print:	94 m^2
# of Stories:	2 — **Single Family**

*based on worst case scenario for proposed single-family homes

Project: ASA Harvie Road

Project Number: 21092

Construction Class	Charge
Wood Frame	1.5
Ordinary	1.0
Non-Combustible	0.8
Fire Resistive	0.6

Construction Class: Wood Frame

Automated Sprinkler Protection		Credit	Total
NFPA 13 sprinkler standard	No	30%	
Standard Water Supply	No	10%	0%
Fully Supervised System	No	10%	

Contents	Charge
Non-Combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Contents Factor: Limited Combustible — **Charge:** -15%

Exposure 1 (north)	Distance to Exposure Building (m)	1.8	25%
Exposure 2 (east)	Distance to Exposure Building (m)	> 45.1	0%
Exposure 3 (south)	Distance to Exposure Building (m)	22.0	10%
Exposure 4 (west)	Distance to Exposure Building (m)	8.7	20%

Separation	Charge
0 - 3.0 m	25%
3.1 - 10.0 m	20%
10.1 - 20.0 m	15%
20.1 - 30.0 m	10%
30.1 - 45.0 m	5%
> 45.1 m	0%

Total: 55% *no more than 75%

Are Buildings Contigious? No

Fire Resistant Building: Are vertical openings and exterior vertical communications protected with a minimum one (1) hr rating?

Calculations: C = 1.5 — Wood Frame

RFF = 220 x C x √A A = 188 m²

Where: *RFF* = required fire flow in liters per minute
C = Coefficient related to the type of construction
A = the total floor area in square meters (excluding basements in building considered

RFF = 4,525 L/min

Round to Nearest 1000 L/min RFF = 5,000 L/min *Must be > 2000 L/min or < 45,000 L/min

Correction Factors:

Occupancy		-750	L/min
Fire Flow Adjusted for Occupancy	**E =**	4,250	L/min
Reduction For Sprinkler	**F =**	0	L/min
Fire Flow w/ Sprinkler Reduction		4,250	L/min
Exposure Charge	**G =**	2,338	L/min
Fire Flow w/ Exposure Charge		6,588	L/min
Required Fire Flow:	**RFF =**	6,588	L/min

As per "Water Supply for Public Fire Protection" pg.20 note H:
RFF **= E - F + G**

E	F	G
4,250	0	2,338

RFF= 4250 L/min - 0 L/min + 2338 L/min
RFF = 6,588 L/min

Round to Nearest 1,000 L/min **RFF = 7,000 L/min**

RFF= 1,848 GPM

RFF = 117 L/s

PEARSON ENGINEERING

108, 116, 122 Harvie Road, Barrie
Fire Flow Calculations - Townhouse

Location:	108, 116, 122 Harvie Road, Barrie	
OBC Occupancy:	Residential Occupancies - Class C	
Building Foot Print:	258 m^2	*Assuming a fire wall every 4 units
# of Stories:	3	**Townhouse Buildings**

**Utilizing worst case scenario for townhouse units

Project: ASA Harvie Road

Project Number: 21092

Construction Class	Charge
Wood Frame	1.5
Ordinary	1.0
Non-Combustible	0.8
Fire Resistive	0.6

Construction Class: Wood Frame

Automated Sprinkler Protection		Credit	Total
NFPA 13 sprinkler standard	No	30%	
Standard Water Supply	Yes	10%	10%
Fully Supervised System	No	10%	

Contents	Charge
Non-Combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Contents Factor: Limited Combustible **Charge:** -15%

Exposure 1 (north)	Distance to Exposure Building (m)	3.4	25%
Exposure 2 (east)	Distance to Exposure Building (m)	8.7	20%
Exposure 3 (south)	Distance to Exposure Building (m)	22.7	10%
Exposure 4 (west)	Distance to Exposure Building (m)	17.6	15%

Separation	Charge
0 - 3.0 m	25%
3.1 - 10.0 m	20%
10.1 - 20.0 m	15%
20.1 - 30.0 m	10%
30.1 - 45.0 m	5%
> 45.1 m	0%

Total: 70% *no more than 75%

Are Buildings Contigious? Yes

Fire Resistant Building: Are vertical openings and exterior vertical communications protected with a minimum one (1) hr rating?

Calculations: *C* = 1.5 Wood Frame

RFF = 220 x C x √A *A* = 774 m²

Where: *RFF* = required fire flow in liters per minute
C = Coefficient related to the type of construction
A = the total floor area in square meters (excluding basements in building considered

RFF = 9,181 L/min

Round to Nearest 1000 L/min RFF = 9,000 L/min *Must be > 2000 L/min or < 45,000 L/min

Correction Factors:

Occupancy		-1,350	L/min
Fire Flow Adjusted for Occupancy	**E =**	7,650	L/min
Reduction For Sprinkler	**F =**	765	L/min
Fire Flow w/ Sprinkler Reduction		6,885	L/min
Exposure Charge	**G =**	5,355	L/min
Fire Flow w/ Exposure Charge		12,240	L/min

As per "Water Supply for Public Fire Protection" pg.20 note H:
RFF **= E - F + G**

E	F	G
7,650	765	5,355

RFF= 7650 L/min - 765 L/min + 5355 L/min

Required Fire Flow: **RFF =** 12,240 L/min **RFF = 12,240 L/min**

Round to Nearest 1,000 L/min **RFF = 12,000 L/min**

RFF= 3,168 GPM

RFF = 200 L/s

PEARSON ENGINEERING

108, 116, 122 Harvie Road, Barrie
Fire Flow Calculations - Apartment Building

Location:	108, 116, 122 Harvie Road, Barrie
OBC Occupancy:	Residential Occupancies - Class C
Building Foot Print:	1,375 m^2
# of Stories:	4 — **Apartment Building**

Project: ASA Harvie Road

Project Number: 21092

Construction Class	Charge
Wood Frame	1.5
Ordinary	1.0
Non-Combustible	0.8
Fire Resistive	0.6

Construction Class: Ordinary

Automated Sprinkler Protection		Credit	Total
NFPA 13 sprinkler standard	Yes	30%	
Standard Water Supply	Yes	10%	50%
Fully Supervised System	Yes	10%	

Contents	Charge
Non-Combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Contents Factor: Limited Combustible — **Charge:** -15%

Exposure 1 (north)	Distance to Exposure Building (m)	22.8	10%
Exposure 2 (east)	Distance to Exposure Building (m)	> 45.1	0%
Exposure 3 (south)	Distance to Exposure Building (m)	> 45.1	0%
Exposure 4 (west)	Distance to Exposure Building (m)	30.3	5%

Separation	Charge
0 - 3.0 m	25%
3.1 - 10.0 m	20%
10.1 - 20.0 m	15%
20.1 - 30.0 m	10%
30.1 - 45.0 m	5%
> 45.1 m	0%

Total: 15% *no more than 75%

Are Buildings Contigious? Yes

Fire Resistant Building: Are vertical openings and exterior vertical communications protected with a minimum one (1) hr rating?

Calculations: C = 1.0 — Ordinary

RFF = 220 x C x √A A = 5,500 m²

Where: *RFF* = required fire flow in liters per minute
C = Coefficient related to the type of construction
A = the total floor area in square meters (excluding basements in building considered

RFF = 16,316 L/min

Round to Nearest 1000 L/min RFF = 16,000 L/min *Must be > 2000 L/min or < 45,000 L/min

Correction Factors:

Occupancy		-2,400	L/min
Fire Flow Adjusted for Occupancy	**E =**	13,600	L/min
Reduction For Sprinkler	**F =**	6,800	L/min
Fire Flow w/ Sprinkler Reduction		6,800	L/min
Exposure Charge	**G =**	2,040	L/min
Fire Flow w/ Exposure Charge		8,840	L/min

As per "Water Supply for Public Fire Protection" pg.20 note H:
RFF = **E - F + G**

E	F	G
13,600	6,800	2,040

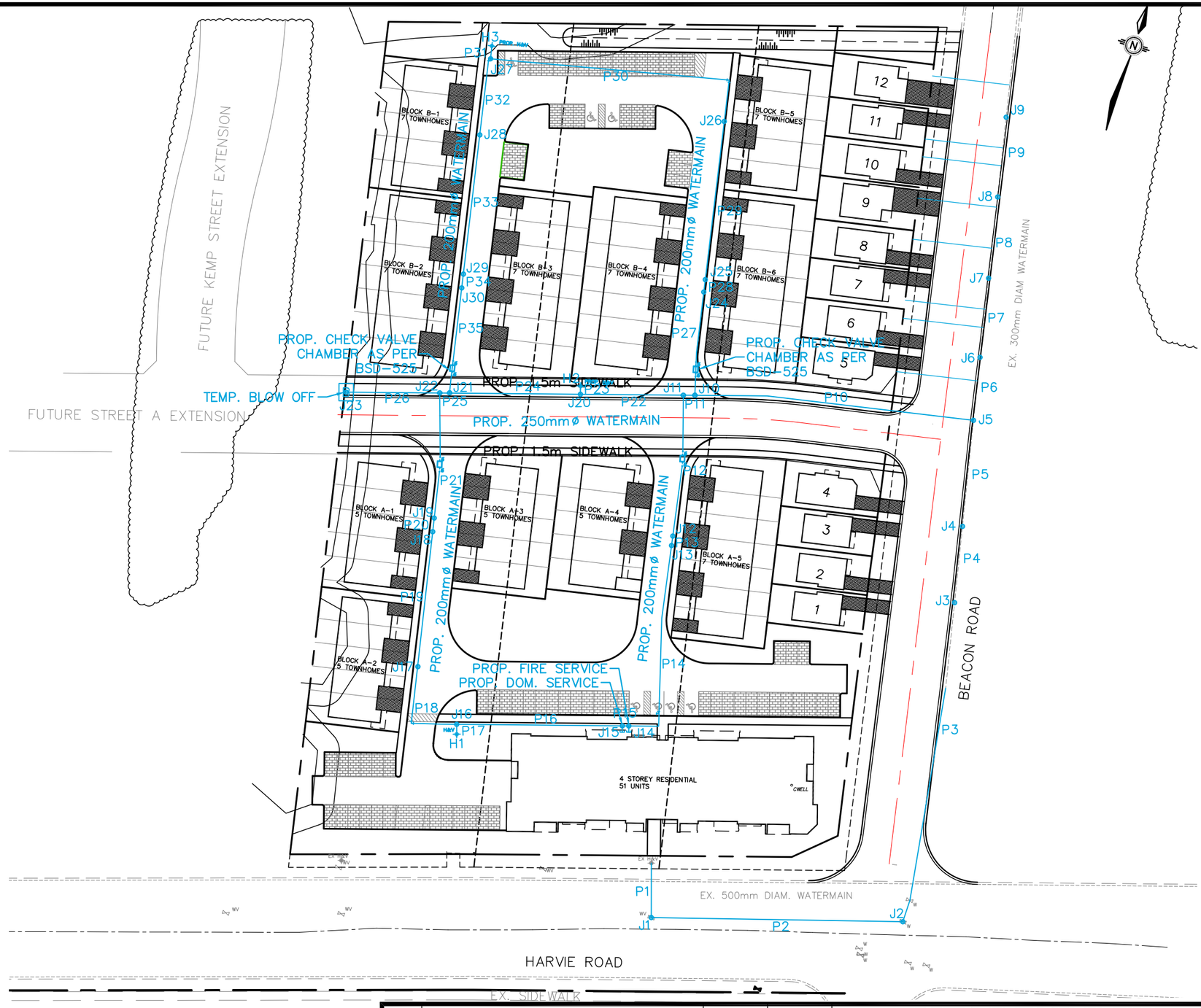
RFF= 13600 L/min - 6800 L/min + 2040 L/min

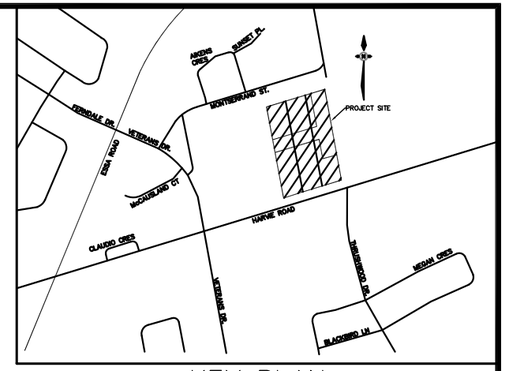
Required Fire Flow: **RFF =** 8,840 L/min — **RFF = 8,840 L/min**

Round to Nearest 1,000 L/min **RFF = 9,000 L/min**

RFF= 2,376 GPM

RFF = 150 L/s





KEY PLAN
NTS

LEGEND

- SITE BOUNDARY
- H&V FIRE HYDRANT
- WATER VALVE
- WATERMAIN

NO.	REVISION NOTE	DATE	BY

ASA DEVELOPMENT INC.
108, 116, 122 HARVIE ROAD
BARRIE, ONTARIO

WATERCAD MODEL LAYOUT

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY MWD/PG	HORIZ SCALE 1:2000	PROJECT #	21092
DRAWN BY PG	VERT SCALE	DRAWING #	FIG-2
CHECKED BY GMP	DATE SEPTEMBER 2021	REVISION #	0

108, 116, 122 Harvie Road, Barrie
WaterCAD FlexTable: Junction Table - Domestic Report

Label	Elevation (m)	Head (m)	Demand (gpm)	Pressure (psi)
Ex. H-4209 (Harvie Rd)	305.1	-	-	-
J-1	305.0	40.14	0.00	57.0
J-2	303.4	41.74	0.00	59.3
J-3 (Lot 1 & 2)	303.0	42.14	0.09	59.8
J-4 (Lot 3 & 4)	302.9	42.24	0.09	60.0
J-5	303.1	42.04	0.00	59.7
J-6 (Lot 5 & 6)	302.9	42.24	0.09	60.0
J-7 (Lot 7 & 8)	302.6	42.54	0.09	60.4
J-8 (Lot 9 & 10)	302.3	42.84	0.09	60.8
J-9 (Lot 11 & 12)	302.6	42.54	0.09	60.4
J-10	303.9	41.21	0.00	58.5
J-11	303.9	41.21	0.00	58.5
J-12 (TH - 5 Units)	303.9	41.21	0.18	58.5
J-13 (TH - 7 Units)	303.9	41.21	0.25	58.5
J-14 (Apt - Fire Service)	299.7	45.41	0.00	64.5
J-15 (Apt - Dom. Service)	300.2	44.91	1.20	63.8
J-16	304.6	40.51	0.00	57.5
Prop. H-1	304.6	40.51	0.00	57.5
J-17 (TH - 5 Units)	304.7	40.41	0.18	57.4
J-18 (TH - 5 Units)	304.9	40.21	0.18	57.1
J-19 (TH - 5 Units)	304.9	40.21	0.18	57.1
J-20	304.4	40.71	0.00	57.8
Prop. H-2	304.4	40.71	0.00	57.8
J-21	305.0	40.11	0.00	56.9
J-22	305.0	40.11	0.00	56.9
J-23	305.4	39.71	0.00	56.4
J-24 (TH - 7 Units)	305.0	40.11	0.25	56.9
J-25 (TH - 7 Units)	304.9	40.21	0.25	57.1
J-26 (TH - 5 Units)	303.8	41.31	0.18	58.6
J-27	304.6	40.51	0.00	57.5
Prop. H-3	304.6	40.51	0.00	57.5
J-28 (TH - 5 Units)	304.7	40.41	0.18	57.4
J-29 (TH - 7 Units)	304.9	40.21	0.25	57.1
J-30 (TH - 7 Units)	304.9	40.21	0.25	57.1

PEARSON ENGINEERING

108, 116, 122 Harvie Road, Barrie
WaterCAD FlexTable: Pipe Table - Domestic Report

Label	Diameter (mm)	Hazen-Williams C	Material	Velocity (m/s)	Headloss (m)	Headloss Gradient (m/m)	Water Age (Hours)	Start Node	Pressure (Start) (psi)	Stop Node	Pressure (Stop) (psi)
P-1A	500	120	PVC	0.02	0.00	0.00	-	7256: Ex. H-4209	-	7258: PMP-1	-
P-1B	500	120	PVC	0.02	0.00	0.00		7258: PMP-1	56.9	7252: J-1	57.0
P-2	500	120	PVC	0.02	0.00	0.00	-	7252: J-1	57.0	7253: J-2	59.3
P-3	300	120	PVC	0.06	0.00	0.00	-	7253: J-2	59.3	7242: J-3	59.8
P-5	300	120	PVC	0.06	0.00	0.00	-	7240: J-4	60.0	7242: J-3	59.8
P-4	300	120	PVC	0.06	0.00	0.00	-	7193: J-5	59.7	7240: J-4	60.0
P-6	300	120	PVC	0.01	0.00	0.00	-	7193: J-5	59.7	7244: J-6	60.0
P-7	300	120	PVC	0.00	0.00	0.00	-	7244: J-6	60.0	7246: J-7	60.4
P-8	300	120	PVC	0.00	0.00	0.00	-	7246: J-7	60.4	7248: J-8	60.8
P-9	300	120	PVC	0.00	0.00	0.00	-	7248: J-8	60.8	7250: J-9	60.4
P-10	155	110	PVC	0.19	0.03	0.00	-	7193: J-5	59.7	7194: J-10	58.5
P-11	200	110	PVC	0.08	0.00	0.00	-	7194: J-10	58.5	7196: J-11	58.5
P-12	200	110	PVC	0.04	0.00	0.00	-	7196: J-11	58.5	7261: J-12	58.5
P-13	200	110	PVC	0.04	0.00	0.00	-	7261: J-12	58.5	7206: J-13	58.5
P-14	200	110	PVC	0.03	0.00	0.00	-	7206: J-13	58.5	7208: J-14	64.5
P-15	200	110	PVC	0.03	0.00	0.00	-	7208: J-14	64.5	7210: J-15	63.8
P-16	200	110	PVC	0.01	0.00	0.00	-	7210: J-15	63.8	7212: J-16	57.5
P-17	200	110	PVC	0.00	0.00	0.00	-	7212: J-16	57.5	7221: H-1	57.5
P-18	200	110	PVC	0.01	0.00	0.00	-	7212: J-16	57.5	7214: J-17	57.4
P-19	200	110	PVC	0.02	0.00	0.00	-	7214: J-17	57.4	7216: J-18	57.1
P-20	200	110	PVC	0.02	0.00	0.00	-	7216: J-18	57.1	7218: J-19	57.1
P-21	200	110	PVC	0.03	0.00	0.00	-	7218: J-19	57.1	7202: J-22	56.9
P-22	200	110	PVC	0.03	0.00	0.00	-	7196: J-11	58.5	7198: J-20	57.8
P-23	200	110	PVC	0.00	0.00	0.00	-	7198: J-20	57.8	7223: H-2	57.8
P-24	200	110	PVC	0.03	0.00	0.00	-	7198: J-20	57.8	7200: J-21	56.9
P-25	200	110	PVC	0.03	0.00	0.00	-	7200: J-21	56.9	7202: J-22	56.9
P-26	200	110	PVC	0.00	0.00	0.00	-	7202: J-22	56.9	7204: J-23	56.4
P-27	200	110	PVC	0.04	0.00	0.00	-	7237: J-24	56.9	7194: J-10	58.5
P-28	200	110	PVC	0.03	0.00	0.00	-	7235: J-25	57.1	7237: J-24	56.9
P-29	200	110	PVC	0.02	0.00	0.00	-	7233: J-26	58.6	7235: J-25	57.1
P-30	200	110	PVC	0.01	0.00	0.00	-	7231: J-27	57.5	7233: J-26	58.6
P-31	200	110	PVC	0.00	0.00	0.00	-	7231: J-27	57.5	7264: H-3	57.5
P-32	200	110	PVC	0.01	0.00	0.00	-	7229: J-28	57.4	7231: J-27	57.5
P-33	200	110	PVC	0.01	0.00	0.00	-	7227: J-29	57.1	7229: J-28	57.4
P-34	200	110	PVC	0.00	0.00	0.00	-	7225: J-30	57.1	7227: J-29	57.1
P-35	200	110	PVC	0.01	0.00	0.00	-	7200: J-21	56.9	7225: J-30	57.1

PEARSON ENGINEERING

108, 116, 122 Harvie Road, Barrie
WaterCAD FlexTable: Fire Flow Report

Fire Flow Required for the Detached Homes:

Label	Satisfies Fire Flow Constraints?	Fire Flow (Required) (L/s)	Fire Flow (Available)* (Upper Limit) (L/s)	Pressure Required (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)
J-3 (Lot 1 & 2)	TRUE	117	353.4	20.3	59.8
J-4 (Lot 3 & 4)	TRUE	117	340.7	20.3	60.0
J-6 (Lot 5 & 6)	TRUE	117	327.4	20.3	60.0
J-7 (Lot 7 & 8)	TRUE	117	327.4	20.3	60.4
J-8 (Lot 9 & 10)	TRUE	117	323.6	20.3	60.8
J-9 (Lot 11 & 12)	TRUE	117	314.6	20.3	60.4
J-14 (Apt - Fire Service)	TRUE	117	226.7	20.3	64.5
Prop. H-1	TRUE	117	209.4	20.3	57.5
Prop. H-2	TRUE	117	249.6	20.3	57.8
Prop. H-3	TRUE	117	211.5	20.3	57.5

Fire Flow Required for the Townhouse Blocks:

Label	Satisfies Fire Flow Constraints?	Fire Flow (Required) (L/s)	Fire Flow (Available)* (Upper Limit) (L/s)	Pressure Required (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)
J-3 (Lot 1 & 2)	TRUE	200	353.4	20.3	59.8
J-4 (Lot 3 & 4)	TRUE	200	340.7	20.3	60.0
J-6 (Lot 5 & 6)	TRUE	200	327.4	20.3	60.0
J-7 (Lot 7 & 8)	TRUE	200	327.4	20.3	60.4
J-8 (Lot 9 & 10)	TRUE	200	323.6	20.3	60.8
J-9 (Lot 11 & 12)	TRUE	200	314.6	20.3	60.4
J-14 (Apt - Fire Service)	TRUE	200	226.7	20.3	64.5
Prop. H-1	TRUE	200	209.4	20.3	57.5
Prop. H-2	TRUE	200	249.6	20.3	57.8
Prop. H-3	TRUE	200	211.5	20.3	57.5

Fire Flow Required for the Apartment Building:

Label	Satisfies Fire Flow Constraints?	Fire Flow (Required) (L/s)	Fire Flow (Available)* (Upper Limit) (L/s)	Pressure Required (Residual Lower Limit) (psi)	Pressure (Calculated Residual) (psi)
J-3 (Lot 1 & 2)	TRUE	200	353.4	20.3	59.8
J-4 (Lot 3 & 4)	TRUE	200	340.7	20.3	60.0
J-6 (Lot 5 & 6)	TRUE	200	327.4	20.3	60.0
J-7 (Lot 7 & 8)	TRUE	200	327.4	20.3	60.4
J-8 (Lot 9 & 10)	TRUE	200	323.6	20.3	60.8
J-9 (Lot 11 & 12)	TRUE	200	314.6	20.3	60.4
J-14 (Apt - Fire Service)	TRUE	200	226.7	20.3	64.5
Prop. H-1	TRUE	200	209.4	20.3	57.5
Prop. H-2	TRUE	200	249.6	20.3	57.8
Prop. H-3	TRUE	200	211.5	20.3	57.5

Appendix B

Sanitary Servicing Calculation

PEARSON ENGINEERING

108, 116, 122 Harvie Road, Barrie
Sanitary Flow Calculations

Design Criteria

Flow per capita (Q):	225	L/cap/day	
Peak Flow	Qp = P * Q * M / 86400 + I * A		
Peaking Factor (Harmon Formula)	M = 1 + (14 / (4 + (P / 1000) ^ 0.5))		Where: 2 <= "M" <= 4
Extraneous Flow:	0.10	L/s/ha	

Site Data

Description	Density		Units		Flow Rate	
Single Detached Home	3.25	people/unit	12	units	225	L/cap/d
Townhouse	2.57	people/unit	65	units	225	L/cap/d
Apartment	1.67	people/unit	51	units	225	L/cap/d

Calculate Population

Pop. Single Family Home	=	3.25	x	12	=	39
Pop. Townhouse	=	2.57	x	65	=	167
Pop. Apartments	=	1.67	x	51	=	85
Pop. Total	=	291	people			

Calculate Average Daily Flows

ADF (L/s)	=	225	x	291		
ADF (L/s)	=	65,525	L/day			
ADF (L/s)	=	0.76	L/s			

Calculate Peaking Factor

$$M = 1 + \frac{14}{4 + \left(\frac{291}{1{,}000}\right)^{0.5}} + 0.1 * 0.12$$

M	=	4.10	
		Use Max Peaking Factor 4	

Calculate Peak Flow

Qp	=	0.76	x	4.00		
	=	3.03	L/s			
Infiltration Allowance	=	0.10	x	2.48		
	=	0.25	L/s			
Qp (Inc. Infiltration Allowance)	=	3.28	L/s			

Appendix C

Stormwater Management Calculations

ASA Development Inv. Harvie Roard, Barrie
Calculation of Runoff Coefficients

Runoff Coefficient	=	0.16	0.08	0.95	0.95	0.60	0.95		Weighted
Surface Cover	=	Grass	Forest	Asphalt	Building	Gravel	Concrete		Runoff Coefficient
PRE DEVELOPMENT	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	24009	23133	10760	172	507	197	0		0.22
EXT1	24872	23729	3840	439	704	0	0		0.21
EXT 2	3880	3175	0	75	580	0	50		0.30
Pre Total	52761	50037	14600	686	1791	197	50		0.22
POST DEVELOPMENT	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	5071	2117	0	1600	798	0	556		0.62
2	10583	3594	0	3182	3458	0	349		0.68
3	7906	2752	0	2389	2526	0	240		0.68
4	449	449	0	0	0	0	0		0.16
EXT 1	24872	23729	3840	439	704	0	0		0.21
EXT 2	3880	3175	0	75	580	0	50		0.30
Post Total	52761	35816	3840	7685	8066	0	1195		0.42

ASA Development Inv. Harvie Roard, Barrie
Allowable Peak Flows

City of Barrie

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	**678.085**	**4.699**	**0.781**
5	**853.608**	**4.699**	**0.766**
10	**975.865**	**4.699**	**0.760**
25	**1146.275**	**4.922**	**0.757**
50	**1236.152**	**4.699**	**0.751**
100	**1426.408**	**5.273**	**0.759**

Modified Rational Method
$Q = C_i CIA / 360$

Where:

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

Area Number	1	EXT1	EXT 2
Area	2.40 ha	2.49 ha	0.39 ha
Runoff Coefficient	0.22	0.21	0.30
Time of Concentration	10 min	10 min	10 min
Return Rate	2 year	2 year	2 year
Peaking Coefficient (C_i)	1.0	1.0	1.0
Rainfall Intensity	83.1 mm/hr	83.1 mm/hr	83.1 mm/hr
Pre-Development Peak Flow	0.123 m^3/s	0.120 m^3/s	0.027 m^3/s
Return Rate	5 year	5 year	5 year
Peaking Coefficient (C_i)	1.0	1.0	1.0
Rainfall Intensity	108.9 mm/hr	108.9 mm/hr	108.9 mm/hr
Pre-Development Peak Flow	0.161 m^3/s	0.157 m^3/s	0.036 m^3/s
Return Rate	10 year	10 year	10 year
Peaking Coefficient (C_i)	1.0	1.0	1.0
Rainfall Intensity	126.5 mm/hr	126.5 mm/hr	126.5 mm/hr
Pre-Development Peak Flow	0.187 m^3/s	0.182 m^3/s	0.041 m^3/s
Return Rate	25 year	25 year	25 year
Peaking Coefficient (C_i)	1.1	1.1	1.1
Rainfall Intensity	148.2 mm/hr	148.2 mm/hr	148.2 mm/hr
Pre-Development Peak Flow	0.241 m^3/s	0.235 m^3/s	0.053 m^3/s
Return Rate	50 year	50 year	50 year
Peaking Coefficient (C_i)	1.2	1.2	1.2
Rainfall Intensity	164.2 mm/hr	164.2 mm/hr	164.2 mm/hr
Pre-Development Peak Flow	0.292 m^3/s	0.284 m^3/s	0.064 m^3/s
Return Rate	100 year	100 year	100 year
Peaking Coefficient (C_i)	1.25	1.25	1.25
Rainfall Intensity	180.2 mm/hr	180.2 mm/hr	180.2 mm/hr
Pre-Development Peak Flow	0.333 m^3/s	0.325 m^3/s	0.074 m^3/s

ASA Development Inv. Harvie Roard, Barrie
Post-Development Peak Flows

City of Barrie

Storm (yrs)	Coeff A	Coeff B	Coeff C
2	678.085	4.699	0.781
5	853.608	4.699	0.766
10	975.865	4.699	0.760
25	1146.275	4.922	0.757
50	1236.152	4.699	0.751
100	1426.408	5.273	0.759

Modified Rational Method
$Q = C_i CIA / 360$

Where:

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

Area Number	To be Controlled 2 & 3	To be Uncontrolled 1 & 4	EXT1	EXT2
Area	1.85 ha	0.55 ha	2.49 ha	0.39 ha
Runoff Coefficient	0.68	0.58	0.21	0.30
Time of Concentration	10 min	10 min	10 min	10 min
Return Rate	2 year	2 year	2 year	2 year
Peaking Coefficient (C_i)	1.00	1.00	1.00	1.00
Rainfall Intensity	83.1	83.1	83.1	83.1
Post-Development Peak Flow	0.290 m^3/s	0.074 m^3/s	0.120 m^3/s	0.027 m^3/s
Return Rate	5 year	5 year	5 year	5 year
Peaking Coefficient (C_i)	1.00	1.00	1.00	1.00
Rainfall Intensity	108.9	108.9	108.9	108.9
Post-Development Peak Flow	0.380 m^3/s	0.097 m^3/s	0.157 m^3/s	0.036 m^3/s
Return Rate	10 year	10 year	10 year	10 year
Peaking Coefficient (C_i)	1.00	1.00	1.00	1.00
Rainfall Intensity	126.5	126.5	126.5	126.5
Post-Development Peak Flow	0.441 m^3/s	0.113 m^3/s	0.182 m^3/s	0.041 m^3/s
Return Rate	25 year	25 year	25 year	25 year
Peaking Coefficient (C_i)	1.10	1.10	1.10	1.10
Rainfall Intensity	148.2	148.2	148.2	148.2
Post-Development Peak Flow	0.568 m^3/s	0.146 m^3/s	0.235 m^3/s	0.053 m^3/s
Return Rate	50 year	50 year	50 year	50 year
Peaking Coefficient (C_i)	1.20	1.20	1.20	1.20
Rainfall Intensity	164.2	164.2	164.2	164.2
Post-Development Peak Flow	0.687 m^3/s	0.176 m^3/s	0.284 m^3/s	0.064 m^3/s
Return Rate	100 year	100 year	100 year	100 year
Peaking Coefficient (C_i)	1.25	1.25	1.25	1.25
Rainfall Intensity	180.2	180.2	180.2	180.2
Post-Development Peak Flow	0.785 m^3/s	0.201 m^3/s	0.325 m^3/s	0.074 m^3/s

ASA Development Inv. Harvie Roard, Barrie
Permeable Pavers Sizing Calculations

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

Design Area Total	=	1.85	ha		
Total Imperviousness	=	68%			
Storage Volume	=	34.5	m^3/ha		(Enhanced 80% long-term S.S. removal)
Area 1 Storage Volume Required	=	1.85		x	34.5
	=	63.8	m^3		

Required storage volume calculated over 12.5 mm of the total impervious area on the site as per the LSRCA Volume Control:

Storage Volume	=	15098		x	0.0125
Area Storage Volume Required	=	188.7	m^3		

Note: Therefore, the storage required with 12.5 mm over the total impervious area on the site governs.

Find Storage Volume provided in Permeable Pavers:

Area of Pavers (A)	=	1125.0	m^2		
Depth of Trench (d)	=	0.50	m		
Storage Volume (V)	=	0.4(A x d)			
	=	225.0	m^3		

		Required		**Provided**	
Area Storage Volume	=	188.7	m^3	225.0	m^3

Use Equation 4.12 to find Area of Permeable Pavers:

Area Design Volume (V)	=	225.0	m^3
Depth of Controlling Filter Medium (d)	=	0.50	m
Coefficient of Permeability of the Controlling Filter Media (k)	=	45.0	mm/hr
Operating Head of Water On the Filter (h)	=	0.15	m
Design Drawdown Time (t)	=	24	hr
Surface Area Of Filter (A)	=	$\frac{1000Vd}{k(h+d)t}$	
	=	160.3	m^2

		Required		**Provided**	
Area 1 Surface Area	=	134.4	m^2	1125.0	m^2

PEARSON ENGINEERING

ASA Development Inv. Harvie Roard, Barrie
Quantity Control Volume Calculations - Block A

DATE: 24-Sep-21
FILE: 21092
CONTRACT/PROJECT: ASA Development
COMPLETED BY: AMC

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre Development Runoff Coefficient	Post Development Runoff Coefficient
2.40	1.06	10	1	0.22	0.68

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

Pre-Development Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.22	0.22	0.22	0.22	0.22	0.22
C_i	1.00	1.00	1.00	1.10	1.20	1.25
I	83.11	108.92	126.55	148.15	164.22	180.15
A	2.40	2.40	2.40	2.40	2.40	2.40
Q	0.12	0.16	0.19	0.24	0.29	0.33

Note: $Q = 0.00278 C C_i I A$

Rainfall Station	Barrie

SWM Pond Design Input

Storm Event (yrs)	Chicago Storm Coefficient A	Chicago Storm Coefficient B	Chicago Storm Coefficient C	Allowable Outflow (m3/s)	Post Development Runoff Coefficient
2	678.085	4.699	0.781	0.040	0.68
5	853.608	4.699	0.766	0.052	0.68
10	975.865	4.699	0.760	0.061	0.68
25	1146.275	4.922	0.757	0.078	0.75
50	1236.152	4.699	0.751	0.095	0.82
100	1426.408	5.273	0.759	0.108	0.85

Results

Storm Event (yrs)	Storage (m^3)	Time (min)
2	108	42
5	146	44
10	171	47
25	225	48
50	271	49
100	315	49

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

Time (min)	2 Year Intensity mm/hr	2 Year Inflow m^3/s	2 Year Outflow m^3/s	2 Year Storage m^3	Difference	5 Year Intensity mm/hr	5 Year Inflow m^3/s	5 Year Outflow m^3/s	5 Year Storage m^3	Difference	10 Year Intensity mm/hr	10 Year Inflow m^3/s	10 Year Outflow m^3/s	10 Year Storage m^3	Difference	25 Year Intensity mm/hr	25 Year Inflow m^3/s	25 Year Outflow m^3/s	25 Year Storage m^3	Difference	50 Year Intensity mm/hr	50 Year Inflow m^3/s	50 Year Outflow m^3/s	50 Year Storage m^3	Difference	100 Year Intensity mm/hr	100 Year Inflow m^3/s	100 Year Outflow m^3/s	100 Year Storage m^3	Difference
1	174.18	0.35	0.04	8	15	225.07	0.45	0.05	10	19	260.01	0.52	0.06	11	22	298.22	0.66	0.08	14	28	334.55	0.80	0.09	17	34	353.96	0.89	0.11	18	39
2	153.52	0.31	0.04	23	12	198.85	0.40	0.05	29	15	229.94	0.46	0.06	33	18	264.99	0.58	0.08	42	22	296.30	0.71	0.09	51	27	316.38	0.79	0.11	56	31
3	137.71	0.28	0.04	34	9	178.75	0.36	0.05	44	12	206.87	0.41	0.06	51	14	239.26	0.53	0.08	64	18	266.91	0.64	0.09	79	22	286.90	0.72	0.11	87	26
4	125.19	0.25	0.04	43	8	162.79	0.33	0.05	56	10	188.54	0.38	0.06	65	12	218.67	0.48	0.08	83	15	243.52	0.59	0.09	101	19	263.10	0.66	0.11	113	22
5	114.99	0.23	0.04	51	7	149.77	0.30	0.05	67	9	173.57	0.35	0.06	77	10	201.77	0.44	0.08	98	13	224.41	0.54	0.09	119	16	243.43	0.61	0.11	134	18
6	106.50	0.21	0.04	58	6	138.93	0.28	0.05	75	7	161.10	0.32	0.06	87	9	187.63	0.41	0.08	111	11	208.47	0.50	0.09	135	14	226.85	0.57	0.11	153	16
7	99.33	0.20	0.04	63	5	129.73	0.26	0.05	83	6	150.52	0.30	0.06	96	8	175.59	0.39	0.08	123	10	194.94	0.47	0.09	149	12	212.68	0.53	0.11	169	14
8	93.16	0.19	0.04	68	4	121.83	0.24	0.05	89	6	141.42	0.28	0.06	103	7	165.20	0.36	0.08	133	9	183.29	0.44	0.09	160	10	200.41	0.50	0.11	183	12
9	87.81	0.18	0.04	72	4	114.96	0.23	0.05	95	5	133.51	0.27	0.06	110	6	156.14	0.34	0.08	141	8	173.15	0.42	0.09	171	9	189.66	0.48	0.11	195	11
10	83.11	0.17	0.04	76	3	108.92	0.22	0.05	100	4	126.55	0.25	0.06	116	5	148.15	0.33	0.08	149	7	164.22	0.39	0.09	180	8	180.15	0.45	0.11	206	10
11	78.94	0.16	0.04	79	3	103.57	0.21	0.05	104	4	120.37	0.24	0.06	121	5	141.05	0.31	0.08	156	6	156.30	0.38	0.09	188	7	171.69	0.43	0.11	216	9
12	75.23	0.15	0.04	82	3	98.78	0.20	0.05	108	4	114.85	0.23	0.06	126	4	134.69	0.30	0.08	162	6	149.22	0.36	0.09	196	7	164.09	0.41	0.11	225	8
13	71.88	0.14	0.04	85	2	94.48	0.19	0.05	112	3	109.89	0.22	0.06	130	4	128.97	0.28	0.08	168	5	142.84	0.34	0.09	203	6	157.23	0.39	0.11	233	7
14	68.86	0.14	0.04	87	2	90.58	0.18	0.05	115	3	105.39	0.21	0.06	134	3	123.77	0.27	0.08	173	5	137.07	0.33	0.09	209	6	151.00	0.38	0.11	240	7
15	66.12	0.13	0.04	89	2	87.04	0.17	0.05	118	3	101.30	0.20	0.06	137	3	119.04	0.26	0.08	177	4	131.81	0.32	0.09	214	5	145.31	0.36	0.11	247	6
16	63.61	0.13	0.04	91	2	83.80	0.17	0.05	120	2	97.56	0.20	0.06	140	3	114.71	0.25	0.08	182	4	127.00	0.31	0.09	219	5	140.09	0.35	0.11	253	6
17	61.31	0.12	0.04	93	2	80.82	0.16	0.05	123	2	94.12	0.19	0.06	143	3	110.72	0.24	0.08	186	4	122.58	0.29	0.09	224	4	135.29	0.34	0.11	258	5
18	59.19	0.12	0.04	95	1	78.08	0.16	0.05	125	2	90.95	0.18	0.06	146	2	107.05	0.24	0.08	189	3	118.50	0.28	0.09	228	4	130.86	0.33	0.11	263	5
19	57.23	0.11	0.04	96	1	75.55	0.15	0.05	127	2	88.02	0.18	0.06	148	2	103.64	0.23	0.08	192	3	114.72	0.28	0.09	232	4	126.75	0.32	0.11	268	4
20	55.41	0.11	0.04	97	1	73.19	0.15	0.05	129	2	85.30	0.17	0.06	150	2	100.48	0.22	0.08	195	3	111.22	0.27	0.09	236	3	122.92	0.31	0.11	272	4
21	53.72	0.11	0.04	99	1	71.00	0.14	0.05	131	2	82.77	0.17	0.06	152	2	97.53	0.22	0.08	198	3	107.95	0.26	0.09	239	3	119.35	0.30	0.11	276	4
22	52.14	0.10	0.04	100	1	68.95	0.14	0.05	132	1	80.40	0.16	0.06	154	2	94.78	0.21	0.08	201	2	104.90	0.25	0.09	242	3	116.02	0.29	0.11	280	3
23	50.67	0.10	0.04	101	1	67.04	0.13	0.05	134	1	78.18	0.16	0.06	156	2	92.19	0.20	0.08	203	2	102.04	0.25	0.09	245	3	112.89	0.28	0.11	283	3
24	49.28	0.10	0.04	102	1	65.24	0.13	0.05	135	1	76.10	0.15	0.06	158	1	89.77	0.20	0.08	205	2	99.36	0.24	0.09	248	2	109.95	0.28	0.11	286	3
25	47.98	0.10	0.04	102	1	63.55	0.13	0.05	136	1	74.15	0.15	0.06	159	1	87.49	0.19	0.08	207	2	96.84	0.23	0.09	250	2	107.18	0.27	0.11	289	3
26	46.76	0.09	0.04	103	1	61.96	0.12	0.05	137	1	72.31	0.14	0.06	160	1	85.34	0.19	0.08	209	2	94.46	0.23	0.09	252	2	104.57	0.26	0.11	292	2
27	45.60	0.09	0.04	104	1	60.46	0.12	0.05	138	1	70.57	0.14	0.06	162	1	83.31	0.18	0.08	211	2	92.21	0.22	0.09	254	2	102.10	0.26	0.11	294	2
28	44.51	0.09	0.04	104	1	59.04	0.12	0.05	139	1	68.92	0.14	0.06	163	1	81.39	0.18	0.08	212	1	90.09	0.22	0.09	256	2	99.76	0.25	0.11	297	2
29	43.47	0.09	0.04	105	0	57.69	0.12	0.05	140	1	67.36	0.13	0.06	164	1	79.56	0.18	0.08	214	1	88.07	0.21	0.09	258	2	97.55	0.24	0.11	299	2
30	42.49	0.09	0.04	106	0	56.41	0.11	0.05	141	1	65.88	0.13	0.06	165	1	77.83	0.17	0.08	215	1	86.16	0.21	0.09	259	1	95.44	0.24	0.11	301	2
31	41.56	0.08	0.04	106	0	55.20	0.11	0.05	141	1	64.47	0.13	0.06	166	1	76.19	0.17	0.08	216	1	84.34	0.20	0.09	261	1	93.44	0.23	0.11	302	2
32	40.67	0.08	0.04	106	0	54.04	0.11	0.05	142	1	63.13	0.13	0.06	166	1	74.62	0.16	0.08	217	1	82.61	0.20	0.09	262	1	91.53	0.23	0.11	304	1
33	39.83	0.08	0.04	107	0	52.94	0.11	0.05	143	0	61.86	0.12	0.06	167	1	73.13	0.16	0.08	218	1	80.96	0.19	0.09	263	1	89.71	0.22	0.11	305	1
34	39.02	0.08	0.04	107	0	51.89	0.10	0.05	143	0	60.64	0.12	0.06	168	1	71.70	0.16	0.08	219	1	79.38	0.19	0.09	265	1	87.97	0.22	0.11	307	1
35	38.25	0.08	0.04	107	0	50.89	0.10	0.05	144	0	59.47	0.12	0.06	168	1	70.33	0.16	0.08	220	1	77.87	0.19	0.09	266	1	86.31	0.22	0.11	308	1
36	37.51	0.08	0.04	107	0	49.92	0.10	0.05	144	0	58.36	0.12	0.06	169	0	69.03	0.15	0.08	221	1	76.43	0.18	0.09	266	1	84.71	0.21	0.11	309	1
37	36.81	0.07	0.04	108	0	49.01	0.10	0.05	144	0	57.29	0.11	0.06	169	0	67.78	0.15	0.08	221	1	75.05	0.18	0.09	267	1	83.19	0.21	0.11	310	1
38	36.13	0.07	0.04	108	0	48.12	0.10	0.05	145	0	56.27	0.11	0.06	170	0	66.58	0.15	0.08	222	1	73.73	0.18	0.09	268	1	81.73	0.20	0.11	311	1
39	35.49	0.07	0.04	108	0	47.28	0.09	0.05	145	0	55.29	0.11	0.06	170	0	65.43	0.14	0.08	222	0	72.46	0.17	0.09	269	1	80.32	0.20	0.11	312	1
40	34.87	0.07	0.04	108	0	46.47	0.09	0.05	145	0	54.35	0.11	0.06	170	0	64.32	0.14	0.08	223	0	71.24	0.17	0.09	269	0	78.97	0.20	0.11	313	1
41	34.27	0.07	0.04	108	0	45.68	0.09	0.05	145	0	53.44	0.11	0.06	170	0	63.26	0.14	0.08	223	0	70.06	0.17	0.09	270	0	77.67	0.19	0.11	313	1
42	33.69	0.07	0.04	108	0	44.93	0.09	0.05	145	0	52.57	0.11	0.06	171	0	62.24	0.14	0.08	224	0	68.93	0.17	0.09	270	0	76.42	0.19	0.11	314	0
43	33.14	0.07	0.04	108	0	44.21	0.09	0.05	145	0	51.73	0.10	0.06	171	0	61.25	0.14	0.08	224	0	67.84	0.16	0.09	270	0	75.22	0.19	0.11	314	0
44	32.61	0.07	0.04	108	0	43.51	0.09	0.05	145	0	50.92	0.10	0.06	171	0	60.30	0.13	0.08	224	0	66.80	0.16	0.09	271	0	74.05	0.19	0.11	315	0
45	32.09	0.06	0.04	108	0	42.84	0.09	0.05	146	0	50.14	0.10	0.06	171	0	59.39	0.13	0.08	224	0	65.78	0.16	0.09	271	0	72.93	0.18	0.11	315	0
46	31.60	0.06	0.04	108	0	42.19	0.08	0.05	146	0	49.38	0.10	0.06	171	0	58.50	0.13	0.08	224	0	64.81	0.16	0.09	271	0	71.85	0.18	0.11	315	0
47	31.12	0.06	0.04	108	0	41.57	0.08	0.05	145	0	48.66	0.10	0.06	171	0	57.65	0.13	0.08	225	0	63.86	0.15	0.09	271	0	70.81	0.18	0.11	315	0
48	30.66	0.06	0.04	108	0	40.96	0.08	0.05	145	0	47.95	0.10	0.06	171	0	56.82	0.13	0.08	225	0	62.95	0.15	0.09	271	0	69.80	0.17	0.11	315	0
49	30.21	0.06	0.04	108	0	40.37	0.08	0.05	145	0	47.27	0.09	0.06	171	0	56.02	0.12	0.08	225	0	62.07	0.15	0.09	271	0	68.82	0.17	0.11	315	0
50	29.78	0.06	0.04	107	0	39.81	0.08	0.05	145	0	46.61	0.09	0.06	171	0	55.25	0.12	0.08	225	0	61.21	0.15	0.09	271	0	67.87	0.17	0.11	315	0

Maximum Storage Volume

PEARSON ENGINEERING

ASA Development Inv. Harvie Roard, Barrie
Quantity Control Volume Calculations - Block B

DATE: 24-Sep-21
FILE: 21092
CONTRACT/PROJECT: ASA Development
COMPLETED BY: AMC

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre Development Runoff Coefficient	Post Development Runoff Coefficient
2.40	0.79	10	5	0.22	0.68

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

Pre-Development Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.22	0.22	0.22	0.22	0.22	0.22
C_i	1.00	1.00	1.00	1.10	1.20	1.25
I	83.11	108.92	126.55	148.15	164.22	180.15
A	2.40	2.40	2.40	2.40	2.40	2.40
Q	0.12	0.16	0.19	0.24	0.29	0.33

Note: $Q = 0.00278 C C_i I A$

Rainfall Station	Barrie

SWM Pond Design Input

Storm Event (yrs)	Chicago Storm Coefficient A	Chicago Storm Coefficient B	Chicago Storm Coefficient C	Allowable Outflow (m3/s)	Post Development Runoff Coefficient
2	678.085	4.699	0.781	0.009	0.68
5	853.608	4.699	0.766	0.011	0.68
10	975.865	4.699	0.760	0.013	0.68
25	1146.275	4.922	0.757	0.017	0.74
50	1236.152	4.699	0.751	0.021	0.81
100	1426.408	5.273	0.759	0.024	0.84

Results

Storm Event (yrs)	Storage (m^3)	Time (min)
2	135	165
5	186	180
10	220	195
25	291	205
50	354	210
100	408	205

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

Time (min)	2 Year Intensity mm/hr	2 Year Inflow m^3/s	2 Year Outflow m^3/s	2 Year Storage m^3	Difference	5 Year Intensity mm/hr	5 Year Inflow m^3/s	5 Year Outflow m^3/s	5 Year Storage m^3	Difference	10 Year Intensity mm/hr	10 Year Inflow m^3/s	10 Year Outflow m^3/s	10 Year Storage m^3	Difference	25 Year Intensity mm/hr	25 Year Inflow m^3/s	25 Year Outflow m^3/s	25 Year Storage m^3	Difference	50 Year Intensity mm/hr	50 Year Inflow m^3/s	50 Year Outflow m^3/s	50 Year Storage m^3	Difference	100 Year Intensity mm/hr	100 Year Inflow m^3/s	100 Year Outflow m^3/s	100 Year Storage m^3	Difference
5	114.99	0.17	0.01	47	21	149.77	0.22	0.01	61	29	173.57	0.26	0.01	71	33	201.77	0.33	0.02	91	44	224.41	0.40	0.02	110	52	243.43	0.45	0.02	125	61
10	83.11	0.12	0.01	69	13	108.92	0.16	0.01	90	18	126.55	0.19	0.01	105	21	148.15	0.24	0.02	135	27	164.22	0.29	0.02	163	33	180.15	0.33	0.02	186	38
15	66.12	0.10	0.01	82	9	87.04	0.13	0.01	108	12	101.30	0.15	0.01	125	15	119.04	0.19	0.02	162	19	131.81	0.23	0.02	195	23	145.31	0.27	0.02	225	27
20	55.41	0.08	0.01	91	7	73.19	0.11	0.01	120	9	85.30	0.13	0.01	140	11	100.48	0.16	0.02	181	15	111.22	0.20	0.02	219	18	122.92	0.23	0.02	252	21
25	47.98	0.07	0.01	98	5	63.55	0.09	0.01	129	7	74.15	0.11	0.01	151	9	87.49	0.14	0.02	196	12	96.84	0.17	0.02	237	14	107.18	0.20	0.02	273	17
30	42.49	0.06	0.01	103	4	56.41	0.08	0.01	137	6	65.88	0.10	0.01	160	7	77.83	0.13	0.02	208	10	86.16	0.15	0.02	251	12	95.44	0.18	0.02	290	14
35	38.25	0.06	0.01	107	4	50.89	0.08	0.01	143	5	59.47	0.09	0.01	167	6	70.33	0.11	0.02	218	8	77.87	0.14	0.02	263	10	86.31	0.16	0.02	304	12
40	34.87	0.05	0.01	111	3	46.47	0.07	0.01	148	4	54.35	0.08	0.01	173	5	64.32	0.10	0.02	226	7	71.24	0.13	0.02	273	9	78.97	0.15	0.02	316	10
45	32.09	0.05	0.01	114	3	42.84	0.06	0.01	153	4	50.14	0.07	0.01	179	5	59.39	0.10	0.02	233	6	65.78	0.12	0.02	282	8	72.93	0.14	0.02	326	9
50	29.78	0.04	0.01	117	2	39.81	0.06	0.01	156	3	46.61	0.07	0.01	183	4	55.25	0.09	0.02	239	5	61.21	0.11	0.02	289	7	67.87	0.13	0.02	335	8
55	27.81	0.04	0.01	119	2	37.23	0.06	0.01	160	3	43.62	0.06	0.01	187	4	51.72	0.08	0.02	245	5	57.32	0.10	0.02	296	6	63.55	0.12	0.02	342	7
60	26.12	0.04	0.01	121	2	35.00	0.05	0.01	163	3	41.03	0.06	0.01	191	3	48.68	0.08	0.02	250	4	53.96	0.10	0.02	302	5	59.82	0.11	0.02	349	6
65	24.64	0.04	0.01	123	2	33.06	0.05	0.01	165	2	38.77	0.06	0.01	194	3	46.02	0.08	0.02	254	4	51.03	0.09	0.02	307	5	56.56	0.10	0.02	355	6
70	23.35	0.03	0.01	124	1	31.35	0.05	0.01	168	2	36.78	0.05	0.01	197	3	43.67	0.07	0.02	258	3	48.44	0.09	0.02	312	4	53.69	0.10	0.02	361	5
75	22.19	0.03	0.01	126	1	29.84	0.04	0.01	170	2	35.02	0.05	0.01	200	2	41.59	0.07	0.02	261	3	46.14	0.08	0.02	316	4	51.13	0.09	0.02	366	4
80	21.16	0.03	0.01	127	1	28.48	0.04	0.01	172	2	33.44	0.05	0.01	202	2	39.72	0.06	0.02	265	3	44.08	0.08	0.02	320	4	48.84	0.09	0.02	370	4
85	20.24	0.03	0.01	128	1	27.25	0.04	0.01	173	2	32.01	0.05	0.01	204	2	38.04	0.06	0.02	267	3	42.22	0.08	0.02	324	3	46.77	0.09	0.02	374	4
90	19.40	0.03	0.01	129	1	26.14	0.04	0.01	175	1	30.72	0.05	0.01	206	2	36.51	0.06	0.02	270	2	40.54	0.07	0.02	327	3	44.90	0.08	0.02	378	3
95	18.63	0.03	0.01	130	1	25.13	0.04	0.01	176	1	29.54	0.04	0.01	208	2	35.12	0.06	0.02	272	2	39.00	0.07	0.02	330	3	43.19	0.08	0.02	381	3
100	17.94	0.03	0.01	131	1	24.21	0.04	0.01	177	1	28.46	0.04	0.01	209	1	33.84	0.06	0.02	274	2	37.59	0.07	0.02	333	2	41.62	0.08	0.02	384	3
105	17.29	0.03	0.01	131	1	23.36	0.03	0.01	179	1	27.47	0.04	0.01	211	1	32.67	0.05	0.02	276	2	36.30	0.06	0.02	335	2	40.18	0.07	0.02	387	3
110	16.70	0.02	0.01	132	1	22.58	0.03	0.01	180	1	26.55	0.04	0.01	212	1	31.59	0.05	0.02	278	2	35.10	0.06	0.02	337	2	38.85	0.07	0.02	390	2
115	16.15	0.02	0.01	133	0	21.85	0.03	0.01	180	1	25.71	0.04	0.01	213	1	30.59	0.05	0.02	280	1	34.00	0.06	0.02	339	2	37.62	0.07	0.02	392	2
120	15.65	0.02	0.01	133	0	21.18	0.03	0.01	181	1	24.92	0.04	0.01	214	1	29.66	0.05	0.02	281	1	32.97	0.06	0.02	341	2	36.47	0.07	0.02	394	2
125	15.17	0.02	0.01	133	0	20.55	0.03	0.01	182	1	24.19	0.04	0.01	215	1	28.79	0.05	0.02	283	1	32.01	0.06	0.02	343	2	35.41	0.07	0.02	396	2
130	14.73	0.02	0.01	134	0	19.96	0.03	0.01	183	1	23.50	0.03	0.01	216	1	27.98	0.05	0.02	284	1	31.11	0.06	0.02	344	1	34.41	0.06	0.02	398	2
135	14.32	0.02	0.01	134	0	19.41	0.03	0.01	183	0	22.86	0.03	0.01	216	1	27.22	0.04	0.02	285	1	30.27	0.05	0.02	346	1	33.47	0.06	0.02	399	1
140	13.93	0.02	0.01	134	0	18.89	0.03	0.01	184	0	22.26	0.03	0.01	217	1	26.50	0.04	0.02	286	1	29.48	0.05	0.02	347	1	32.59	0.06	0.02	401	1
145	13.57	0.02	0.01	134	0	18.41	0.03	0.01	184	0	21.69	0.03	0.01	218	1	25.83	0.04	0.02	287	1	28.74	0.05	0.02	348	1	31.77	0.06	0.02	402	1
150	13.22	0.02	0.01	134	0	17.95	0.03	0.01	184	0	21.15	0.03	0.01	218	0	25.20	0.04	0.02	287	1	28.04	0.05	0.02	349	1	30.99	0.06	0.02	403	1
155	12.90	0.02	0.01	135	0	17.52	0.03	0.01	185	0	20.65	0.03	0.01	219	0	24.60	0.04	0.02	288	1	27.38	0.05	0.02	350	1	30.25	0.06	0.02	404	1
160	12.59	0.02	0.01	135	0	17.11	0.03	0.01	185	0	20.17	0.03	0.01	219	0	24.03	0.04	0.02	289	1	26.75	0.05	0.02	351	1	29.55	0.05	0.02	405	1
165	12.30	0.02	0.01	135	0	16.72	0.02	0.01	185	0	19.72	0.03	0.01	219	0	23.50	0.04	0.02	289	0	26.16	0.05	0.02	352	1	28.89	0.05	0.02	405	1
170	12.02	0.02	0.01	135	0	16.36	0.02	0.01	185	0	19.29	0.03	0.01	220	0	22.99	0.04	0.02	290	0	25.59	0.05	0.02	352	1	28.27	0.05	0.02	406	1
175	11.76	0.02	0.01	135	0	16.01	0.02	0.01	185	0	18.88	0.03	0.01	220	0	22.50	0.04	0.02	290	0	25.06	0.04	0.02	353	0	27.67	0.05	0.02	407	0
180	11.51	0.02	0.01	135	0	15.67	0.02	0.01	185	0	18.49	0.03	0.01	220	0	22.04	0.04	0.02	290	0	24.54	0.04	0.02	353	0	27.10	0.05	0.02	407	0
185	11.27	0.02	0.01	134	0	15.36	0.02	0.01	186	0	18.12	0.03	0.01	220	0	21.60	0.04	0.02	290	0	24.06	0.04	0.02	354	0	26.56	0.05	0.02	407	0
190	11.05	0.02	0.01	134	0	15.05	0.02	0.01	185	0	17.76	0.03	0.01	220	0	21.18	0.03	0.02	291	0	23.59	0.04	0.02	354	0	26.04	0.05	0.02	408	0
195	10.83	0.02	0.01	134	0	14.76	0.02	0.01	185	0	17.42	0.03	0.01	220	0	20.77	0.03	0.02	291	0	23.15	0.04	0.02	354	0	25.55	0.05	0.02	408	0
200	10.62	0.02	0.01	134	0	14.49	0.02	0.01	185	0	17.10	0.03	0.01	220	0	20.39	0.03	0.02	291	0	22.72	0.04	0.02	354	0	25.07	0.05	0.02	408	0
205	10.43	0.02	0.01	134	0	14.22	0.02	0.01	185	0	16.79	0.02	0.01	220	0	20.02	0.03	0.02	291	0	22.31	0.04	0.02	354	0	24.62	0.05	0.02	408	0
210	10.24	0.02	0.01	134	0	13.97	0.02	0.01	185	0	16.49	0.02	0.01	220	0	19.67	0.03	0.02	291	0	21.92	0.04	0.02	354	0	24.18	0.04	0.02	408	0
215	10.05	0.01	0.01	133	0	13.72	0.02	0.01	185	0	16.20	0.02	0.01	220	0	19.33	0.03	0.02	291	0	21.55	0.04	0.02	354	0	23.76	0.04	0.02	408	0
220	9.88	0.01	0.01	133	0	13.49	0.02	0.01	185	0	15.93	0.02	0.01	220	0	19.00	0.03	0.02	290	0	21.18	0.04	0.02	354	0	23.36	0.04	0.02	408	0

Maximum Storage Volume

Appendix D

Water Balance Calculations

PEARSON ENGINEERING

ASA Development Inv. Harvie Roard, Barrie
Pre-Development Water Balance

Catchment Designation	Site				
	Grassed	Gravel/ Paved	Building	Total	
Area	23133	369	507	24009	
Pervious Area	23133	0	0	23133	
Impervious Area	0	369	507	876	
Infiltration Factors					
Topography Infiltration Factor	0.3	0	0		(From MOE Table 3.1 for Flat Land)
Soil Infiltration Factor	0.4	0	0		(From MOE Table 3.1 for Medium combinations of clay and loam)
Land Cover Infiltration Factor	0.1	0	0		
MOE Infiltration Factor	0.8	0	0		
Actual Infiltration Factor	0.8	0	0		
Run-Off Coeffiecient	0.2	1	1		
Runoff from Impervious Surfaces	0	0.95	0.95		
Inputs (per Unit Area)					
Precipitation	932.9	932.9	932.9	932.9	(Precipitation values from Environment Canada)
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	932.9	932.9	932.9	932.9	
Outputs (per Unit Area)					
Precipitation Surplus	371.9	886.3	886.3	390.7	
Net Surplus	371.9	886.3	886.3	390.7	
Evapotranspiration	561.0	46.6	46.6	542.2	
				0.0	
Infiltration	297.5	0.0	0.0	286.7	
Rooftop Infiltration	0.0	0.0	0.0	0.0	
Total Infiltration	297.5	0.0	0.0	286.7	
Runoff Pervious Areas	74.4	0.0	0.0	71.7	
Runoff Impervious Areas	0.0	886.3	886.3	32.3	
Total Runoff	74.4	886.3	886.3	104.0	
Total Outputs	932.9	932.9	932.9	932.9	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0.0	
Inputs (Volumes)					
Precipitation	21581	344	473	22398	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	21581	344	473	22398	
Outputs (Volumes)					
Precipitation Surplus	8603	327	449	9379	
Net Surplus	8603	327	449	9379	
Evapotranspiration	12978	17	24	13019	
Infiltration	6883	0	0	6883	
Rooftop Infiltration	0	0	0	0	
Total Infiltration	6883	0	0	6883	
Runoff Pervious Areas	1721	0	0	1721	
Runoff Impervious Areas	0	327	449	776	
Total Runoff	1721	327	449	2497	
Total Outputs	21581	344	473	22398	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

PEARSON ENGINEERING

ASA Development Inv. Harvie Roard, Barrie
Post-Development Water Balance (No Infiltration)

Catchment Designation	Site				
	Grassed	Paved	Building	Total	
Area	8911	8316	6782	24009	
Pervious Area	8911	0	0	8911	
Impervious Area	0	8316	6782	15098	
Infiltration Factors					
Topography Infiltration Factor	0.3	0	0		(From MOE Table 3.1 for Flat Land)
Soil Infiltration Factor	0.4	0	0		(From MOE Table 3.1 for Medium combinations of clay and loam)
Land Cover Infiltration Factor	0.1	0	0		
MOE Infiltration Factor	0.8	0	0		
Actual Infiltration Factor	0.8	0	0		
Run-Off Coeffiecient	0.2	1	1		
Runoff from Impervious Surfaces	0	0.95	0.95		
Inputs (per Unit Area)					
Precipitation	932.9	932.9	932.9	932.9	(Precipitation values from Environment Canada)
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	932.9	932.9	932.9	932.9	
Outputs (per Unit Area)					
Precipitation Surplus	371.9	886.3	886.3	695.3	
Net Surplus	371.9	886.3	886.3	695.3	
Evapotranspiration	561.0	46.6	46.6	237.6	
Infiltration	297.5	0.0	0.0	110.4	
Rooftop Infiltration	0.0	0.0	0.0	0.0	
Total Infiltration	297.5	0.0	0.0	110.4	
Runoff Pervious Areas	74.4	0.0	0.0	27.6	
Runoff Impervious Areas	0.0	886.3	886.3	557.3	
Total Runoff	74.4	886.3	886.3	584.9	
Total Outputs	932.9	932.9	932.9	932.9	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0.0	
Inputs (Volumes)					
Precipitation	8313	7758	6327	22398	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	8313	7758	6327	22398	
Outputs (Volumes)					
Precipitation Surplus	3314	7370	6011	16695	
Net Surplus	3314	7370	6011	16695	
Evapotranspiration	4999	388	316	5703	
Infiltration	2651	0	0	2651	
Rooftop Infiltration	0	0	0	0	
Total Infiltration	2651	0	0	2651	
Runoff Pervious Areas	663	0	0	663	
Runoff Impervious Areas	0	7370	6011	13381	
Total Runoff	663	7370	6011	14043	
Total Outputs	8313	7758	6327	22398	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

PEARSON ENGINEERING

ASA Development Inv. Harvie Roard, Barrie
Post Development Water Balance (With Infiltration)

Catchment Designation	Site				
	Grassed	Impervious	Building (with Infil.)	Total	
Area	8911	8316	6782	24009	
Pervious Area	8911	0	0	8911	
Impervious Area	0	8316	6782	15098	
Infiltration Factors					
Topography Infiltration Factor	0.3	0	0		(From MOE Table 3.1 for Flat Land)
Soil Infiltration Factor	0.4	0	0		(From MOE Table 3.1 for Medium combinations of clay and loam)
Land Cover Infiltration Factor	0.1	0	0		
MOE Infiltration Factor	0.8	0	0		
Actual Infiltration Factor	0.8	0	0		
Run-Off Coeffiecient	0.2	1	1		
Runoff from Impervious Surfaces	0	0.95	0.95		
Inputs (per Unit Area)					
Precipitation	932.9	932.9	932.9	932.9	(Precipitation values from Environment Canada)
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	932.9	932.9	932.9	932.9	
Outputs (per Unit Area)					
Precipitation Surplus	371.9	886.3	886.3	695.3	
Net Surplus	371.9	886.3	886.3	695.3	
Evapotranspiration	561.0	46.6	46.6	237.6	
Infiltration	297.5	0.0	0.0	110.4	
Rooftop Infiltration	0.0	0.0	**624.0**	176.3	Depth of rainfall over the rooftop required to be infiltrated to achieve water balance.
Total Infiltration	297.5	0.0	624.0	286.7	
Runoff Pervious Areas	74.4	0.0	0.0	27.6	
Runoff Impervious Areas	0.0	886.3	262.3	381.0	
Total Runoff	74.4	886.3	262.3	408.7	
Total Outputs	932.9	932.9	932.9	932.9	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0.0	
Inputs (Volumes)					
Precipitation	8313	7758	6327	22398	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	8313	7758	6327	22398	
Outputs (Volumes)					
Precipitation Surplus	3314	7370	6011	16695	
Net Surplus	3314	7370	6011	16695	
Evapotranspiration	4999	388	316	5703	
Infiltration	2651	0	0	2651	
Rooftop Infiltration	0	0	4232	4232	
Total Infiltration	2651	0	4232	6883	
Runoff Pervious Areas	663	0	0	663	
Runoff Impervious Areas	0	7370	1779	9149	
Total Runoff	663	7370	1779	9811	
Total Outputs	8313	7758	6327	22398	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

ASA Development Inv. Harvie Roard, Barrie
Water Balance Calculations

Annual Rainfall Depth Req'd

Required Rainfall Depth	=	624.0	mm	(From Post-Development Water Balance (With Infiltration))

Find Percent of Annual Rainfall that Req'd Rainfall Depth represents:

Annual Rainfall for Study Area	=	932.9	mm
% Annual Rainfall	=	624.0 mm / 932.9 mm	
	=	67%	

From MOE Figure C-2, 67% of annual rainfall occurs for storm events of 10 mm or less.

Find storage volume required for rainfall events of 13 mm to rooftop infiltration gallery:

Roof Top Area	=	6782	m^2		
Rainfall Depth	=	12	mm		
Storage Volume Required	=	A		x	D
	=	6782		x	12
	=	81	m^3		

Minimum Infiltration Volume as per City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines Section 4.1.3 is as follows:

Storage Volume Required	=	Site Area		x	5 mm
	=	24,009		x	0.005
	=	120	m^3		

It is proposed to infiltrate the 25 mm storm event over the rooftop areas, resulting in a storage volume of 172m³ exceeding the City of Barrie Criteria. Therefore, water balance for the site is achieved.

Appendix E

Phosphorus Calculations

Table 2. Land-Use Specific Phosphorus Export Coefficients (kg/ha/yr) for Lake Simcoe Subwatersheds

Subwatershed	Phosphorus Export (kg/ha/yr)											
				High Intensity Development								
	Cropland	Hay-Pasture	Sod Farm/Golf Course	Commercial /Industrial	Residential	Low Intensity Development	Quarry	Unpaved Road	Forest	Transition	Wetland	Open Water
Monitored Subwatersheds												
Beaver River	0.22	0.04	0.01	1.82	1.32	0.19	0.06	0.83	0.02	0.04	0.02	0.26
Black River	0.23	0.08	0.02	1.82	1.32	0.17	0.15	0.83	0.05	0.06	0.04	0.26
East Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hawkestone Creek	0.19	0.10	0.06	1.82	1.32	0.09	0.10	0.83	0.03	0.04	0.03	0.26
Lovers Creek	0.16	0.07	0.17	1.82	1.32	0.07	0.06	0.83	0.06	0.06	0.05	0.26
Pefferlaw/Uxbridge Brook	0.11	0.06	0.02	1.82	1.32	0.13	0.04	0.83	0.03	0.04	0.04	0.26
Whites Creek	0.23	0.10	0.42	1.82	1.32	0.15	0.08	0.83	0.10	0.11	0.09	0.26
Unmonitored Subwatersheds												
Barrie Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
GeorginaCreeks	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Hewitts Creek	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Innisfil Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Maskinonge River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Oro Creeks North	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26
Oro Creeks South	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Ramara Creeks	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
Talbot/Upper Talbot River	0.19	0.07	0.12	1.82	1.32	0.13	0.08	0.83	0.05	0.06	0.05	0.26
West Holland River	0.36	0.12	0.24	1.82	1.32	0.13	0.08	0.83	0.10	0.16	0.10	0.26

3.2.2 Methods - Calculating Pre-development Conditions

The pre-development or “existing conditions” phosphorus load is calculated through the following steps, by the user:

1. The user will rely on the information documented and detailed in the EIS for the development that will be used to support the planning application to the Municipality.
2. The user will choose the subwatershed or geographic area of the Lake Simcoe watershed in which the development is proposed from a drop down list provided by the database. If the development area spans two or more subwatersheds, the areas within each subwatershed should be modelled separately.
3. Specific land use classifications will be delineated and their boundaries overlain on an orthographic aerial photograph that shall be included in their submission.

that class of BMP. In two cases, (sorbtive media interceptors and soakways/infiltration trenches), although there are no Ontario phosphorus removal efficiencies reported in the review materials, the techniques are not limited by geography. The reported ranges in efficiency for these BMP classes are narrow so the median efficiency is chosen as a representative phosphorus removal efficiency. In all other cases, there are unacceptable regional differences and wide ranges in efficiencies that would not support the derivation of single representative phosphorus removal efficiencies. In the case of dry swales, the non-Ontario removal efficiencies may be usable, but the range of reported values is large such that it will be necessary to identify design criteria that will limit the range in efficiencies for this class of BMPs before a value can be chosen.

Table 3. Phosphorus Removal Efficiencies for Major Classes of BMPs Using the Decision Tree (Figure 5)

BMP Class	Reference IDs[1]	Reported Phosphorus Removal Efficiency (%)		Relevant to Ontario?	Range <40%?	Are Non-Ontario values acceptable?	Possible design criteria?	Median % Removal Efficiency
		Min	Max					
Post-development BMPs								
Bioretention Systems	8-10, 12,13, 34-38, 40	-1552	80	no	no	no	No	none
Constructed Wetlands	104, 106, 109	72	87	yes	yes			77
Dry Detention Ponds	104, 109	0	20	no	yes	yes		10
Dry Swales	24, 26-32	-216	94	no	no	no	possible	none
Enhanced Grass/Water Quality Swales	21, 104	34	55	no	yes	no	No	none
Flow Balancing Systems	106	77		no	?	yes	Min data	77
Green Roofs	2	-248		no	no	no	No	none
Hydrodynamic Devices	109	-8		no	?	yes		none
Perforated Pipe Infiltration/Exfiltration Systems	7, 4	81	93	yes	yes			87
Sand or Media Filters	104, 109	30	59	no	yes	yes		45
Soakaways - Infiltration Trenches	6, 104	50	70	no	yes	yes		60
Sorbtive Media Interceptors	111	78	80	no	yes	yes		79
Underground Storage	106	25		no	?	yes	Min data	25
Vegetated Filter Strips/Stream Buffers	6, 42, 104	60	70	no	yes	yes	Yes	65
Wet Detention Ponds	104-106, 109	42	85	yes	yes			63

Notes: [1]References associated with IDs are provided in Appendix 7.

ASA Development Inv. Harvie Roard, Barrie
Phosphorus Budget

Barrie Creeks	Low Intensity Development	Forest	High Intensity Residential	
Phosphorus Export (kg/ha/year)	0.13	0.05	1.32	

Pre-Development Condition

	Low Intensity Development	Forest	High Intensity Residential
Area (ha)	1.32	1.08	0.00
Total P (kg)	0.17	0.05	0.00

Total Pre-Development P (kg) **0.23**

Post-Development Condition (Uncontrolled):

	Low Intensity Development	Forest	High Intensity Residential
Area (ha):	0.00	0.00	2.40
Total P (kg) :	0.00	0.00	3.17

Total Uncontrolled Post-Development (kg): **3.17**

Post-Development Condition (Controlled):

Untreated Area	Low Intensity Development	Forest	High Intensity Residential
Area (ha):	0.00	0.00	1.07
Total P (kg) :	0.00	0.00	1.41

Area Draining to Underground Infiltration & Pavers	Low Intensity Development	Forest	High Intensity Residential
Area (ha):	0.00	0.00	1.33
Total P (kg) :	0.00	0.00	1.76

Soakaway Infiltration	**Rooftops**
Total P (kg):	0.90
Soakaway Infiltration Proficiency (%):	60
P Removed (kg):	0.54
P Remaining (kg):	0.36

Sand or Media Filters	**Permeable Pavers**
Total P (kg):	0.81
Sand or Media Filters Proficiency (%):	45
P Removed (kg):	0.37
P Remaining (kg):	0.45

Total Post-Development P (kg): **2.21**

Appendix F

Letters to Utilities

PEARSON ENGINEERING

September 23, 2021 File:21092

Attention: Lorraine Cibirka

Bell Canada
Access Network Design
2nd Floor, 136 Bayfield Street
Barrie, ON L4M 3B1

Dear Lorraine,

Re: Proposed Residential Development
108, 116 and 122 Harvie Road, City of Barrie
Request for Confirmation – Bell Canada Servicing

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 108, 116 and 122 Harvie Road in the City of Barrie. The development proposes construction of 128 units consisting of a 4-storey residential building having 51 units, 12 single family townhomes and 11 townhouse blocks with 65 units. The site is currently three existing residential properties, and the proposed development can be found on the attached Site Plan.

We request that, if available, you provide us your existing servicing and plan in this area, and we would appreciate any comments you could provide on the serviceability of the proposed development.

We thank you in advance for your assistance and co-operation in providing the background data. If you have any questions regarding the enclosed or require any additional information, please feel free to give me a call at (705) 719-4785 ext. 233.

Regards,
PEARSON ENGINEERING LTD.

April Cleaves, C.E.T.
Project Manager

PEARSON ENGINEERING

September 23, 2021 File:21092

Attention: David Smith

Enbridge
10 Churchill Dr.
Barrie ON
L4N 8Z5

Dear David,

Re: Proposed Residential Development
108, 116 and 122 Harvie Road, City of Barrie
Request for Confirmation – Enbridge servicing

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 108, 116 and 122 Harvie Road in the City of Barrie. The development proposes construction of 128 units consisting of a 4-storey residential building having 51 units, 12 single family townhomes and 11 townhouse blocks with 65 units. The site is currently three existing residential properties, and the proposed development can be found on the attached Site Plan.

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Regards,
PEARSON ENGINEERING LTD.

April Cleaves, B.A. Tech., C.E.T.
Project Manager

PEARSON ENGINEERING

September 24, 2021 File:21092

Attention: Stephen Cranley

Power Stream Inc.
55 Patterson Road
Barrie, ON
L4N 3W2

Dear Stephen,

Re: Proposed Residential Development
108, 116 and 122 Harvie Road, City of Barrie
Request for Confirmation – Electric servicing

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 108, 116 and 122 Harvie Road in the City of Barrie. The development proposes construction of 128 units consisting of a 4-storey residential building having 51 units, 12 single family townhomes and 11 townhouse blocks with 65 units. The site is currently three existing residential properties, and the proposed development can be found on the attached Site Plan.

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Regards,
PEARSON ENGINEERING LTD.

April Cleaves, B.A. Tech., C.E.T.
Project Manager

PEARSON ENGINEERING

September 24, 2021 File:21092

Attention: Xinyi Wang

Rogers Cable
1 Sperling Drive
Barrie, Ontario
L4M 6B8

Dear Xinyi,

Re: Proposed Residential Development
108, 116 and 122 Harvie Road, City of Barrie
Request for Confirmation – Rogers servicing

We are currently preparing a Functional Servicing Report to examine the infrastructure requirements for a proposed residential development located at 108, 116 and 122 Harvie Road in the City of Barrie. The development proposes construction of 128 units consisting of a 4-storey residential building having 51 units, 12 single family townhomes and 11 townhouse blocks with 65 units. The site is currently three existing residential properties, and the proposed development can be found on the attached Site Plan.

We request that, if available, you provide us your existing servicing and plan in this area, and we would appreciate any comments you could provide on the serviceability of the proposed development.

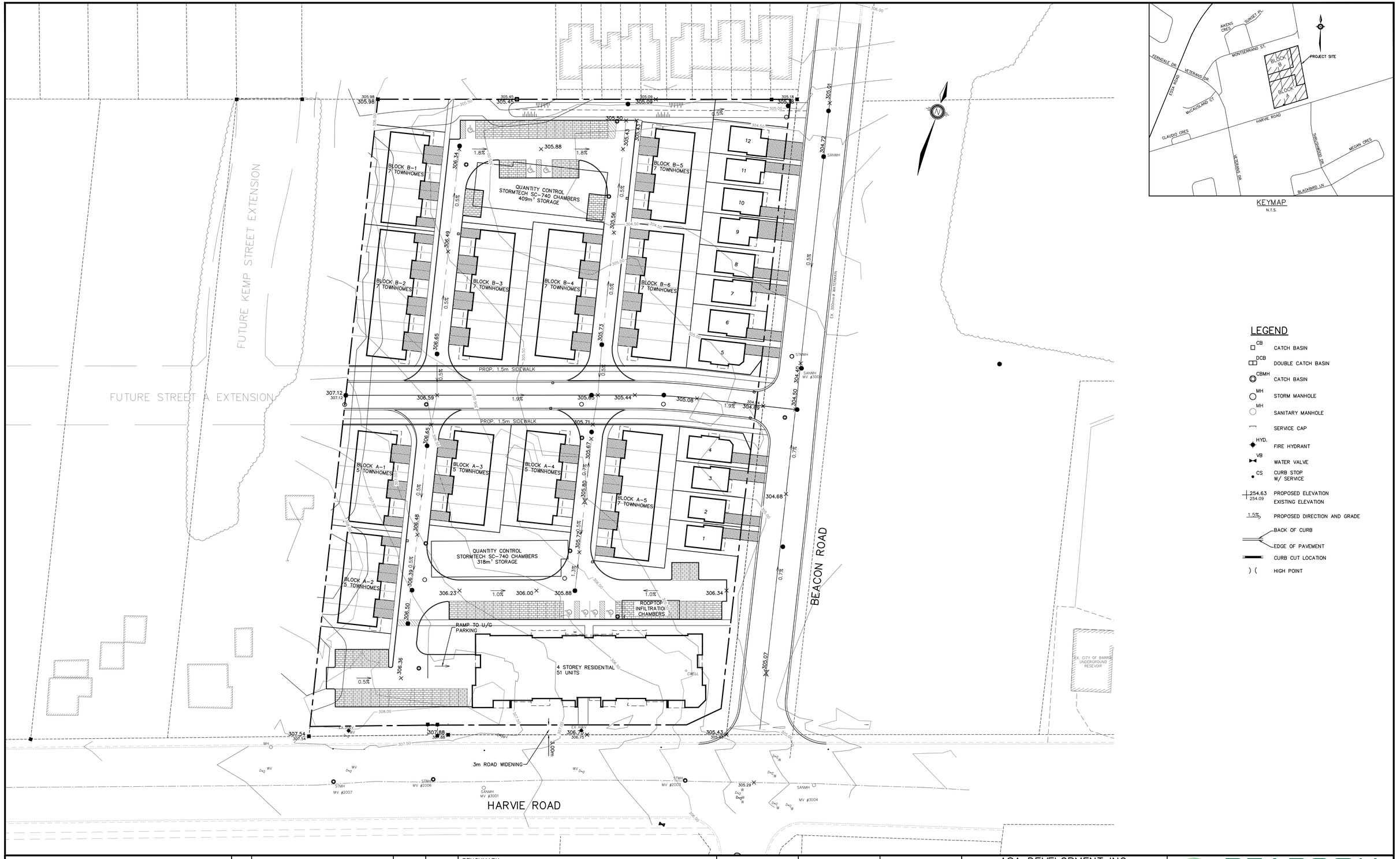
We thank you in advance for your assistance and co-operation in providing the background data. If you have any questions regarding the enclosed or require any additional information, please feel free to give me a call at (705) 719-4785 ext. 233.

Regards,
PEARSON ENGINEERING LTD.

April Cleaves, B.A. Tech., C.E.T.
Project Manager

Appendix G

Pearson Engineering Drawings



KEYMAP
N.T.S.

LEGEND

- CB — CATCH BASIN
- DCB — DOUBLE CATCH BASIN
- CBMH — CATCH BASIN
- MH — STORM MANHOLE
- MH — SANITARY MANHOLE
- SERVICE CAP
- HYD. — FIRE HYDRANT
- VB — WATER VALVE
- CS — CURB STOP W/ SERVICE
- 254.63 / 254.09 — PROPOSED ELEVATION / EXISTING ELEVATION
- 1.5% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (— HIGH POINT

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF PROPOSED RESIDENTIAL SUBDIVISION LOCATED AT 108, 116, 122 HARVIE ROAD IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANT DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY

BENCHMARK

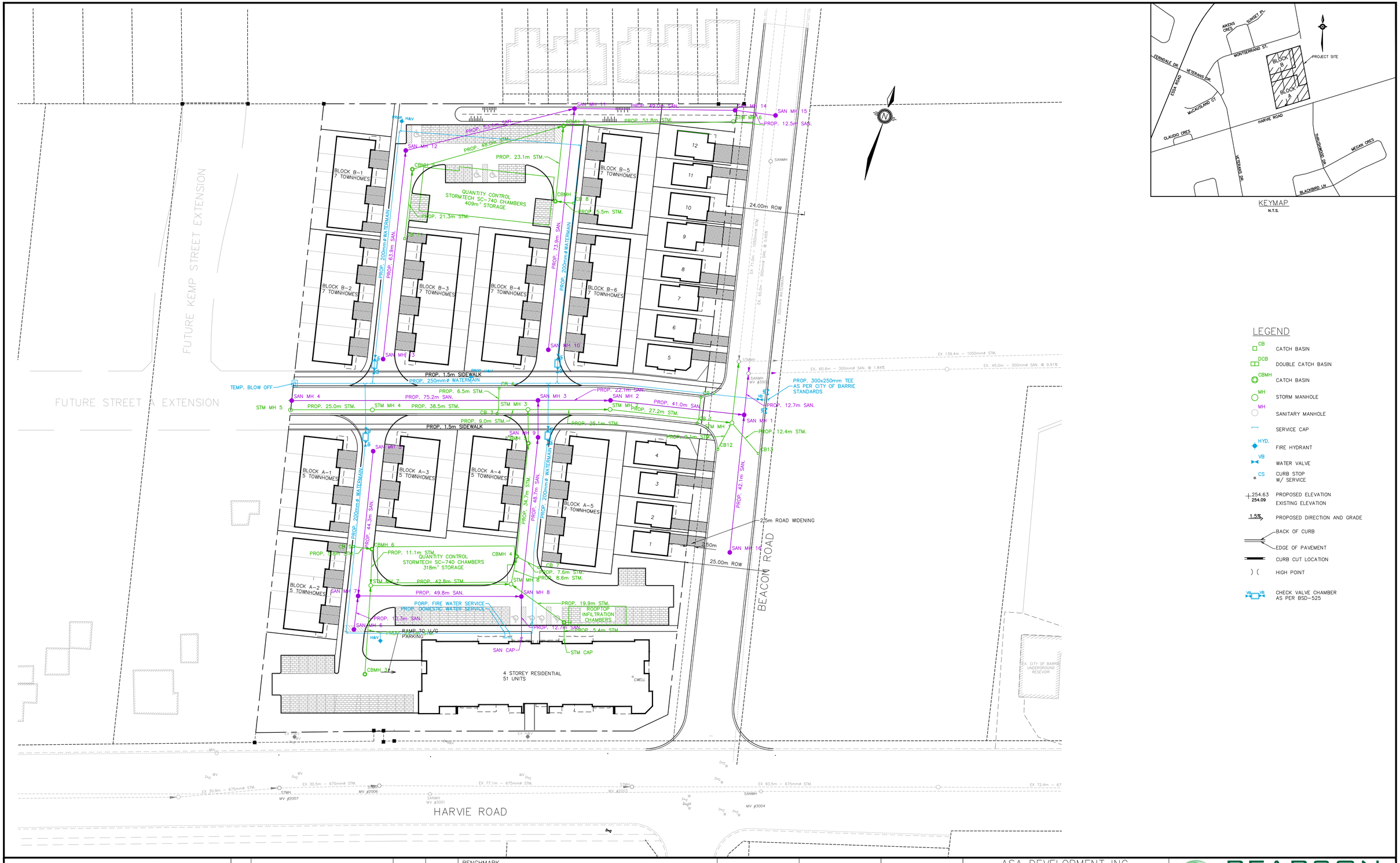
LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Sept. 24, 2021
PROVINCE OF ONTARIO

ASA DEVELOPMENT INC.
108, 116, 122 HARVIE ROAD
BARRIE, ONTARIO

SITE GRADING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY PG/MWD	HORIZ SCALE 1:500	PROJECT #	21092
DRAWN BY PG	VERT SCALE N/A	DRAWING #	SG-1
CHECKED BY GMP	DATE AUGUST 2021	REVISION #	0



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- 1.5% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (— HIGH POINT
- VB — CHECK VALVE CHAMBER AS PER BSD-525

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF PROPOSED RESIDENTIAL SUBDIVISION LOCATED AT 108, 116, 122 HARVIE ROAD IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANT DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY

BENCHMARK

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Sept. 24, 2021
PROVINCE OF ONTARIO

ASA DEVELOPMENT INC.
108, 116, 122 HARVIE ROAD
BARRIE, ONTARIO

SITE SERVICING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	PG/MWD	HORIZ SCALE 1:500	PROJECT # 21092
DRAWN BY	PG	VERT SCALE	DRAWING # SS-1
CHECKED BY	GMP	DATE AUGUST 2021	REVISION # 0

KEYMAP
N.T.S.

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- 1.5% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (— HIGH POINT
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA — 1 / 1.00 ha — RUNOFF COEFFICIENT / AREA IN HECTARES
- CATCHMENT BOUNDARY

BENCHMARK

NO.	REVISION NOTE	DATE	BY

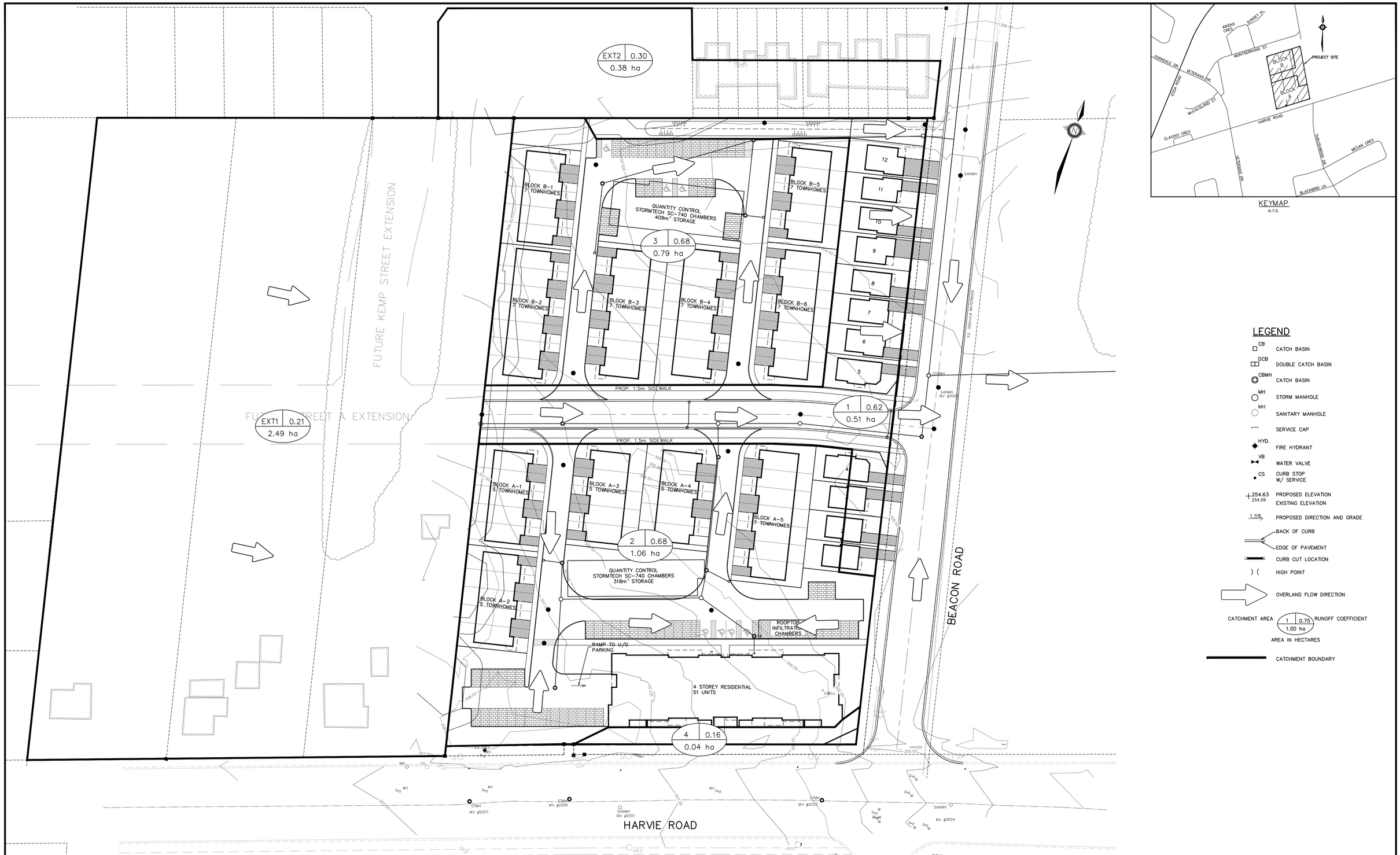
LICENCED PROFESSIONAL ENGINEER — M.W. DEJEAN — Sept. 24, 2021 — PROVINCE OF ONTARIO

ASA DEVELOPMENT INC.
108, 116, 122 HARVIE ROAD
BARRIE, ONTARIO

PRE-DEVELOPMENT STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	PG/MWD	HORIZ SCALE	1:500
DRAWN BY	PG	VERT SCALE	N/A
CHECKED BY	GMP	DATE	AUGUST 2021
PROJECT #	21092		
DRAWING #	STM-1		
REVISION #	0		



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- 1.5% — PROPOSED DIRECTION AND GRADE
- BACK OF CURB
- EDGE OF PAVEMENT
- CURB CUT LOCATION
-) (— HIGH POINT
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA 1 / 0.75 / 1.00 ha — RUNOFF COEFFICIENT / AREA IN HECTARES
- CATCHMENT BOUNDARY

BENCHMARK

NO.	REVISION NOTE	DATE	BY

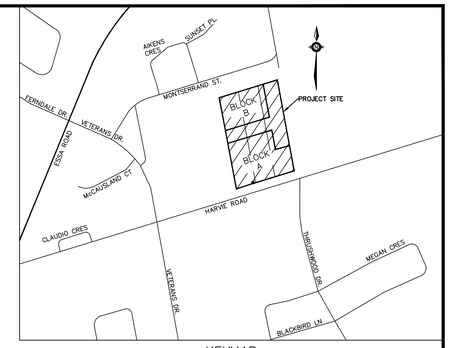
LICENCED PROFESSIONAL ENGINEER — M.W. DEJEAN — Sept. 24, 2021 — PROVINCE OF ONTARIO

ASA DEVELOPMENT INC.
108, 116, 122 HARVIE ROAD
BARRIE, ONTARIO

POST-DEVELOPMENT STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	PG/MWD	HORIZ SCALE	1:500
DRAWN BY	PG	VERT SCALE	N/A
CHECKED BY	GMP	DATE	AUGUST 2021
PROJECT #	21092		
DRAWING #	STM-2		
REVISION #	0		



KEYMAP
N.T.S.

LEGEND

- PROP. SILT FENCE
- POST DEVELOPMENT OVERLAND FLOW DIRECTION
- PRE DEVELOPMENT OVERLAND FLOW DIRECTION

SITE DATA

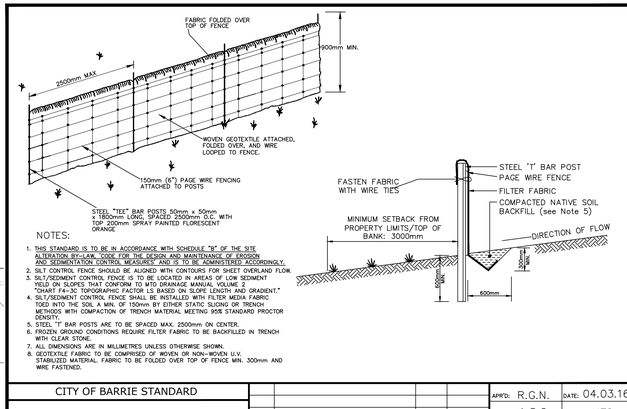
1. OVERALL SITE AREA – 2.81ha
2. EXISTING LAND USE – RESIDENTIAL

SEQUENCE OF CONSTRUCTION

1. ENGINEER TO BE NOTIFIED PRIOR TO INITIATION OF ANY ON SITE WORKS.
2. SILT FENCE AS PER DETAIL BSD-23A. CONSTRUCTION ACCESS MATS AS PER CITY STANDARD ARE TO BE INSTALLED PRIOR TO THE COMMENCEMENT OF ANY WORKS ONSITE.
3. VEGETATION REMOVAL MAY COMMENCE AFTER ALL SILT FENCE IS INSTALLED AND APPROVED BY THE ENGINEER.
4. COMMENCE WITH EARTH WORKS AND SITE SERVICING.
5. EROSION CONTROL MEASURES TO BE MAINTAINED AS DIRECTED BY THE ENGINEER DURING THE CONSTRUCTION PERIOD. ADDITIONAL CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
6. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED WITH SEED, SOD, MULCH OR OTHER ADEQUATE COVERING, AS INSTRUCTED BY THE ENGINEER.

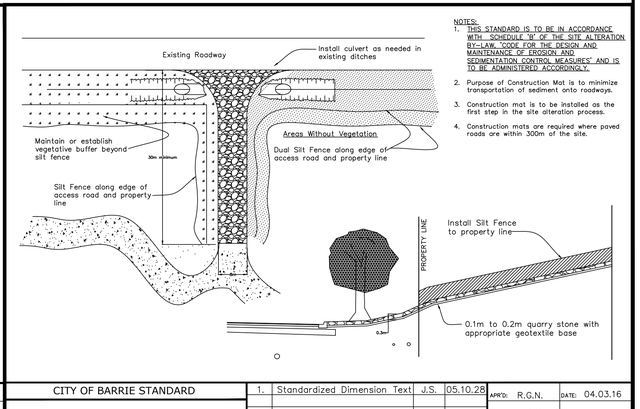
NOTES FOR SEDIMENT & EROSION CONTROL

1. DISTURBED AREAS THAT HAVE FAILED TO HAVE STABLE GROUND COVER ESTABLISHED BY OCTOBER 30TH SHALL BE PROTECTED WITH A SILTATION CONTROL FENCE OR STRAW MULCH ETC. AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION BECOMES ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
2. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30m FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE ADMINISTRATOR.
3. SILT FENCE SHALL BE PUT IN PLACE PRIOR TO AND MAINTAINED DURING ALL GRADING. SILT FENCE TO BE INSPECTED PRIOR TO COMMENCEMENT OF EARTH GRADING ACTIVITIES. SILT FENCE TO BE INSPECTED AND REPAIRED OR REPLACED IF DAMAGED AS DIRECTED BY THE SITE ADMINISTRATOR.SILT CONTROLS TO BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAIN EVENT. INSTALLATION SHALL BE TO THE MANUFACTURER'S RECOMMENDED SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE A WEEK, AND AFTER EVERY RAINFALL EVENT.
5. MUD MATS AT ALL LOCATIONS WHERE CONSTRUCTION TRAFFIC ENTERS OR LEAVES THE SITE SHALL BE USED. MUD MATS TO CONSIST OF 300mm MIN.100mm TO 200mm CLEAR STONE HAVING DIMENSIONS 8.0m WIDE X 30.0m LONG.
6. CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 577, CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AS WELL AS ALL APPLICABLE MUNICIPAL STANDARDS.
7. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES. SUCH MEASURES SHOULD BE PRESENTED IN WRITING FOR APPROVAL OF THE SITE ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE MUNICIPALITY AND CONSERVATION AUTHORITY.
8. THE TOPS OF ALL FILTER FABRIC MUST BE A MINIMUM OF 1.0 METRES ABOVE THE GROUND LEVEL AND ATTACHED TO THE FENCE WITH A CONTINUOUS STEEL WIRE. ALTERNATIVELY, THE FILTER FABRIC MUST BE FOLDED OVER THE TOP OF THE FENCE AND ATTACHED TO THE FENCE WITH WIRE LOOPED THROUGH THE FABRIC ON BOTH SIDES OF THE FENCE. FILTER FABRIC IS TO BE TERRAFIX 270R OR EQUIVALENT.
9. ALL DISTURBED GROUND LEFT FOR MORE THAN 30 DAYS SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, OR COVERING OR OTHER EQUIVALENT CONTROL MEASURES. THIS PERIOD OF INACTIVITY SHALL BE AT THE DISCRETION OF THE CITY OF BARRIE'S MANAGER OF ENGINEERING BUT SHALL NOT EXCEED THIRTY DAYS OR SUCH LONGER PERIOD DEEMED ADVISABLE BY THE CITY OF BARRIE'S MANAGER OF ENGINEERING.
10. CONTRACTOR RESPONSIBLE FOR MUD TRACKING, PREVENTION, AND MAINTENANCE ON HAMILTON RD.



NOTES:
1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY-LAW, "CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES" AND IS TO BE ADMINISTERED ACCORDINGLY.
2. SILT CONTROL FENCE SHOULD BE ALIGNED WITH CONTOURS FOR SHEET OVERLAND FLOW.
3. SILT/SEDIMENT CONTROL FENCE IS TO BE LOCATED IN AREAS OF LOW SEDIMENT YIELD ON SLOPES THAT CONFORM TO MTO DRAINAGE MANUAL VOLUME 2 "CHART F4-3C TOPOGRAPHIC FACTOR LS BASED ON SLOPE LENGTH AND GRADIENT."
4. SILT/SEDIMENT CONTROL FENCE SHALL BE INSTALLED WITH FILTER MEDIA FABRIC TOED INTO THE SOIL A MIN. OF 150mm BY EITHER STATIC SLICING OR TRENCH METHODS WITH COMPACTION OF TRENCH MATERIAL MEETING 95% STANDARD PROCTOR DENSITY.
5. STEEL "T" BAR POSTS ARE TO BE SPACED MAX. 2500mm ON CENTER.
6. FROZEN GROUND CONDITIONS REQUIRE FILTER FABRIC TO BE BACKFILLED IN TRENCH WITH CLEAR STONE.
7. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
8. GEOTEXTILE FABRIC TO BE COMPRISED OF WOVEN OR NON-WOVEN U.V. STABILIZED MATERIAL. FABRIC TO BE FOLDED OVER TOP OF FENCE MIN. 300mm AND WIRE FASTENED.

CITY OF BARRIE STANDARD					
TYPICAL DETAIL OF SILTATION CONTROL FENCE				APR'D: R.G.N.	DATE: 04.03.16
	2	FENCE DIM. & NOTE #4 CHANGE	M.S.	05.01.17	DRAWN: A.S.C.
	1	MODIFICATIONS BY ENV. SER.		04.04.06	SCALE: NTS
	NO.	REVISION	APR'D	DATE	BSD-23A



NOTES:
1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY-LAW, "CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES" AND IS TO BE ADMINISTERED ACCORDINGLY.
2. Purpose of Construction Mat is to minimize transportation of sediment onto roadways.
3. Construction mat is to be installed as the first step in the site alteration process.
4. Construction mats are required where paved roads are within 300m of the site.

CITY OF BARRIE STANDARD					
CONSTRUCTION ENTRANCE MAT	1.	Standardized Dimension Text	J.S.	05.10.28	APR'D: R.G.N. DATE: 04.03.16
					DRAWN: A.S.C. SCALE: N.T.S
	NO.	REVISION	APR'D	DATE	BSD-23D

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF PROPOSED RESIDENTIAL SUBDIVISION LOCATED AT 108, 116, 122 HARVIE ROAD IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANT DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY

BENCHMARK

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Sept. 24, 2021
PROVINCE OF ONTARIO

ASA DEVELOPMENT INC.
108, 116, 122 HARVIE ROAD
BARRIE, ONTARIO

ENVIRONMENTAL REMOVAL AND PROTECTION PLAN

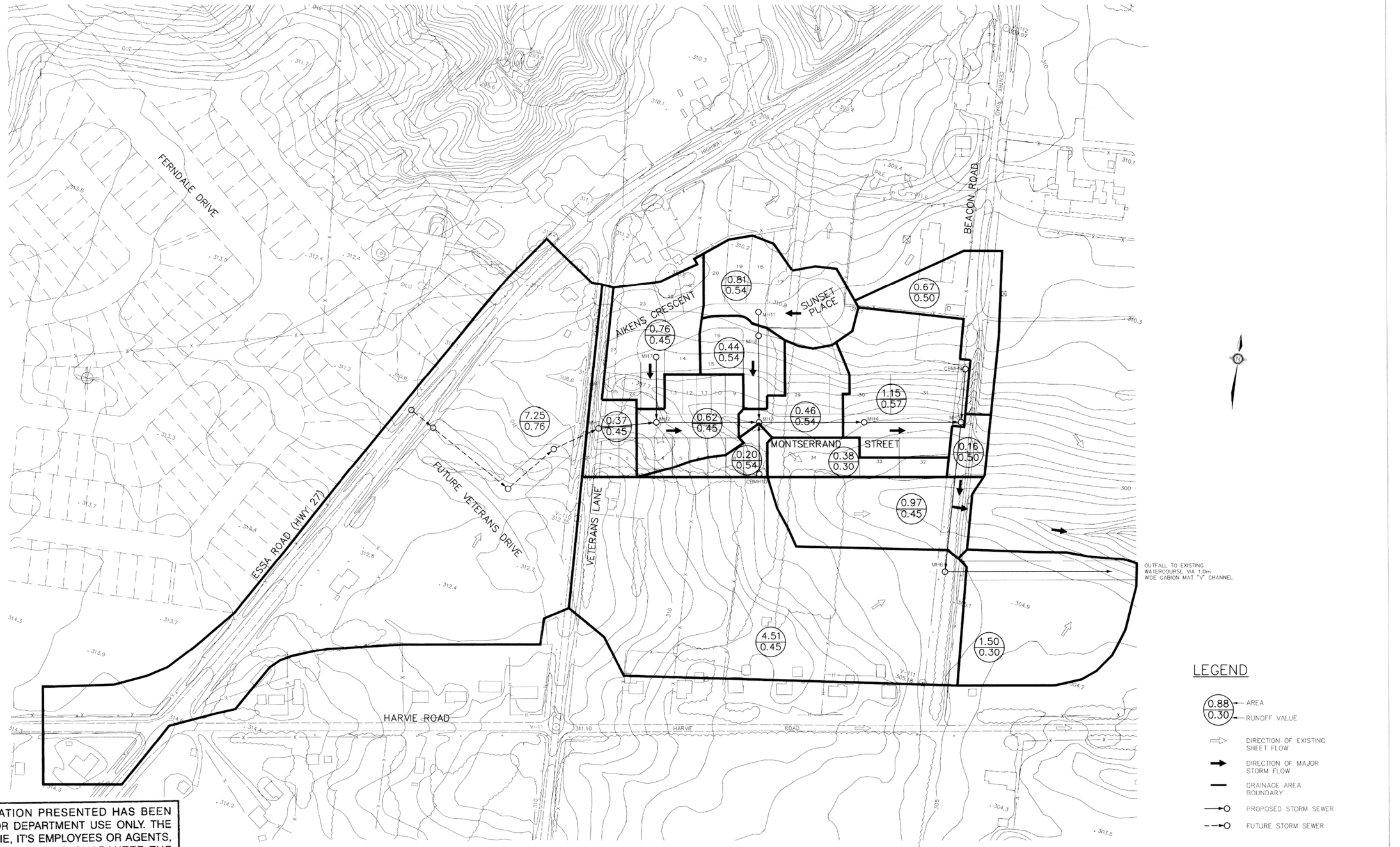
PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	PG/MWD	HORIZ SCALE 1:500	PROJECT # 21092
DRAWN BY	PG	VERT SCALE N/A	DRAWING # EPR-1
CHECKED BY	GMP	DATE AUGUST 2021	REVISION # 0

P:\Autodesk Vault\Working Folders\21092 - ASA, 3393 Beacon Road, Barrie\Engineering\21092 - BASE - EROSION AND SEDIMENT CONTROL.dwg Layout:EPR-1 Plotted Sep 24, 2021 @ 3:36pm by acleaves @ PEARSON ENGINEERING LTD.

Appendix H

External Drawings



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LICENCED PROFESSIONAL ENGINEER
H.C.D. CLAVIC
PROVINCE OF ONTARIO

BENCHMARK:

NO.	REVISIONS	DATE	INITIAL
4	AS CONSTRUCTED	FEB 06	R.P.
3	ADD MEDIUM DENSITY BLOCK SERVICING	MAY 97	S.N.
2	THIRD SUBMISSION	MAR. 96	H.G.
1	FIRST SUBMISSION COMMENTS	FEB. 96	H.G.

Approved
CITY OF BARRIE
APPROVED
DATE. . . . . .
DIRECTOR OF MUNICIPAL WORKS

Approved

BEACON ROAD SUBDIVISION

STORM DRAINAGE AREA PLAN

RG ROBINSON AND ASSOCIATES (BARRIE) LTD CONSULTING ENGINEERS
10 High Street, Suite 200, Barrie, Ontario (705) 721-9222

SCALE: 1:1500
322-91014-21/26
DESIGN HG CHECKED HG
DRAWN MR DATE DEC. 95
DWG. Nº G-4

Sub 202
1995-081-007

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