

19501 – 136 BAYFIELD STREET

Functional Servicing and Stormwater Management Report

VERSION 4 ▪ NOVEMBER 2022

REPORT PREPARED FOR

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TMIG PROJECT NUMBER 19501



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1 INTRODUCTION

The Municipal Infrastructure Group (TMIG) has been retained by Rockap Holdings c/o One Space Architecture + Interior Design to prepare a detailed Functional Servicing and Stormwater Management Report along with a corresponding grading and servicing design in support of a rezoning and site plan approval application. The subject property is located at the northwest corner of Bayfield Street and Sophia Street W., civic address of 136 Bayfield Street.

This report will:

- Provide background information regarding the subject property,
- Summarize the existing site conditions,
- Provide information regarding the proposed development conditions,
- Outline the proposed grading for the development, and
- Outline the existing and proposed municipal servicing.

The recommended servicing has been developed in accordance with the applicable design criteria and requirements of the City of Barrie (the City), Simcoe County (the Region), and the Lake Simcoe Region Conservation Authority (LSRCA).

Figure 1-1 Location Plan



1.1 Project Background

The subject property is 8,853 m² in area and is bound by Bayfield Street to the east, Sophia Street W. to the south, Maple Avenue to the west, and an existing 3-storey office building to the north. The site is currently occupied by a large 4-storey office building in the northeast corner of the site and a two-storey house at the southwest corner of the site (accessed from Sophia Street W.). The remaining site area is an at-grade parking lot with two vehicle accesses from Maple Avenue.

The site is in an area that is well established and serviced by a network of municipal infrastructure including roads, sewer, watermains, and other services and utilities. The sanitary and water for the existing office building is serviced from Bayfield Street and the house is serviced from Sophia Street W. Currently, the site is zoned C2-1 (Transition Centre Commercial) and allotted as such is the City's infrastructure.

The existing topography of the site slopes heavily from north to south with existing site elevations ranging from approximately 235.50 to 244.00. Onsite storm sewers collect minor storm flows from catchbasins located throughout the site, discharging into the municipal sewer system flowing south within Maple Avenue. During major storm events, excess runoff flows overland from north to south and out to Bayfield Street, Maple Avenue, and Sophia Street W.

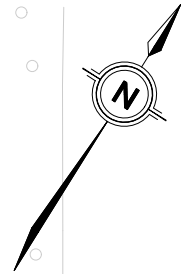
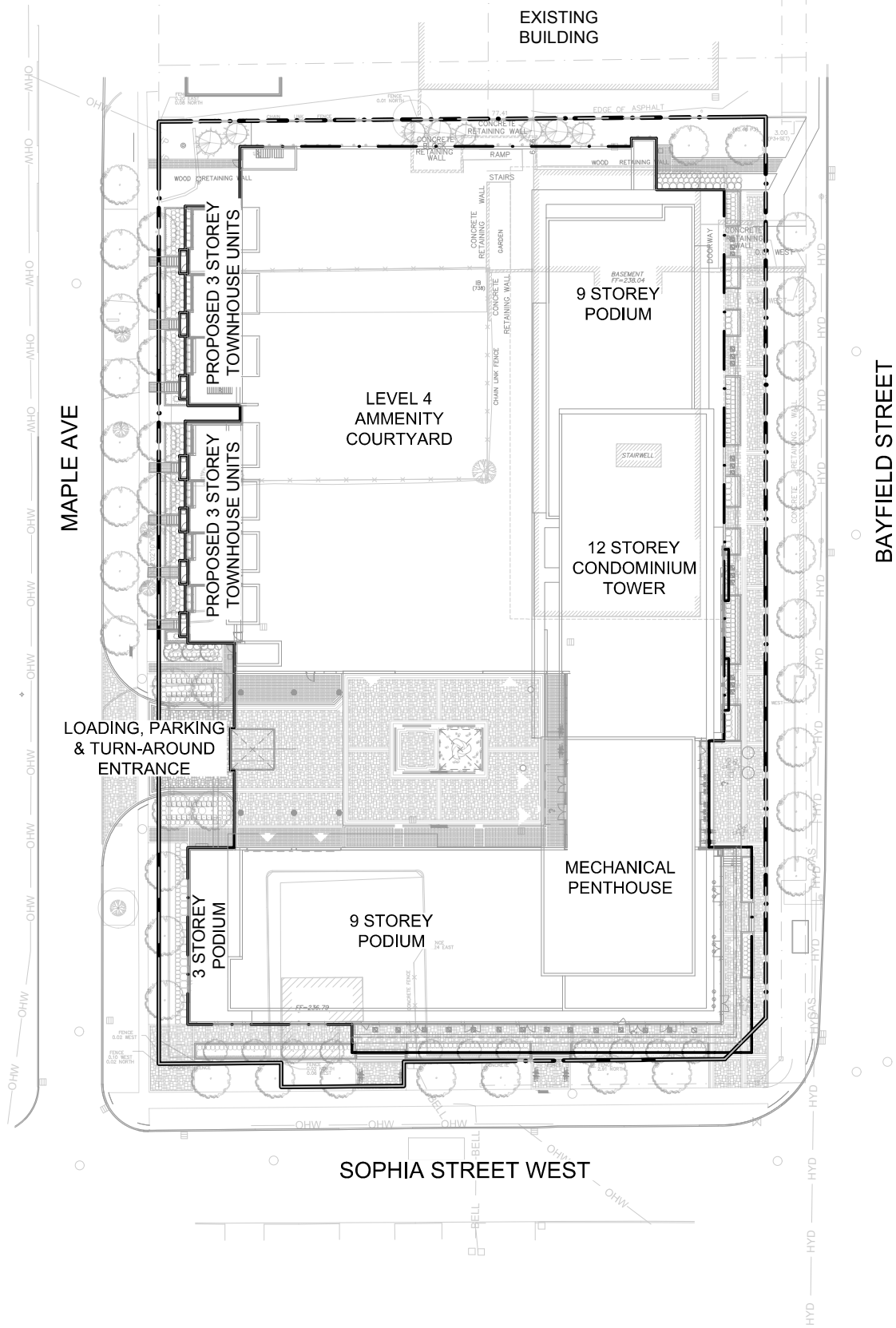
1.2 Proposed Development

The proposed development includes the construction of a new 12-storey, 292-unit condo tower with commercial uses at grade. The development will also include 8 townhouse units located at the northwest side of the site. Parking will be provided indoor at the first, second, and third floor levels. The parking entrance, loading areas, and internal vehicle drop-off loop will be accessed from a new vehicular site entrance off Maple Avenue, east of the development site. Fire truck and garbage access will also be from the internal vehicle drop-off loop.

Refer to **Figure 1.2** for the proposed development plan.

1.3 Utilities

The property is in a well-established location in the City of Barrie and serviced by a network of municipal infrastructure including roads, sewers, watermains and other services and utilities. Some utilities will be required to be relocated and removed to accommodate the proposed development. The location of the known utilities is shown on the **Servicing Plan (Drawing S1)**.



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SCALE: 1:750
DATE: APRIL 2022
DESIGNED BY: C.B.
CHECKED BY: B.D.

PROJECT No.
19501
FIGURE No.
F1-2

2 STORMWATER MANAGEMENT

2.1 Existing Stormwater Management

As per the City of Barrie's storm drainage plans, included in **Appendix A**, the site is divided into three distinct drainage areas discharging west to Maple Avenue, south to the Sophia Street W., and east to Bayfield Street. Minor runoff (5-year storm event) from these areas have been accounted for in the downstream storm sewer networks. Major runoff (up to 100-year storm event) has been accounted for the downstream major system (overland street flow, channels, culverts, etc.). Post-development discharge from the site will be restricted to the specified runoff rates allotted for each drainage area. Details and allowable runoff rates for each drainage area are detailed in **Table 2.1**, below.

Table 2.1 - Drainage Area Details and Allowable Runoff

Drainage Area Outlet	Area (m ²)	Runoff coefficient	5-year Storm Event Runoff (L/s)	100-year Storm Event Runoff (L/s)
Maple Avenue	5384	0.60	97.74	161.66
Sophia Street W.	1399	0.70	29.63	49.01
Bayfield Street	2070	0.70	43.84	72.51

In existing conditions, onsite storm sewers collect minor storm flows from the parking lot area on-site, discharging into the municipal sewer system within Maple Avenue. The Maple Avenue storm sewer network flows south and into the 1650mm x 1500mm storm culvert flowing west along the north side of Sophia Street W. The culvert is part of the larger Sophia Creek watershed drainage system which flows from Cundles Road and Duckworth Street and ultimately outlets directly to Kempenfelt Bay. No information was found with respect to existing on-site stormwater quality and quantity controls.

Refer to **Appendix A** for the City of Barrie Storm Drainage Plans and the Stormwater Management Design Calculations, **Figure 2-1** for the onsite existing stormwater drainage area plan, and to the **Servicing Plan (Drawing S1)** for the location of the existing storm sewer infrastructure.

2.1.1 Queen's Park Neighborhood Renewal

The development site is located within the vicinity of the Queen's Park Neighbourhood Renewal Project. The program includes the reconstruction of infrastructure and roadways in the Queens Park Neighbourhood. The neighbourhood and infrastructure were initially constructed in mid 1950's and many aspects of the roadway and infrastructure are reaching the end of their life and require replacement. Phase A1 of the program involves road reconstruction, sidewalk replacements, watermain replacement, sanitary sewer replacement, storm sewer replacement and upgrades, and local drainage improvements along Maple Avenue (from Wellington Street W. to Sophia Street W.), Sophia Street W. (from Ross Street to Bayfield Street), and Mary Street (from Wellington Street W. to Sophia Street W.).

The City of Barrie submitted the 100% LSRCA design drawings, dated January 17, 2022. These design drawings were obtained from the City and have been used in the proposed design of the development site with the assumption that the Queen's Park Neighbourhood Renewal Project will be completed prior to the construction completion of the development site.

2.2 Proposed Stormwater Management

The proposed stormwater management design is based on the MOE *Stormwater Management Planning & Design* (2003), The City of Barrie *Storm Drainage and Stormwater Management Policies and Design Guidelines* (2017), and The *LSRCA Technical Guidelines for Stormwater Management Submissions* (2016).

The proposed development will be serviced by a 300mm storm service sloped at 1.00%, extending to a manhole located within the Maple Avenue boulevard located at the southwest corner of the site. This manhole has been proposed as part of the Queen's Park Neighbourhood Renewal Project (detailed in **Section 2.1.1**) and will connect to the existing onsite storm sewers prior to the redevelopment of the site.

The proposed storm service will extend to the storm sewer control manhole just within the property line to serve as the storm control and sampling access for the site. The main emergency overland flow route from the site will discharge west out to Maple Avenue where it will flow south to Sophia Street W. The site has been designed to allow some landscaped and walkway areas along the property lines to flow unrestricted to Bayfield Street, Sophia Street W. and Maple Avenue. Refer to **Figure 2-2** for details regarding the proposed drainage.

As detailed in **Section 2.1**, the proposed development will be designed to control stormwater flows to the major and minor runoff rates as per The Storm Drainage Plan. A treatment train approach will be provided for quality and quantity controls including traditional on-site measures wherever possible. The proposed building structure covers most of the development site and therefore, there is no opportunity for on-site infiltration.

The proposed sewer connection location is shown on the **Servicing Plan (S1)**.

2.2.1 Groundwater and Foundation Drainage

Based on the findings of the *Hydrogeological Impact Assessment*, completed by PGL Environmental Consultants, dated November 2022, long-term dewatering will not be required at the site as the proposed structure will be slab-on grade construction. The water meter pump and sprinkler room, elevator pits, and any other infrastructure below the stated finished floor elevations will be waterproofed.

The expected short-term (construction) dewatering rate for the site is 225,000L/day (incorporating a 5x safety factor). An Environmental Activity and Sector Registry will likely be required for excavation dewatering work at the site. The groundwater quality on site was analysed and the results indicate that the ground water samples met City of Barrie Sewer Use by-law for discharge to both the storm and sanitary sewers. As requested by the City due to potential capacity concerns in the downstream sanitary sewers, the temporary construction dewatering will be discharged into the storm system.

Refer to **Appendix B** for excerpts from The Hydrogeological Impact Assessment and Groundwater Analysis Results, and **Appendix A** for the Stormwater Management Design Calculations.

2.2.2 Stormwater Quantity Control

As detailed in **Section 2.1**, three separate drainage areas existing onsite. Based on the runoff coefficients provided, and the City of Barrie IDF curve calculation (provided in **Appendix A**) the downstream storm sewers have been sized to allow for the minor runoff (5-year storm event) from these areas and major runoff (up to 100-year storm event) has been accounted for the downstream major systems (overland street flow, channels, culverts, etc.). Under proposed conditions, the development will be designed to control stormwater flows to the restricted runoff rates.

The LSRCA requires that post development peak flows to be controlled to predevelopment levels for all storm events from the 2-year through the 100-year event. Calculations demonstrating the storage volume requirement and corresponding release rate at all storm events are provided in **Appendix A**. It should be noted however, that the proposed stormwater quantity control strategy is to control all storm events to the 5-year allowable release rate that the Maple Avenue storm sewer was designed to receive as per the Queen's Park Neighbourhood Renewal Project (refer to **Appendix A** for the drainage area plan for the storm sewer). This quantity control strategy is a more conservative approach as all storm events above the 5-year event will be controlled only to the 5-year level.

In post-development conditions, the site has been designed to allow some landscaped and walkway areas along the property lines to flow unrestricted offsite. The post-development unrestricted runoff rates for each drainage area are detailed in **Table 2.2**, below.

Table 2.2 - Post-Development Unrestricted Runoff Rates

Drainage Area Outlet	Landscaped Area (m ²) (C=0.25)	Impervious Area (m ²) (C=0.95)	Composite Runoff C	5-year Storm Event Runoff (L/s)	100-year Storm Event Runoff (L/s)
Maple Avenue	526	258	0.48	12.86	21.26
Sophia Street W.	128	512	0.81	15.68	25.94
Bayfield Street	171	336	0.71	10.89	18.01

The remaining 6922m² of the site will be controlled via a proposed orifice to the storm sewer system within Maple Avenue. As indicated in **Table 2.2**, The unrestricted portion of the site discharging to Maple Avenue will release 21.26L/s during the 100-year storm event. Therefore, the orifice must have a maximum discharge rate of 99.98 L/s (21.26L/s 100-year uncontrolled flow subtracted from the total allowable outlet rate of 121.24L/s). The detailed calculations of the 100-year discharge rates can be found in **Appendix A**.

A stormwater storage vault will be constructed within the first level of the building at the southwest corner of the site and directly adjacent to the storm service. The vault will be designed to have a 115mm diameter outlet orifice plate, restricting the controlled outlet rate to 49.38L/s. This is less than the maximum 5-year allowable release rate of 52.04L/s. During large storm events, runoff will back up in the proposed system and utilize the active storage volume provided within the vault. To achieve this controlled outlet rate, the site will require a minimum active storage volume of 231.0m³. The storage vault has been designed with 231.0m³ of active storage volume.

During the 100-year storm event, the vault will fill to the designated high-water level (239.50m) with a 0.30m freeboard to the top of emergency overflow elevation. If events larger than the 100-year occur, the emergency flows will fill the freeboard volume, spill over the top of the separated outlet chamber and out to the storm control manhole. The pipe out of the stormwater management tank has been sized in order to convey the emergency 100-year flow rate from the tank into the control manhole. The storm service from the control manhole out of the site has only been designed to convey the restricted 5-year flow and therefore, emergency flows will overflow from the access lid at the surface (235.83m) and discharge out to Maple Avenue.

Refer to **Appendix A** for complete stormwater management calculations, **Servicing Plan (Drawing S1)**, and **Details Drawing D1** for the vault configuration details.

2.2.3 Stormwater Quality Control

The objective of the post development quality control for the site is to achieve enhanced 80% long-term total suspended solid (TSS) removal (enhanced) as per the Ministry of the Environment *Stormwater Management Planning and Design Manual*, dated March 2003, and the City of Barrie *Storm Drainage and Stormwater Management Policies and Design Guidelines*.

All of the area flowing to the stormwater management tank is unrestricted roof area from the building. Runoff from rooftop areas is considered “clean” water (TSS removal rate = 90%) and does not require quality control. Therefore, no additional quality control treatment is required in order to achieve the enhanced TSS removal requirement.

Due to the nature of the proposed development, it is not feasible to capture and provide quality control for the non-roof areas. It should be noted however, that in existing conditions, the site has an imperviousness of 100% through at-grade parking and rooftop surfaces, with no evidence of any on-site quality controls. With the proposed development primarily consisting of rooftop surfaces, which is considered “clean” water, there will be an overall net increase in water quality.

A *Phosphorous Budget Assessment* was completed by PGL Environmental Consultants, dated October 2022, to demonstrate how phosphorous loadings are minimized between pre- and post-development site conditions. The phosphorous loads for the pre- and post- conditions were found to be 1.61kg/year and 1.17kg/year, respectively. Using the Phosphorous Loading Tool, the change in Phosphorous loading at the site after development was a decrease of 0.44kg/year.

Refer to **Appendix C** for excerpts from the *Phosphorous Budget Assessment*, and **Appendix A** for complete stormwater quality control calculations.

2.2.4 Stormwater Water Balance

The primary objective of the Water Balance Targets/Criteria is to capture and manage annual rainfall on the development site itself to preserve the pre-development hydrology through a combination of infiltration, evapotranspiration, landscaping, rainwater reuse and/or other low impact development practices. As per the City of Barrie *Storm Drainage and Stormwater Management Policies and Design Guidelines*, small infill or re-development sites (<5ha) shall be designed with controls in place such that the 5mm storm can be retained on site through infiltration, evapotranspiration and/or water reuse. The total 5mm volume required to be retained on site is 44.3m³.

As noted previously, due to the site conditions and proposed development, infiltration of stormwater into the subsurface is not a viable stormwater quantity control/water balance solution.

The LSRCA's stormwater management guidelines for Volume Control has identified a requirement to store the 25mm for all new impervious surfaces for development projects. Since the existing site is 100% impervious (with rooftop and asphalted surfaces), there is no overall increase in impervious surfaces due to the development, therefore no volume for water balance is required under the LSRCA guidelines. However, best efforts will be made for the site to ensure that some runoff retention is achieved through the retention of the first 5mm of all rainfall events.

The first step in the analysis of water balance is initial abstraction. The initial abstraction of water depends on the surface with which the water lands. For example, a landscaped area with permeable soils has an initial abstraction of 5mm whereas an impervious surface like an asphalt road has an initial abstraction of 0.6mm. The initial abstraction for the proposed site is 19.8m³.

The remaining 24.5m³ volume of water within the private developments, after initial abstraction, is required to be captured in the underground storage vault and reused on site. In order to be able to reuse stormwater from the site for irrigation purposes, a 0.35m sump is located at the bottom of the vault below the orifice elevation that will store clean water collected that can be re-used on-site with the irrigation system.

The detailed landscaping calculation to determine the amount of water required for irrigation within the 72-hour draw down time for the proposed development has not yet been completed and provided by the landscape architect.

A *Water Balance Study* was completed by PGL Environmental Consultants, dated October 2022, to assess the hydrologic conditions at the Site both prior to and following the proposed development to evaluate the changes to infiltration and runoff. The results of the assessment indicate that after development, we anticipate that there will be a 0.7% decrease in average annual runoff from the site and a 9.3% increase in infiltration. The decrease in runoff and increase in infiltration were due to the addition of more pervious surfaces at the Site. Refer to **Appendix D** for excerpts from the *Water Balance Study*.

A summary of the stormwater management plan is shown in **Table 2-3**, below. Refer to **Appendix A** for complete calculations, **Servicing Plan (Drawing S1)** and **Drawing D1** for the vault configuration details.

Table 2.3 - Stormwater Management Summary

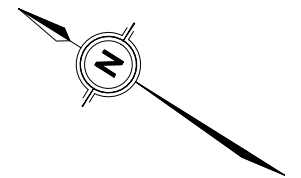
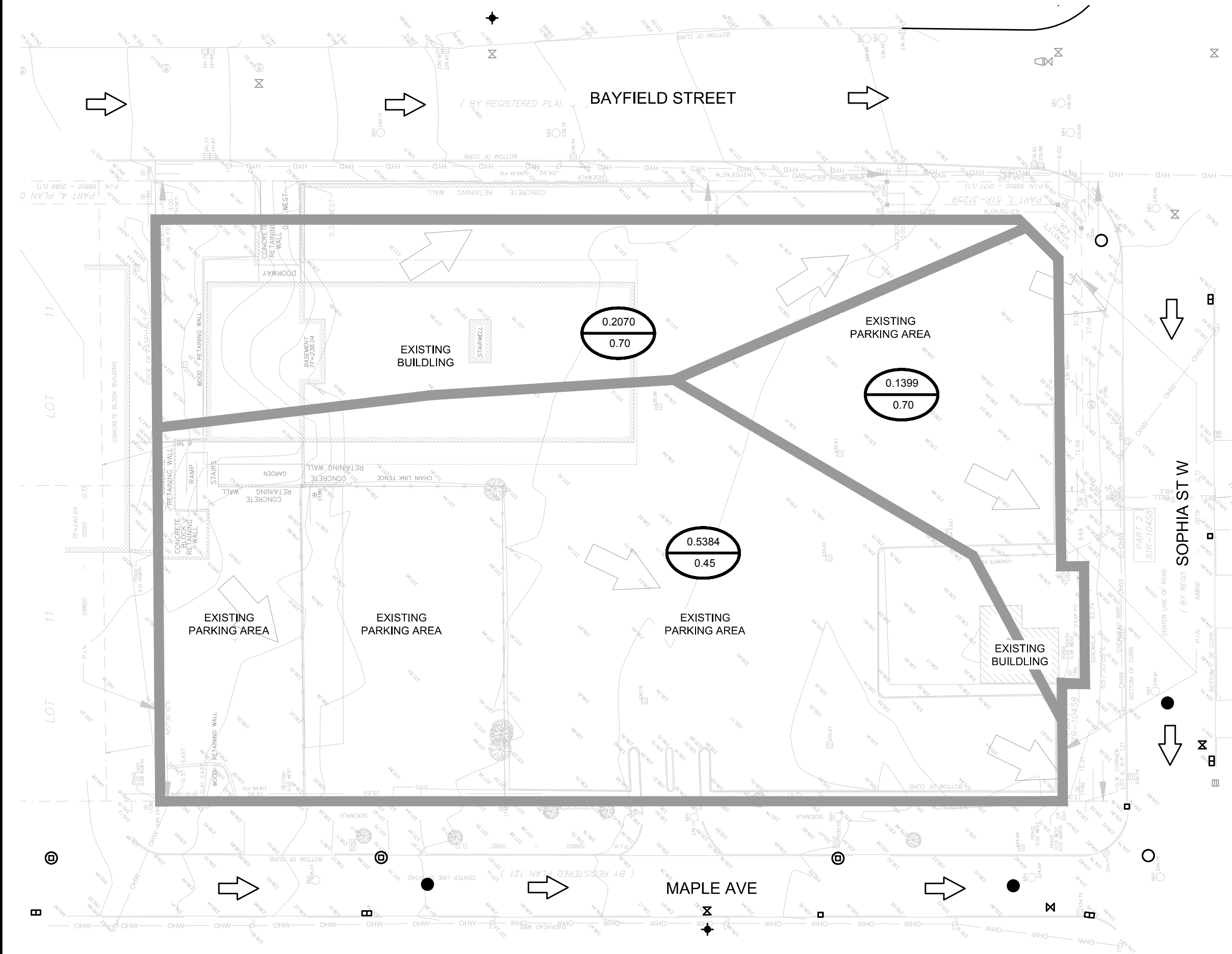
SWM Measure	Required	Provided
Runoff to Bayfield Street (East)		
5-year	43.84 L/s	10.89 L/s
100-year	72.51 L/s	18.01 L/s
Runoff to Sophia Street W. (South)		
5-year	29.63 L/s	15.68 L/s
100-year	49.01 L/s	25.94 L/s
Controlled Release Rate (Orifice Size)	52.04 L/s	49.38 L/s (115mm orifice plate)
Runoff to Maple Avenue		(unrestricted + release rate)
5-year	73.30 L/s	-
100-year	-	70.64 L/s (21.26 L/s + 49.38L/s)
Active Storage Volume	231 m ³	231.0 m ³
Dead Storage Volume (Reuse)	24.5 m ³	24.9 m ³
Treatment Method / TSS% Removal	80%	87% (majority rooftop area)

2.3 Erosion and Sediment Control

Details for erosion and sedimentation control during construction will be subject to the City of Barrie approval prior to issuance of Building Permit. During the site grading and servicing works, there is potential for sediment-laden runoff to be directed toward the adjoining properties, municipal streets, and existing storm infrastructure. Therefore, prior to any grading activity, sediment control fencing and hoarding must be installed along the site perimeter. Additional measures will include construction of an entrance “mud-mat” on the access to be used during construction to minimize mud tracking offsite. Material stockpiles are to be located in appropriate locations. Inlet sediment control devices are to be used on existing catchbasins in municipal right-of-ways that may be affected by the construction of this site. The erosion and sediment control methods are shown on the **Erosion and Sediment Control Plan (Drawing E1)**.

All erosion and sediment control BMPs shall be designed, constructed and maintained in all development site in accordance with the City of Barrie requirements. Sediment and erosion control devices on the site are to be inspected on a regular basis, as well as after every rain event, and must be repaired as necessary to prevent any off-site environmental impacts. Frequent inspections of catch basins must be conducted.

Additionally, a detailed construction management plan will be provided by the contractor, to the satisfaction of the City. The detailed construction management plan will include items such as crane movement, staging of construction materials, contractor parking etc.



LEGEND

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- × 200.00 0.5% MH 1A / PROP ITEMS
 ● × 200.00 0.5% EX MH 1A / EX ITEMS
 - - - - - LIMIT OF PROPERTY LINE
 [Grey Bar] DRAINAGE AREA
 [White Arrow] EX OVERLAND FLOW ROUTE
 (1.0000 / 0.90) AREA (HECTARES) RUN-OFF COEFFICIENT

- × $\frac{200.00}{\text{EX MH 1A}} \frac{0.5\%}{\text{EX ITEMS}}$

- . — . — . — LIMIT OF PROPERTY LINE

- _____ DRAINAGE AREA

- EX OVERLAND FLOW ROUTE

-

- AREA (HECTARES)
RUN-OFF COEFFICIENT

DRAINAGE AREAS AND RUNOFF COEFFICIENTS
AS PER THE CITY OF BARRIE'S STORM
DRAINAGE PLANS.

NOT FOR CONSTRUCTION



.....
The Municipal Infrastructure Group Ltd

ROCKAP HOLDINGS

136 BAYFIELD

EXISTING DRAINAGE AREA PLAN

PROJECT #
19501

DRAWING #

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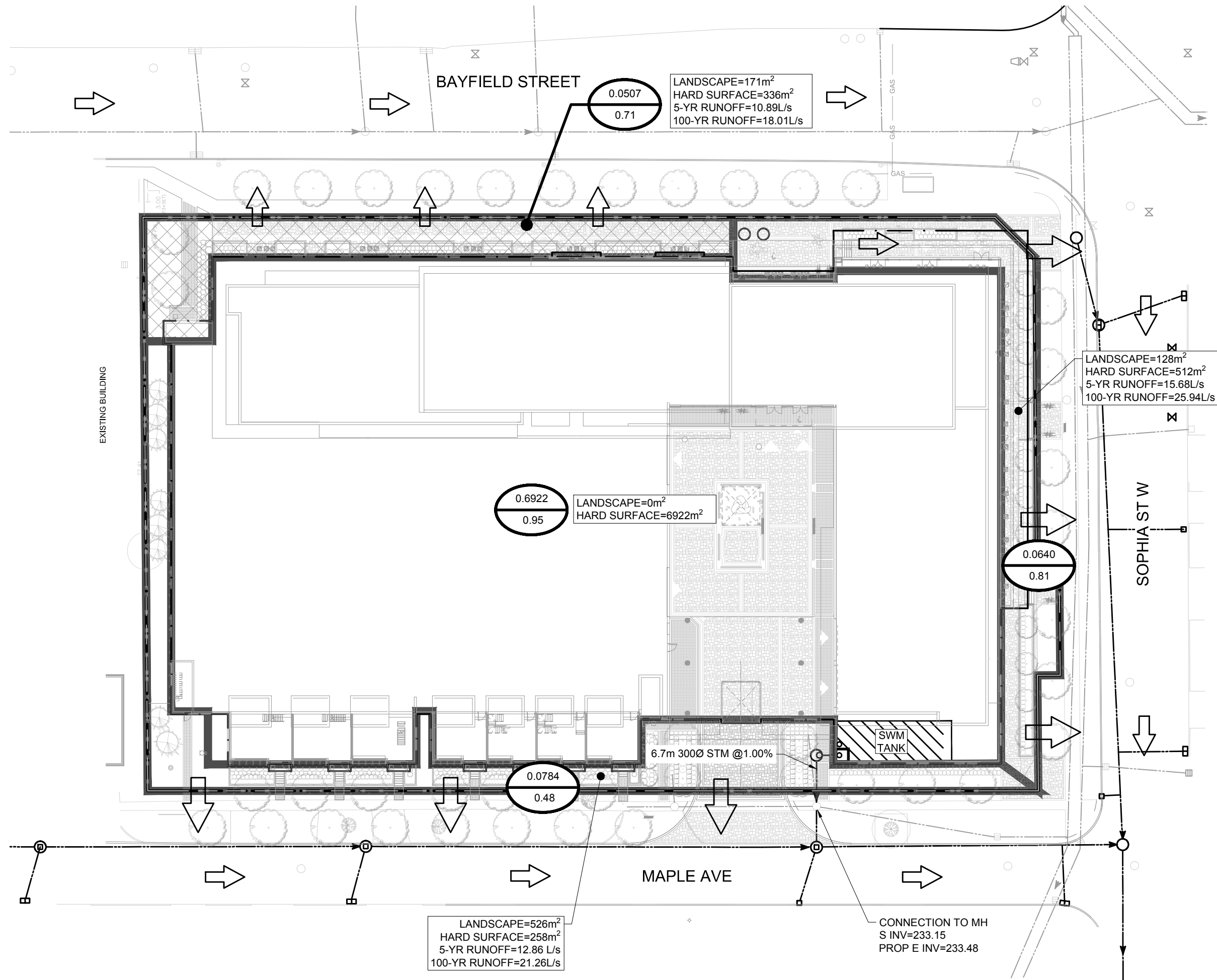
DATE: APRIL 2022

DRAWN BY: C.B.

DESIGNED BY: C.B.

CHECKED BY: B.D.

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LEGEND

- x 200.00 0.5% MH 1A PROP ITEMS
- x 200.00 0.5% EX MH 1A EX ITEMS
- LIMIT OF PROPERTY LINE
- DRAINAGE AREA
- ➔ PROP OVERLAND FLOW ROUTE
- 1.0000
0.90 AREA (HECTARES)
RUN-OFF COEFFICIENT

NOT FOR CONSTRUCTION



ROCKAP HOLDINGS

136 BAYFIELD

PROPOSED DRAINAGE AREA PLAN

PROJECT #
19501

DRAWING #
F2-2

SCALE: 1:500

DATE: APRIL 2022

DRAWN BY: C.B.

DESIGNED BY: C.B.

CHECKED BY: B.D.

3 SANITARY SERVICING

3.1 Existing Sanitary Servicing

The existing site servicing details obtained from The City of Barrie engineering plan and profiles and a topographical survey completed of the area indicate that there is sanitary infrastructure in the vicinity of the site.

The existing office building is serviced by a 150mm diameter sanitary service from Bayfield Street and the house is serviced from Sophia Street W. Currently, the site is zoned C2-1 (Transition Centre Commercial) and allotted as such is the City's infrastructure. As per the City of Barrie Sanitary Drainage Map, the majority of the site is to drain east to the 300mm diameter sanitary sewer along Bayfield Street. From there, it flows south along Bayfield Street to the 600mm diameter trunk sewer that starts at Sophia Street W., continuing down Bayfield Street.

The peak dry-weather sanitary flow for the existing site is estimated at 2.16L/s (based on an office population equivalent of 3.3 persons per 100m² and an average sanitary flow of 225L/P/D). With an additional 0.1L/s/ha for inflow/infiltration, the peak wet weather sanitary discharge from the site is estimated at 2.25L/s.

Refer to **Appendix E** for the City of Barrie Sanitary Drainage Plan and the Sanitary Design Calculations, and to the **Servicing Plan (Drawing S1)** for the location of the existing sanitary sewer infrastructure.

3.2 Proposed Sanitary Servicing

The existing sanitary services laterals extending into the property line from are to be decommissioned as per City of Barrie standards. As per City requirements, a separate sanitary service will be provided for the commercial area that is separate from the residential wastewater discharge. The two new sanitary services for the proposed development (one for residential and one for commercial areas) will consist of 150mm diameter connections at a 2.0% slope. The saddle connections will be made to the existing 300mm sanitary sewer within Bayfield Street, east of the development site. As in existing conditions, it then flows south along Bayfield Street to the 600mm diameter trunk sewer that starts at Sophia Street W. The proposed servicing is shown on the **Servicing Drawing (S1)**.

The total residential peak dry-weather sanitary flow for the 292-unit condo tower and 8-unit townhouse unit development has been calculated as 5.24L/s. The total commercial peak wet-weather sanitary flow for the 477m² commercial area has been calculated as 0.15L/s, based on a retail population equivalent of 1.1 persons per 100m² and an average sanitary flow of 225L/P/D. The commercial flow also includes an additional 0.1L/s/ha for inflow/infiltration. Therefore, the total the peak wet weather sanitary discharge from the site is estimated at 5.39L/s. This is an estimated peak increase of 3.14L/s from the existing site.

In the receiving municipal sewer along Bayfield Street, the 3.14L/s increase in sanitary flow corresponds to only 2.5% of the total flow capacity in the pipe.

Refer to **Appendix E** for details of the calculations.

3.2.1 Downstream Sanitary Trunk Analysis

A Wastewater Collection Master Plan for the City of Barrie was completed by Cole Engineering Group Ltd. in July 2019. The plan was created to evaluate the City's wastewater collection system based on existing conditions and anticipated future development in the City. The Plan also identifies wastewater servicing projects that will be required to accommodate and facilitate growth and intensification over the planning horizon.

As per the City's performance criteria, during the 25-year design storm event, a trunk and local sewers should maintain a depth ratio (d/D) below 0.7 for sewers with diameters greater than 375mm and below 0.5 for sewers

with diameters of 375mm and less. The existing infrastructure was assessed using existing needs and projects future needs (2021 to 2071).

Figure 6-6 (Appendix E) presents the existing system performance under a 25-year design storm event. Based on the analysis of existing system performance, the system downstream of the development site has adequate capacity to handle existing peak wet weather flows resulting from a 25-year design storm event.

For assessment of future conditions, the City provided a breakdown of projected residential and employment population broken by traffic zone. The development site is located within Traffic Zone 141. Between the existing and the 2041 period, there is a projected residential population increase of 520 people and an employment population increase of 155 people. Therefore, there is a total projected increase of 675 people in Traffic Zone 141 by 2041. In post-development conditions, there will be an anticipated onsite increase of only 314 people (difference between 511 post-development population and 197 pre-development). Therefore, the 2041 scenario/analysis can be used to represent the downstream effects of the proposed development.

Figure 8-6 (Appendix E) presents the performance of the existing system with additional flows representing 2041 growth conditions. This figure presents system performance as a result of the 25-year design storm event.

As shown in **Figure 8-6**, surcharge conditions are predicted with a freeboard of less than 1.8m directly upstream of the Barrie Wastewater Treatment Facility. The model predicted surcharge conditions in select pipes located directly upstream of pumping stations, however this is typical of flows upstream of pumping stations and is not believed to indicate sewer capacity issues.

Figure 8-6 also shows that the majority of the sanitary sewer system downstream of the proposed development site (flowing south along Bayfield Street) remains at a peak conduit depth ratio of less than 0.5. The only exception in the last segment of trunk sewer prior to Simcoe Street, pipe where the d/D was greater than 0.7 was identified on the last leg of Bayfield. Similarly, this is likely due to it being directly upstream of pumping stations and a sewer capacity issues.

Based on the findings of the study, the Wastewater Collection Master Plan highlighted the locations required system improvements. These areas are highlighted in **Figure 10-1** and **Figure 10-2**, included in **Appendix E**. These improvements were identified as required to provide the City's level of service ($d/D < 0.7$ for sewers with diameters greater than 375mm and $d/D < 0.5$ for sewers with diameters of 375mm or less) for a 25-year storm event. As shown in these figures, no improvements or upgrades are required downstream of the development.

Based on these findings, no improvements are required based on the 2041 intensification of Traffic Zone 141. Since the anticipated population increase onsite (314 people) is less than the 2041 projected increase (675 people), the downstream sanitary system has enough capacity to accommodate the proposed development.

Sanitary sewer design calculations and the Wastewater Collection Master Plan figures can be found in **Appendix E**. The layout of the proposed sanitary sewers servicing the proposed development is shown on the **Servicing Plan (Drawings S1)**.

4 WATER SERVICING

4.1 Existing Water Servicing

The existing site servicing details obtained from The City of Barrie engineering plan and profiles, the Queen's Park Neighbourhood Renewal Project drawings, and a topographical survey completed of the area indicate that there is watermain infrastructure available in the vicinity of the site, including;

- 300mm watermain along Maple Avenue to the west of the site (Queen's Park Renewal Project)
- 300mm watermain along Sophia Street W. to the south of the site (Queen's Park Renewal Project)
- 200mm watermain along Bayfield Street to the east of the site
- The existing office building is serviced by a 100mm water service from Bayfield Street and the house is serviced from Sophia Street W. (size unknown).
- Two existing hydrants are located adjacent to the site on the east side of Bayfield Street. Two new hydrants are to be constructed on Maple Avenue as part of the Queen's Park Renewal Project.

The existing sewer infrastructure is shown on the **Servicing Drawing (S1)**.

4.2 Proposed Water Servicing

Existing water services extending into the site are to be decommissioned as per City of Barrie standards.

Under proposed conditions the development is anticipated to have a maximum required fire flow demand of 217L/s (based on the Fire Underwriters Survey, 2020). The anticipated domestic flow for the development under proposed conditions has been calculated as 2.37L/s, thus the fire flow plus maximum day demand is 219.4L/s. The domestic flow was based on the average daily demand and peaking factor as per the *Water Supply Master Plan Update*, completed by WSP, dated July 2019.

As part of the Queen's Park Neighbourhood Renewal Project (QPNR), the watermains will be upgraded (to the sizes indicated in **Section 4.1**) on Sophia Street W. and Maple Avenue. A water servicing analysis has been prepared to simulate the available fire flow and residual pressures in the watermain system when the QPNR is completed. These results indicate that the available flow for the subject site (denoted as node J260) is 226L/s at a residual pressure of 20psi. Therefore, the watermain upgrades as part of the QPNR project is expected to provide sufficient watermain capacity for the subject development under maximum day plus fire flow conditions (219.4L/s).

The proposed water service connections will be made to the 300mm diameter watermain located within Sophia Street, south of the subject site. A 150mm domestic service will extend into the building at the DCW pump room. The second and third connections, a 200mm fire service for each tower, will extend into the building at the Sprinkler Room. The water services will include backflow preventers and meters within the building.

Booster pumps may be required for fire and domestic pressure at the upper levels of the condominium developments. The internal onsite water supply and distribution system will be designed and specified to comply with the current standards and specifications of the City of Barrie and the Ontario Building Code and NFPA 13. The mechanical consultant will provide details during the site plan approval and building permit application stage.

Two siamese connections will be placed near the main residential entrance. The connections are located within the maximum allowable distance from the municipal hydrants (less than 45m). The principal entrances are located no more than 90m from a municipal hydrant.

The water demand calculations are shown in **Appendix F** and the proposed and existing watermain infrastructure are shown on the **Servicing Drawing (S1)**.

5 CONCLUSION

The proposed development will see the construction of a new 12-storey, 292-unit condo tower with commercial uses at grade and include 8 townhouse units. The proposed development can be serviced utilizing the existing and proposed infrastructure outlined in the **Servicing Drawing (S1)**.

The 60% design drawings from the Queen's Park Renewal Project were obtained from the City and have been used in the proposed design of the development site with the assumption that the Queen's Park Neighbourhood Renewal Project will be completed prior to the construction completion of the development site.

Stormwater Servicing

- The site is divided into three distinct drainage areas. The proposed development will restrict discharge from the site to the minor and major flow rates allotted for each drainage area.
- The water balance requirement will be achieved by reuse of the initial 5mm storm retention within the stormwater vault.
- All of the area flowing to the stormwater management tank is unrestricted roof area from the building and therefore no additional quality control treatment is required in order to achieve the enhanced TSS removal requirement.
- The proposed development will be serviced by a new 300mm storm sewer with a slope of 1.0% to the Queen's Park Neighbourhood Renewal Project manhole within Maple Avenue.
- A stormwater storage vault will be constructed within the first level. The vault will be designed to have a 125mm diameter outlet orifice plate, restricting the controlled outlet rate to 58.34L/s.
- The high-water levels are below the finished floor elevations and therefore there is no long-term dewatering onsite. The water meter pump and sprinkler room, elevator pits, and any other infrastructure below the stated finished floor elevations will be waterproofed.

Sanitary Servicing

- The total peak sanitary flow for the proposed development (including the infiltration allowance) has been calculated as 5.24L/s for the residential area and 0.15L/s for the commercial area.
- The proposed development will be serviced by two separate services for the residential and commercial areas of the site. The two 150mm diameter connections will be sloped at 2.0%, connecting to the existing 300mm sanitary sewer within Bayfield Street.
- Downstream pipes have enough available capacity to accommodate the increase in design flow. This conclusion is based on the analysis completed for the 2019 Wastewater Collection Master Plan for the City of Barrie using the 2041 intensification scenario.

Water Servicing

- The proposed water servicing is dependent on the completion of the City's QPNR project and will provide an available fire flow demand of 226L/s to the subject site.
- A 150mm domestic connection and two 200mm fire connections will be made to the 300mm watermain within Sophia Street W as part of the QPNR project.
- The proposed development has a maximum day domestic demand of 2.37L/s and fire demand of 217L/s.
- Fire protection for the proposed development will be achieved through the existing hydrants that surround the site and through internal sprinkler systems. Two siamese connections will be placed near the main entrance and the underground parking entrance to the proposed building.

We trust that this Functional Servicing and Stormwater Management Report for the 136 Bayfield Street development is satisfactory for your rezoning and site plan approval application purposes. If you have any questions or comments, please do not hesitate to contact the undersigned.

Sincerely,

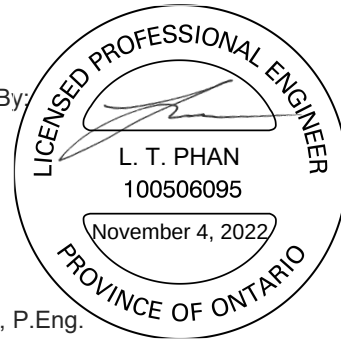
THE MUNICIPAL INFRASTRUCTURE GROUP LTD.

Prepared By:



Caitlin Beaudoin, P.Eng.
Site Plan Project Manager

Reviewed By:



Luan Phan, P.Eng.
Project Engineer, Urban Development

APPENDIX A

Stormwater Management Design Calculations

Project Name: 136 BAYFIELD	
Project #: 19501	Prepared by: C.B.
Date: April 2022	Checked by: B.D

ALLOWABLE RELEASE FLOW

1. Pre, External & Post Development Uncontrolled Area:

Note: Post Dev. Controlled Area is shown in Orifice Calculations

Table 1. a) Total Uncontrolled Area

Type of Land	T (min)	Runoff Coef. (C)	Pre Dev. Site (A)	Pre Dev. Incoming External (A)	Uncontrolled Area (m ²)	
					Total Pre Dev. (A)	Post Dev. Uncontrolled (A)
Total Unrestricted Area			5384	-	5384	784
Combined T (min)					10	10
Combined Runoff Coefficient			0.45	-	0.45	0.54
Landscape	10	0.25	0	0	0	457
Impervious	10	0.95	0	0	0	327
Gravel	10	0.50	0	0	0	0
Commercial	10	0.45	5384	0	5384	0

Table 1. b) Restricted and Allotted Area

Note: Restricted flows = 42L/s/ha.

Type of Land	T (min)	Runoff Coef. (C)	Restricted or Unrestricted	Restricted Flow (L/s)	Uncontrolled Area (m ²)	
					Pre Dev. Site (A)	Post Dev. Uncontrolled (A)
Allotment to East (Pre Dev.)	10	0.70	Unrestricted	-	2070	0
Allotment to South (Pre Dev.)	10	0.70	Unrestricted	-	1399	0
Allotment to East (Post Dev.)	10	0.71	Unrestricted	-	0	507
Allotment to South (Post Dev.)	10	0.81	Unrestricted	-	0	640

2. Formulas, Coefficients & Average Rainfall Intensity:

$i = a(T+b)^{-c}$, where i (mm/h) ; T (min)

$Q = A(i)C/3600$, where A (m²) ; i (mm/h)

Note: a,b,c = coefficients as per municipal standards

Description Units	Return Period (years)				
	2	5	10	25	50
a	678.085	853.608	975.865	1146.275	1236.152
b	4.699	4.699	4.699	4.922	4.699
c	0.781	0.766	0.76	0.757	0.751
Total Unrestricted Area i (mm/h)	83.11	108.92	126.55	148.15	164.22

3. Pre Development Flow:

Description Units	Return Period (years)				
	2	5	10	25	50
Total Unrestricted Area Q (L/s)	55.93	73.30	85.17	99.70	110.52

Summary: The Pre Development Flow is $Q_2=55.9L/s$, $Q_5=73.3L/s$, $Q_{10}=85.2L/s$, $Q_{25}=99.7L/s$, $Q_{50}=110.5L/s$, $Q_{100}=121.2L/s$.

4. Allotted Flow:

Note: Post Dev. Allotments are uncontrolled flows to adjacent lands.

Description Units	Return Period (years)				
	2	5	10	25	50
Allotment to East (Pre Dev.) Q (L/s)	33.45	43.84	50.94	59.63	66.10
Allotment to South (Pre Dev.) Q (L/s)	22.61	29.63	34.42	40.30	44.67
Adjacent Lands Allotment (Pre Dev.) Q (L/s)	56.06	73.47	85.36	99.93	110.77
Allotment to East (Post Dev.) Q (L/s)	8.31	10.89	12.65	14.81	16.42
Allotment to South (Post Dev.) Q (L/s)	11.97	15.68	18.22	21.33	23.65
Adjacent Lands Allotment (Post Dev.) Q (L/s)	20.28	26.58	30.88	36.15	40.07

Summary: The uncontrolled release flow for 'Adjacent Lands Allotment (Pre Dev.)' is $Q_2=56.1L/s$, $Q_5=73.5L/s$, $Q_{10}=85.4L/s$, $Q_{25}=99.9L/s$, $Q_{50}=110.8L/s$, $Q_{100}=121.5L/s$.

Summary: The uncontrolled release flow for 'Adjacent Lands Allotment (Post Dev.)' is $Q_2=20.3L/s$, $Q_5=26.6L/s$, $Q_{10}=30.9L/s$, $Q_{25}=36.1L/s$, $Q_{50}=40.1L/s$, $Q_{100}=44L/s$.

Summary: The uncontrolled release flow for 'Allotment to East (Post Dev.)' is less than the 'Allotment to East (Pre Dev.)'.

Summary: The uncontrolled release flow for 'Allotment to South (Post Dev.)' is less than the 'Allotment to South (Pre Dev.)'.

5. Post Development Uncontrolled Flow:

Description Units	Return Period (years)				
	2	5	10	25	50
Total Unrestricted Area Q (L/s)	9.77	12.81	14.88	17.42	19.31
Restricted Flat Roof (42L/s/ha) Q (L/s)	0.00	0.00	0.00	0.00	0.00
Restricted Green Roof (42L/s/ha) Q (L/s)	0.00	0.00	0.00	0.00	0.00
Cumulative Flow Q (L/s)	9.81	12.86	14.94	17.49	19.38

Summary: The Post Development Uncontrolled Flow is $Q_2=9.8L/s$, $Q_5=12.9L/s$, $Q_{10}=14.9L/s$, $Q_{25}=17.5L/s$, $Q_{50}=19.4L/s$, $Q_{100}=21.3L/s$.

6. Allowable Flow:

Description Units	Return Period (years)				
	2	5	10	25	50
Pre Development Flow Q (L/s)	55.93	73.30	85.17	99.70	110.52
Allowable Release Flow Q (L/s)	55.93	73.30	85.17	99.70	110.52
Post Development Uncontrolled Flow Q (L/s)	9.81	12.86	14.94	17.49	19.38
100-yr Uncontrolled Release Flow Q (L/s)	21.26	21.26	21.26	21.26	21.26
Remaining Release Flow for Orifice Q (L/s)	34.67	52.04	63.90	78.44	89.26

Summary: The Allowable Release Flow is $Q_5=73.3L/s$.

Summary: The 100-yr Uncontrolled Release Flow is $Q_{100}=21.26L/s$.

Summary: The Remaining Release Flow for Orifice is $Q_5=52.04L/s$.

Project Name: 136 BAYFIELD		
Project #: 19501	Prepared by: C.B.	
Date: April 2022	Checked by: B.D	

ORIFICE CALCULATIONS - POST DEV. CONTROLLED FLOWS

7. Summary Table of Allowable Flow:

Description Units	Return Period (years)				
	2	5	10	25	50
Allowable Release Flow Q (L/s)	55.93	73.30	85.17	99.70	110.52
100-yr Uncontrolled Release Flow Q (L/s)	21.26	21.26	21.26	21.26	21.26
Remaining Release Flow for Orifice Q (L/s)	34.67	52.04	63.90	78.44	89.26

Summary: The remaining release flow for the orifice is Q5=52L/s.

8. Total Post Development Area:

Types of Land	T (min)	Runoff Coef. (C)	Area (m ²)			TSS Removal Rate
			Post Dev. Uncontrolled (A)	Post Dev. Controlled (A)	Total Post Dev. (A)	
Total Area			784	6922	7706	
Combined T (min)			10	10	10	
Combined Runoff Coefficient			0.54	0.95	0.91	
Landscape	10	0.25	457	0	457	100%
Impervious	10	0.95	327	0	327	0%
Unrestricted Flat Roof	10	0.95	0	6922	6922	90%
Total					7706	87%

Summary: The maximum storage facility inflow (Q) = 331L/s.

Summary: The TSS removal rate is 87% which is ≥ 80%.

9. Orifice Design:

Orifice Details:	
Post Development Return Period to be Controlled	= 100 year
Pre Development Return Period to Control to	= 5 year
Orifice Discharge Coefficient (C)	= 0.62 Plate
Orifice Inside Diameter	= 115 mm
Orifice Area	= 0.010 m ²
High Water Head from invert (h)	= 3 m
Allowable Orifice Flow (Q)	= 52.04 L/s
Actual Orifice Flow (Q)	= CA(2gh) ^{1/2}
	= 49.38 L/s

Summary: The Orifice is a Plate with an Inside Diameter of 115mm.

Summary: The Actual Orifice Flow is Q100=49.4L/s.

10. Storage Facility Design:

Storage Facility	= Vault
Storage Volume Required (V ₁)	= 231.0 m ³ (Storage Calc's)

Storm Service Connection (5yr):

Diameter (mm)	Slope (%)	Velocity (m/s)	Full Flow Capacity (L/s)	Actual Flow (%)
300	1	1.37	96.7	51%

100-Year Emergency Outlet from Tank to MH (331 L/s):

Diameter (mm)	Slope (%)	Velocity (m/s)	Full Flow Capacity (L/s)	Actual Flow (%)
450	2	2.54	403.2	82%

Vault Elevations:

Surface Elevation	= 241.50 m
Top of Vault Elevation	= 239.80 m
High Water Level (HWL)	= 239.50 m
Orifice Invert Elevation	= 236.50 m
Bottom of Vault Elevation	= 236.15 m
P1 Slab Elevation	= 236.15 m

Vault Details:

Freeboard Height	= 0.3 m
High Water Head from invert (h)	= 3 m
Area Required (A ₁)	= V ₁ / h
	= 77 m ²
Area Provided (A ₂)	= 77 m ²
Storage Volume Provided	= A ₂ (h)
	= 231.0 m ³

5mm Storm Retention:

Initial Abstraction	Depth (mm)	Area (m ²)	IA (m ³)
TOTAL		7706	19.8
Landscape	5	457	2.3
Impervious	0.6	327	0.2
Gravel	5	0	0.0
Building (Flat Roof)	2.5	6922	17.3
Building (Green Roof)	5	0	0.0

Total Area	A =	8853 m ²
Storm Event to be Captured	E =	5 mm
5mm Storm Volume Required	A(E)=	44.3
Initial Abstraction	IA =	19.8 m ³
Dead Storage Volume	V =	A(E)-IA
	=	8853(5)/1000-19.8
	=	24.5 m ³

Summary: The Active Storage Volume Required is 231m³.

Summary: The Active Storage Volume Provided is 231m³.

Summary: The Dead Storage Volume Required is 24.5 m³.

Summary: The Dead Storage Volume Provided is 24.9 m³.

APPENDIX B

Excerpts of Hydrogeological Impact Assessment

136 Bayfield Street and 14 Sophia Street West
Barrie, ON

Hydrogeological Impact Assessment



PREPARED FOR:
Rockap Holdings Inc.
701 St. Nicolas Court
Mississauga, ON L5H 4M5

PREPARED BY:
PGL Environmental Consultants
250 Water Street, Suite 102
Whitby, ON L1N 0G5

PGL File: 5689-02.01

November 2022



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Executive Summary

PGL Environmental Consultants (PGL) conducted a Hydrogeological Impact Assessment (HIA) at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario (the Site). This HIA was completed on behalf of Rockap Holdings Inc. (the Client) as part of their plan to redevelop the Site.

Redevelopment of the Site will involve constructing a 12-storey, mixed-use condominium building with 282 residential apartments, 10 live-work units, and ground-floor commercial space. Eight ground-related units fronting Maple Avenue will be constructed as part of the redevelopment plan. The redevelopment will also include structured parking, along with amenity areas such as a large outdoor courtyard and private balconies and terraces. No underground levels are proposed as part of the redevelopment. The property is currently improved with a four-storey commercial building and a two-storey commercial building. These buildings will be removed as part of the redevelopment efforts.

The HIA was completed by PGL to assess the following for the Site: (1) groundwater conditions; (2) construction dewatering requirements; (3) long-term dewatering requirements; (4) dewatering discharge options; and (5) potential effects that may result from any dewatering and discharge.

Key results of the HIA at the Site are summarized as follows:

- Excavation dewatering activities at the Site will largely be restricted to shallow materials at the Site (roughly the upper 2m of the subsurface);
- The excavation dewatering rate was estimated at 45,000L/day. A rate of 225,000L/day (incorporating a 5X safety factor) is recommended for permitting purposes;
- Long-term dewatering will not be required as the proposed structures will be slab-on-grade;
- Groundwater quality results indicate that discharge would likely meet the City of Barrie criteria for discharge to the sanitary sewer system or the storm sewer system;
- An Environmental Activity and Sector Registry will likely be required for dewatering activities;
- Groundwater quality results did not exceed any Provincial Water Quality Objectives standards for which the sample was tested (detection limits for certain parameters exceeded the corresponding standards);
- Dewatering activities may lower groundwater levels beneath exposed portions of Sophia Creek (i.e., sections not running through a culvert), and therefore, dewatering has the potential to reduce baseflow in the creek;
- Monitoring requirements to evaluate potential impacts to Sophia Creek should be confirmed with the Lake Simcoe Region Conservation Authority prior to dewatering activities; and
- No adverse effects to existing water users, local aquifers, or any other natural features are expected as a result of the proposed dewatering.

Geotechnical concerns related to dewatering were beyond the scope of this assessment. V.A. Wood Associates Ltd. previously completed a geotechnical investigation at the Site.

This Executive Summary is subject to the same standard limitations as contained in the report and must be read in conjunction with the entire report.

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List of Acronyms

asl	-	above sea level
bgs	-	below ground surface
BH##	-	borehole
ESA	-	Environmental Site Assessment
HIA	-	Hydrogeological Impact Assessment
LSRCA	-	Lake Simcoe Region Conservation Authority
MECP	-	Ministry of the Environment, Conservation and Parks
MW##	-	monitoring well
PGL	-	PGL Environmental Consultants
PWQO	-	Provincial Water Quality Objectives
WHPA	-	Wellhead Protection Area

1.0 INTRODUCTION

PGL Environmental Consultants (PGL) conducted a Hydrogeological Impact Assessment (HIA) at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario (the Site). This HIA was completed on behalf of Rockap Holdings Inc. (the Client) as part of their plan to redevelop the Site. The Site location is shown in Figure 1.

Redevelopment of the Site will involve constructing a 12-storey, mixed-use condominium building with 282 residential apartments, 10 live-work units, and ground-floor commercial space. Eight ground-related units fronting Maple Avenue will be constructed as part of the redevelopment plan. The redevelopment will also include structured parking, along with amenity areas such as a large outdoor courtyard and private balconies and terraces. No underground levels are proposed as part of the redevelopment. Future land use will be mixed-use residential and commercial. Redevelopment plans are included as Appendix 1.

The property is currently improved with a four-storey commercial building and a two-storey commercial building. The current land use is commercial. These buildings will be removed as part of the redevelopment efforts at the Site.

The Site falls within the Sophia Creek watershed. Within this watershed, Sophia Creek drains into the storm sewer system. A portion of Sophia Creek, as contained within the storm sewer system, runs along the southern boundary of the Site (see Figure 1 and Appendix 3). The presence of this feature in close proximity to the proposed development represents an important consideration for Site dewatering and discharge activities.

Initial hydrogeological field investigation work was completed at the Site in 2019. Concurrently, V.A. Wood Associates Ltd. (V.A. Wood) completed a preliminary geotechnical investigation of the Site. As part of this investigation work, five boreholes (BH1 to BH5) were drilled and completed as monitoring wells (MW1 to MW5). Borehole logs for these wells are included as Appendix 2.

Based in part on the findings of the initial studies, as well as on the close proximity of Sophia Creek, the redevelopment plans for the Site were altered in 2020 to remove all subsurface levels and incorporate parking in aboveground levels. The HIA (PGL, 2021)¹ and geotechnical report (V.A. Wood, 2022)² were updated to reflect these changes.

PGL (2020A)³ also completed a regulatory Phase 1 Environmental Site Assessment (ESA) for the Site. PGL identified four Areas of Potential Environmental Concern related to the onsite importation of fill of unknown quality, offsite operation of a dry-cleaning facility to the south of the Site, offsite retail gasoline distribution to the south of the Site, and offsite storage of fuels in tanks to the north of the Site. Based on these findings, PGL recommended a Phase 2 ESA for the Site.

¹ PGL (2021) *Hydrogeological Impact Assessment [for 136 Bayfield Street and 14 Sophia Street West[,] Barrie, ON]*. June 2021, pp. 86.

² V.A. Wood (2022) *Preliminary Geotechnical Investigation Proposed Condominium [-] 136 Bayfield Street and 14 Sophia Street West[,] Barrie, Ontario]*. October 2022, pp. 38.

³ PGL (2020A) *Phase 1 Environmental Site Assessment [for 136 Bayfield Street and 14 Sophia Street West[,] Barrie, ON]*. April 2020, pp. 279.

PGL (2020B)⁴ subsequently completed a regulatory Phase 2 ESA for the Site. Investigation work included drilling 15 boreholes (BH101 to BH107 and BH201 to BH208) to maximum depths of 7.6m below ground surface (bgs). Four of these boreholes were completed as monitoring wells (BH101M to BH103M and BH205M) to depths of 4m bgs. Additionally, groundwater samples were collected from pre-existing monitoring wells MW3 and MW5. All collected samples met the applied Site Condition Standards with the exception of:

- Fill material in the northern portion of the Site that had elevated levels polycyclic aromatic hydrocarbons; and
- Groundwater in the southern portion of the Site that had an elevated level of cadmium.

The identified impacts will need to be addressed prior to submission for a Record of Site Condition, either through remediation or a Risk Assessment. It is expected that Site development activities will incorporate remedial excavation work.

This HIA report represents an update to the previous HIA. It was completed to incorporate new Site details and address comments from the Client and the regulator.

2.0 SCOPE OF WORK

The HIA was completed by PGL to assess the following for the Site: (1) groundwater conditions; (2) construction dewatering requirements; (3) long-term dewatering requirements; (4) dewatering discharge options; and (5) potential effects that may result from any dewatering and discharge.

To address the above objectives, PGL completed the following scope of work:

1. Contracted V.A. Wood to complete a geotechnical investigation (V.A. Wood, 2022)⁵ including drilling and installing five monitoring wells (borehole logs and monitoring well records are included as Appendix 2);
2. Reviewed and evaluated existing Site information, including:
 - a. Site redevelopment plans (Appendix 1);
 - b. Results of the geotechnical study (V.A. Wood, 2022)⁶ including borehole logs and monitoring well records (Appendix 2);
 - c. Information pertaining to the surrounding watershed and associated infrastructure (Appendix 3), including:
 - i. Drainage features for the surrounding area (C.C. Tatham & Associates Ltd., 2017); and
 - ii. Cross-sections of Sophia Creek showing current drainage features (City of Barrie Municipal Works Department, 2002) and proposed upgrades (Barrie Engineering Department, 2020);
 - d. Available Ministry of the Environment, Conservation and Parks (MECP) well records, Ministry of Natural Resources and Forestry Heritage maps, Lake Simcoe Region Conservation Authority (LSRCA) maps, and the City of Barrie Official Plan (pertinent figures included in Appendix 3);

⁴ PGL (2020B) *Phase 2 Environmental Site Assessment [for 136 Bayfield Street and 14 Sophia Street West].* Barrie, ON]. April 2020, pp. 202.

⁵ See footnote 2.

⁶ *Ibid.*

5. Developed the new wells;
6. Collected manual groundwater level measurements at MW1 to MW5 (when accessible) during five monitoring events from May 2019 to June 2021;
7. Completed single well response tests at MW1 to MW5 to estimate hydraulic conductivity values for the relevant subsurface materials;
8. Estimated the zone of influence resulting from any required excavation dewatering at the Site;
9. Estimated pumping rates required for any required excavation dewatering at the Site;
10. Estimated the zone of influence resulting from any long-term dewatering at the Site, if such dewatering is required;
11. Estimated pumping rates related to any long-term dewatering at the Site, if such dewatering is required;
12. Collected one groundwater sample and submitted this sample for comparison to the City of Barrie Sewer Use Bylaw criteria;
13. Identified dewatering discharge options based on the groundwater sample results; and
14. Assessed whether dewatering activities may adversely affect any existing users or environmentally sensitive features.

This report has been prepared in an effort to address the relevant requirements of the Ontario *Water Resources Act*, Ontario Regulation 387/04, and Toronto Municipal Code Chapter 681 – Sewers.

3.0 SITE DESCRIPTION

The Site is a rectangular property on the west side of Bayfield Street, immediately north of Sophia Street West. It is bounded to the west by Maple View Drive, to the north by an institutional property (part of Georgian College), to the east by Bayfield Street, and to the south by Sophia Street West. The Site is 8,860m² (0.886ha).

The Site is improved with a four-storey commercial building on the northeast side and a two-storey commercial building on the southwest side. Most of the remaining Site area is asphalt-covered for parking. There are small, landscaped areas scattered across the Site. The Site is currently used for commercial purposes.

Surrounding properties are used primarily for commercial, institutional, and residential. This includes several larger buildings along Bayfield Street, with smaller single-family homes in the surrounding area.

3.1 Topography and Physical Setting

The Site is located at the intersection of the Simcoe Uplands and the Simcoe Lowlands physiographic regions, with the Simcoe Uplands covering the northern portion of the Site and the Simcoe Lowlands covering the southern portion of the Site (Chapman and Putnam, 1984).⁷ The physiographic landform type is identified as drumlinized till plains in the northern portion of the Site (Simcoe Uplands) and sand plains in the southern portion of the Site (Simcoe lowlands). The

⁷ Chapman, L.J., and Putnam, D.F. (1984) *The Physiography of Southern Ontario*; Ontario Geological Survey. Special Volume 2, 270p. Accompanied by Map P.2715 (coloured), scale 1:600 000.

boundary between the northern and southern portions of the Site is interpreted as a shorecliff, likely associated with a previous shoreline for glacial Lake Algonquin.

The ground surface elevation at the Site ranges from roughly 244m above sea level (asl) in the northern portion of the Site to 235m asl in the southern portion of the Site (Appendix 1). The surrounding lands generally slope toward the southeast, toward Kempenfelt Bay, the western arm of Lake Simcoe. Kempenfelt Bay is approximately 600m south of the Site. The slope at the Site is particularly pronounced, likely due to the presence of the shorecliff at the Site.

Sophia Creek runs adjacent the southern part of the Site. The creek is contained within the storm sewer system, specifically a culvert, in the vicinity of the Site. The culvert runs along the north side of Sophia Street, ending approximately 300m east of the Site and 40m west of the Site (Appendix 3).

The City of Barrie Official Plan (2022)⁸ shows a Natural Heritage Area at the southern part of the Site. The Natural Heritage Area relates to Sophia Creek. This portion of the Site is classified as 'Level 1 with Existing Development.'

Based on a review of MECP (2021)⁹ records, the Site falls within:

- A Source Protection Area associated with Lake Simcoe;
- A Wellhead Protection Area (WHPA) with a 5-to-25-year travel time (WHPA-D) to municipal wells No. 11, 12, 14, and 15, located near the shore of Kempenfelt Bay;
- An Issues Contributing Area related to the potential for sodium and chloride in groundwater to adversely affect municipal wells No. 11, 12, 14, and 15, located near the shore of Kempenfelt Bay;
- A Significant Groundwater Recharge Area; and
- A Highly Vulnerable Aquifer Area.

The southern part of the Site is identified as a Regulated Area by the LSRCA (Appendix 3), due to the presence of Sophia Creek. As such, construction activities at the Site will very likely require a permit from the LSRCA.

No further Natural Resources Heritage Sites, Area of Natural and Scientific Research sites, Oak Ridges Moraine, Niagara Escarpment, or Environmentally Sensitive areas were identified within 250m of the Site.

3.2 Geology

Geological maps indicate that the surficial materials in the southern portion of the Site consist of coarse-textured glaciolacustrine deposits of sand, gravel, minor silt and clay associated with a relic shoreline, while the surficial materials in the northern portion of the Site consist of stone-poor, sandy silt to silty sand-textured till (Ontario Geological Survey, 2010)¹⁰. Review of borehole logs at the Site suggest that surficial materials at the Site generally range from silty sand till to sandy silt till, with a thin layer (approximately 1m thick) of gravelly sand noted in most boreholes (this material is

⁸ City of Barrie (2022) *Official Plan 2051*. February 15, 2022, pp. 230.

⁹ MECP (2021) *Source Protection Information Atlas*. Available online: <https://www.liaoapplications.lrc.gov.on.ca/SourceWaterProtection/> [accessed October 12, 2022].

¹⁰ Ontario Geological Survey (2010) *1:50 000 Scale Surficial Geology of Southern Ontario*. OGSEarth (Miscellaneous Release - Data 128-Rev).

generally interpreted as fill, although it may represent reworked native material). The onsite drilling results are broadly consistent with the regional mapping.

Overburden at the Site is underlain by limestone and shale of the Verulam Formation, part of the Simcoe Group (Ontario Geological Survey, 2011)¹¹. Based on a review of available borehole records, the depth to bedrock is likely on the order of 100m at the Site (Ontario Geological Survey, 2006).¹²

Based on a review of boreholes completed at the Site (Appendix 2), the following simplified overburden units were identified:

Table A: Site Geology

Stratigraphy	Approximate Typical Depths (m bgs)
Sand to Gravelly Sand Fill	0 to 1.5
Silty Sand Till to Sandy Silt Till	1.5 to 15.4 (max. investigated depth)

Unit depths, thicknesses, and compositions were variable across the Site; however, the above listed units were generally continuous across the Site (where investigated).

3.3 Hydrogeology

For the purposes of this study, Site hydrogeology was separated into two systems:

- A shallow system incorporating the upper 1.5m of sand to gravelly sand and fill (Shallow Sand System); and
- A deeper system incorporating the silty sand till to sandy silt till (Deep Till System).

All the monitoring wells installed at the Site are screened over the Deep Till System; however, the shallowest monitoring well, MW3, may be influenced by the Shallow Sand System.

Given the presence of a shallow layer of coarse material overlying a finer and denser till material, perched groundwater systems may occur at the Site. Groundwater flow in both systems would be expected to flow toward the south to southeast; however, groundwater flow directions in perched systems are often variable. Additionally, past development activities at the Site and surrounding properties may have introduced preferential pathways that affect groundwater flow directions.

¹¹ Ontario Geological Survey (2011) *1:250 000 Scale Bedrock Geology of Ontario*. OGSEarth (Miscellaneous Release - Data 126-Rev 1).

¹² Ontario Geological Survey (2006) *Bedrock topography and overburden thickness mapping, Southern Ontario*. OGSEarth (Miscellaneous Release--Data 207).

4.0 HYDROGEOLOGICAL WORK PROGRAM

The following sections outline the collection of hydrogeological data at the Site.

4.1 Borehole Drilling and Well Construction

In May 2019, V.A. Wood drilled five boreholes at the Site. Each of these boreholes was completed as a monitoring well. Monitoring well details are summarized in Table A4.1 of Appendix 4. Borehole logs and monitoring well records are included in Appendix 2. All monitoring wells were developed prior to further testing or monitoring.

4.2 Groundwater Elevations, Flow Directions, and Hydraulic Gradients

PGL measured groundwater levels at all of monitoring wells MW1 to MW5 (when accessible) at the Site during five monitoring events from May 2019 to June 2021. Results of these events are included in Table A4-2 of Appendix 4. Results are shown graphically in Table A4-3 of Appendix 4. Results for May 16, 2019, are shown on Figure 2.

In general, water levels showed broadly similar trends in each of the wells. Water levels fluctuated less than 1m at each well, based on the collected results.

The horizontal groundwater flow gradient was estimated at 0.04, by comparing results in the northern portion of the Site (i.e., at MW4) to those in the southern portion of the Site (i.e., at MW1). This result is consistent with a broadly southward groundwater flow direction.

The vertical gradient could not be readily estimated as no shallow well was in close proximity to the lone deep well, MW5. That said, water levels at MW5 appear broadly consistent with the prevailing trend in the shallow wells, suggesting that any vertical gradient is likely modest.

4.3 Hydraulic Conductivity Tests

Single well response tests (commonly called “slug tests”) were completed at each of the monitoring wells. Two tests were completed at each well, except for monitoring well MW5, where only one test was completed due to the slow response time in this well.

Results were collected using data loggers supplemented with manual measurements, with data collected both before and during the test. The results were analyzed using the Bouwer-Rice (1976)¹³ method, applying the normalized head ranges recommended by Butler (2008)¹⁴, where appropriate. The anisotropy ratio (i.e., vertical hydraulic conductivity over horizontal hydraulic conductivity) was estimated at 0.1 for the silty sand till to sandy silt till (i.e., all wells), based on literature values for similar materials (e.g., Fan and Miguez-Macho, 2010).¹⁵

¹³ Bouwer, H. and Rice, R.C. (1976) *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells*. Water Resources Research, 12, 423-428.

¹⁴ Powers, J.P.; Corwin, A.B.; Schmall, P.C.; and Kaeck, W.E. (2007) *Construction Dewatering and Groundwater Control: New Methods and Applications*. Jon Wiley and Sons (Third Edition).

¹⁵ Fan, Y. and Miguez-Macho, G. (2010) *A simple hydrologic framework for simulating wetlands in climate and earth system models*. Climate Dynamics 37(1):253-278 (July 2010).

The calculated hydraulic conductivities are shown below in Table B with the individual test reports included in Appendix 5. Where two test were completed, the reported hydraulic conductivity value is the geometric mean of the two test results.

Table B: Calculated Hydraulic Conductivities

Well	Test	Hydraulic Conductivity (m/s)	Reported Hydraulic Conductivity (m/s)	Interval
MW1	1	7.3E-07	7.4E-07	Intermediate
	2	7.5E-07		
MW2	1	4.8E-07	5.7E-07	Intermediate
	2	6.7E-07		
MW3	1	7.9E-06	8.1E-06	Shallow
	2	8.3E-06		
MW4	1	3.4E-07	3.9E-07	Intermediate
	2	4.5E-07		
MW5	1	6.9E-08	6.9E-08	Deep

The hydraulic conductivity values summarized above are broadly consistent with the expected ranges for the corresponding geological materials (e.g., Domenico and Schwartz, 1990)¹⁶, except for the value recorded for MW3. The hydraulic conductivity value for this well is unusually high for a silty sand to sandy silt till unit and may reflect an influence from shallow coarser materials.

The geometric mean of the hydraulic conductivity values for the shallow and intermediate wells was calculated at 1.1E-06m/s. This value was used in all dewatering calculations. It is interpreted as adequately representative for the mix of shallow materials at the Site.

5.0 CONSTRUCTION DEWATERING

The following sections outline considerations specific to construction dewatering at the Site.

5.1 Construction Excavation Activities

Based on the most recent development plans provided by the Client (Appendix 1), the excavation will effectively cover the whole Site, or roughly 8,860m² (0.886ha). The lowest portion of the ground floor of the building will occur at an elevation of 236.15m asl. Given that slope at the Site, regrading activities will be required to level the terrain. To allow for the construction of the building foundation and associated utilities, excavation work will extend 2 to 3m below grade (Appendix 1). This equates to a minimum elevation of 233.15m asl. Based on the provided drawings, it is our understanding that elements of the building foundation will extend to broadly comparable depths and elevations.

¹⁶ Domenico, P.A.; and Schwartz, F.W. (1990) *Physical and Chemical Hydrogeology*. John Wiley and Son, New York, 824 pp.

The percentage of the Site to be developed as impermeable is expected to be 90.7%. This represents an improvement relative to current Site conditions, where 91.5% of the Site is impermeable (PGL, 2022)¹⁷.

5.2 Need for Dewatering

Based on the water levels measured at the Site, excavation dewatering will be required. It is noted that, due to the regrading activities required to level out the terrain at the Site, current water levels may not reflect water levels post-regrading. As such, peak water levels at the Site were assumed to occur at the proposed regraded ground level (i.e., 236.15m asl) as a broadly conservative assumption.

Long-term dewatering will not be required at the Site as the proposed structures will be slab-on-grade. As such, no estimates for the zone of influence or required dewatering rate are provided for long-term dewatering.

5.3 Zone of Influence for Excavation Dewatering

PGL calculated the zone of influence estimate for excavation dewatering using a water balance method after Marinelli and Niccoli (2000)¹⁸. This method relies on the assumption that the total groundwater infiltration rate within the radius of influence must equal the pumping rate of groundwater from the excavation, with the radius of influence set to ensure that these two rates balance.

The estimated zone of influence for excavation dewatering was estimated at 133m from the edge of excavation. Calculations and assumptions pertaining to the zone of influence estimate are shown in Appendix 5.

As a precautionary measure, a zone of influence of 300m was used to evaluate potential offsite impacts. This zone of influence is illustrated on Figure 3.

5.4 Pumping Requirements for Excavation Dewatering

PGL estimated the dewatering requirements for excavation work at the Site using the Marinelli and Niccoli (2000)¹⁹ equation for flow to an excavation. This method calculates steady-state radial flow to the sides of an excavation as well as upwelling through the base of the excavation. This method also relies on the zone of influence values discussed in Section 5.3.

The excavation dewatering rate was estimated at 45,00L/day. A rate of 225,000L/day (incorporating a 5X safety factor) is recommended for permitting purposes.

Calculations and assumptions related to the excavation dewatering calculations are shown in Appendix 6.

¹⁷ PGL (2022) *Water Balance Study [for 136 Bayfield Street and 14 Sophia Street West[,] Barrie, ON]*. October 2022, pp. 26.

¹⁸ Marinelli, F. and Niccoli W. (2000) *Simple analytical equations for estimating ground water inflow to a mine pit*. Groundwater 38:2 (311-134), March-April 2000.

¹⁹ *Ibid.*

5.5 Permitting for Water Takings

In Ontario, groundwater takings for construction dewatering at or above 50,000L/day but less than 400,000L/day require registration on the Environmental Activity and Sector Registry. An Environmental Activity and Sector Registry will likely be required for excavation dewatering work at the Site.

5.6 Discharge Water Quality

One groundwater sample was collected at the Site for comparison to the City of Barrie sewer use bylaw criteria for (1) sanitary and combined sewer discharge; and (2) storm sewer discharge. Sample results were also compared to selected Provincial Water Quality Objectives (PWQO) as Sophia Creek runs through the storm sewer system near the Site.

The sample was collected on July 19, 2019, at MW4. PGL interprets this sampling location as adequately representative of expected discharge water quality. Sample results and supporting documentation are included as Appendix 7. Tables comparing the results to selected PWQO criteria are included in Appendix 8.

The sample from MW4 met all criteria when compared to the City of Barrie sewer use bylaw criteria for sanitary and combined sewer discharge. The sample from MW4 also met all criteria when compared to the City of Barrie sewer use bylaw criteria for storm sewer discharge.

The sample from MW4 met all PWQO criteria for which it was tested; however, the detection limits for certain parameters exceeded the corresponding PWQO criterium. These parameters included:

- Six polycyclic aromatic hydrocarbons, specifically anthracene, benzo(a)anthracene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and fluoranthene;
- Four metals, specifically cobalt, copper, silver, and zinc; and
- One pesticide, specifically hexachlorobenzene.

It is interpreted that the above-listed parameters are unlikely to represent contaminants of concern at the Site.

Confirmatory sampling to evaluate water quality (particularly with respect to PWQO criteria and/or other LSRCA requirements) should be completed once the dewatering system for the Site is in place.

5.7 Discharge Options

If discharge is planned to the sanitary sewer system, no treatment is anticipated; however, appropriate confirmatory samples and a discharge permit from the City of Barrie would be required.

If discharge is planned to the storm sewer system, no treatment is anticipated to meet City of Barrie discharge requirements; however, as Sophia Creek travels through the storm sewer system near the Site, Site-specific discharge requirements should be confirmed with the LSRCA. Comparison of groundwater sample results to selected PWQO criteria did not identify any exceedances (Appendix 8). Once Site-specific requirements are confirmed, and the dewatering and discharge system is in place, appropriate confirmatory samples should be collected to evaluate actual discharge water quality. A discharge permit from the City of Barrie would also be required.

6.0 HYDROGEOLOGICAL IMPACT ASSESSMENT

PGL assessed potential impacts to groundwater quality and quantity because of the proposed excavation dewatering work.

6.1 Groundwater Quantity

Impacts to groundwater quantity are expected to be largely restricted to the shallow materials (i.e., less than 1.5m deep) at the Site. These materials include fill, sand, gravelly sand, and the upper portion of the silty sand till to sandy silt till. This shallow system is unlikely to be used as a drinking water source locally.

Based on available mapping and cross-sections for the area (LSRCA, 2015)²⁰, the Site likely overlies Newmarket Till. Newmarket Till is interpreted to overlie the uppermost aquifer in the area, identified as Aquifer A1. Given that borehole logs from the Site identify till material extending upwards of 15m bgs, and dewatering activities will occur at much shallower depths (on the order of 1.5m bgs), substantive impacts to any underlying aquifers are not expected.

A water well search was conducted within 300m from the Site, which is greater than the anticipated zone of influence from either excavation or long-term dewatering. Twenty-three water well records were identified within 300m of the Site (Figure 3). None of the 23 wells are designated as groundwater drinking wells. It is expected that all properties within 300m of the Site are municipally serviced with drinking water.

Impacts to surface water features, notably Sophia Creek, may occur as a result of regrading and/or excavation dewatering activities at Site. While Sophia Creek runs through a culvert in the immediate vicinity of the Site, the creek is exposed approximately 40m west of the Site. This location is within the predicted zone of influence. Drawdown at this location is estimated to be on the order of 1.4m²¹; although it should be noted that this estimate may be heavily influenced by changes in subsurface materials and ground surface elevation. It is also unclear whether Sophia Creek is influenced by groundwater elevations in this area (i.e., the creek may be a perched feature separated from the water table).

Monitoring should be undertaken during dewatering activities at the Site to evaluate whether such activities are adversely affecting Sophia Creek. Mitigation measures (including discharge to the creek to help maintain flow) may be required.

No other environmentally sensitive receptors were identified within 300m of the Site.

6.2 Groundwater Quality

Excavation dewatering efforts at the Site are not expected to substantively degrade water quality at the Site and surrounding areas. This assumes that there is adequate capture of groundwater entering the excavation and that captured water is adequately treated and discharged in an appropriate manner.

²⁰ LSRCA (2015) *Approved Assessment Report: Lake Simcoe and Couchiching-Black River Source Protection Area [-] Part 1: Lake Simcoe Watershed*. Available online: <https://ourwatershed.ca/resources/reports-and-plans/assessment-reports/> [accessed October 12, 2022].

²¹ Calculated using the Dupuit-Forchheimer equation for horizontal unconfined flow and solving for drawdown 40m from the edge of the excavation.

Discharge to the storm sewer system, if required, is unlikely to adversely affect groundwater conditions at the Site. As discussed previously in Sections 5.6 and 5.7 of this report, such discharge may be held to more stringent standards (e.g., PWQO criteria) than are typical for most sites in the area (i.e., City of Barrie storm sewer discharge criteria).

PGL (2020B)²² previously completed a Phase 2 ESA for the Site. All collected samples met the applied Site Condition Standards except for:

- Fill material in the northern portion of the Site, which had elevated levels polycyclic aromatic hydrocarbons; and
- Groundwater in the southern portion of the Site, which had an elevated level of cadmium.

Such contamination could adversely affect water quality at the Site, if not properly managed. It is expected that remedial excavation work will be completed as part of Site redevelopment activities, and such efforts will help to reduce impacts to soil and groundwater.

6.3 Monitoring and Mitigation

With respect to potential impacts to groundwater quantity as a result of the proposed short-term dewatering, potential adverse affects largely relate to Sophia Creek, and in particular, nearby sections of the creek that are not contained within a culvert. Water levels in the creek should be monitored at regular intervals (i.e., weekly) both before and during the proposed dewatering. Water levels should be measured at an accessible point upstream of the Site (i.e., at the exposed portion of the creek approximately 150m west of the Site) and downstream (i.e., at the exposed section of the creek approximately 40m east of the Site). Specific details of this monitoring should be confirmed with the LSRCA and/or other regulatory parties.

With respect to potential impacts to water quality as a result of Site discharge, specific water quality monitoring requirements should be determined once the discharge methodology (e.g., to the storm sewer system or the sanitary system) is confirmed. Specific details of this monitoring should be confirmed with the LSRCA and/or other regulatory parties.

With respect to existing contamination at the Site, it is expected that remedial excavation work will be completed as part of Site redevelopment activities, and such efforts will help to reduce impacts to soil and groundwater. Contaminant management mitigation measures will involve removing excavated soil and groundwater and ensuring it is appropriately disposed of offsite in accordance with all relevant regulations. Efforts will also be made to ensure that any potential preferential pathways formed as part of the development process (e.g., gravel-filled infrastructure lines) are identified and addressed in accordance with best practices (e.g., use of low hydraulic conductivity barriers at set intervals within such features).

Assuming the remedial excavation work is successful in addressing existing contamination, the contaminant monitoring measures will consist of confirmatory sampling consistent with the requirements of Ontario Regulation 153/04 will be completed. As an alternative, a Risk Assessment, consistent with the requirements of Ontario Regulation 153/04, could be completed to address any contamination that is not adequately addressed through the remedial excavation work.

²² See footnote 4.

7.0 SUMMARY

The results of the HIA indicate the following for the Site:

- Dewatering activities at the Site will largely be restricted to shallow materials at the Site (roughly the upper 2m of the subsurface);
- The excavation dewatering rate was estimated at 45,000L/day. A rate of 225,000L/day (incorporating a 5X safety factor) is recommended for permitting purposes;
- Long-term dewatering will not be required as the proposed structures will be slab-on-grade;
- Groundwater quality results indicate that discharge would likely meet the City of Barrie criteria for discharge to the sanitary sewer system or the storm sewer system;
- An Environmental Activity and Sector Registry will likely be required for dewatering activities;
- Groundwater quality results did not exceed any PWQO standards for which the sample was tested (detection limits for certain parameters exceeded the corresponding standards);
- Dewatering activities may lower groundwater levels beneath exposed portions of Sophia Creek (i.e., sections not running through a culvert), and therefore, dewatering has the potential to reduce baseflow in the creek;
- Monitoring requirements to evaluate potential impacts to Sophia Creek should be confirmed with the LSRCA prior to dewatering activities; and
- No adverse effects to existing water users, local aquifers, or any other natural features are expected as a result of the proposed dewatering.

8.0 STATEMENT OF LIMITATIONS AND CONDITIONS FOR REPORT

8.1 Complete Report

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to PGL by the Client, communications between PGL and the Client, and any other reports, proposals or documents prepared by PGL for the Client relative to the specific site described herein, all of which together constitute the Report.

In order to properly understand the suggestions, recommendations and opinions expressed herein, reference must be made to the whole of the Report. **PGL is not responsible for use by any part of portions of the Report without reference to the whole report.**

8.2 Basis of Report

The Report has been prepared for the specific site and purposes that are set out in the contract between PGL and the Client. The findings, recommendations, suggestions, or opinions expressed in the Report are only applicable to the site and purposes in relation to which the Report is expressly provided, and then only to the extent that there has been no material alteration to or variation from the information provided or available to PGL.

8.3 Use of the Report

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may use or rely upon the Report or any portion thereof without PGL's written consent, and such use shall be on terms and conditions as PGL may expressly approve. Ownership in and copyright for the contents of the Report belong to PGL. Any use which a third party makes of the Report, is the sole responsibility of such third party. **PGL accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report.**

Respectfully submitted,

PGL ENVIRONMENTAL CONSULTANTS

Per:



Michael Howlett, M.Sc., M.B.A., P.Geo.
Hydrogeologist

A handwritten signature in blue ink, appearing to read "Christina Trotter".

Christina Trotter, M.Sc., P.Geo.
Senior Hydrogeologist

MRH/CET/neg/ncb/neg
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APPENDIX C

Excerpts of Phosphorous Budget Report

136 Bayfield Street and 14 Sophia Street West
Barrie, ON

Phosphorous Budget

PREPARED FOR:
Rockap Holdings Ltd.
701 St. Nicolas Court
Mississauga, ON L5H 4M5

PREPARED BY:
PGL Environmental Consultants
250 Water Street, Suite 102
Whitby, ON L1N 0G5

PGL File: 5689-02.02

October 2022 v4



solve and simplify

Executive Summary

PGL Environmental Consultants (PGL) conducted a Phosphorous Budget Assessment at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario (the Site) with respect to pre- and post-development Site conditions. The investigation was completed for Rockap Holdings Ltd.

Under the Lake Simcoe Protection Plan, a stormwater management plan must demonstrate how phosphorous loadings are minimized between pre-development and post-development Site conditions. PGL used the Ontario Ministry of the Environment, Conservation and Parks' database application Lake Simcoe Phosphorous Loading Development Tool Version 2 updated 30-March-2012 (MECP, 2012) to complete the phosphorous budget for the proposed development.

PGL assessed the pre-development, post-development, and construction phase phosphorus loading with best-management practices (BMPs) for the Site using the Phosphorus Loading Tool. The phosphorus loads were found to be 1.61kg/year, 1.17kg/year, and 0.22kg/year, respectively. This amounts to a 14% reduction in Phosphorus loading (Pre-Development – (Post-Development + Construction) = 0.22kg/year.

As outlined in the Lake Simcoe Phosphorus Offsetting Policy, any remaining phosphorus load that cannot be controlled would need to be offset to achieve the zero-export target. The proposed development does not include best-management practices or low impact design measures for phosphorus reduction. Therefore, the applicable Phosphorous Offsetting fees to Lake Simcoe Region Conservation Authority, based on the offset value of \$35,770/kg with an offset ratio of 2.5:1 and Phosphorous loading of 1.39kg/year, is \$124,300.75.

Phosphorus loading for the final development, and any associated offset payments, may change if the design changes and includes best-management practices for further phosphorous reduction.

This Executive Summary is subject to the same standard limitations as contained in the report and must be read in conjunction with the entire report.

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LIST OF APPENDICES

Appendix 1	Proposed Drainage Area Plan by TMIG Ltd., version date September 21, 2022.
Appendix 2	Drainage Areas – email from Caitlin Beaudoin of TMIG Ltd., June 7, 2021
Appendix 3	MECP, 2012 Phosphorus Budget Tool: Project Development Summary (October 11, 2022)
Appendix 4	Erosion and Sediment Control Plan by TMIG Ltd., version date September 21, 2022.

List of Acronyms

BMP	-	best management practice
LID	-	low impact development
LSPOP	-	Lake Simcoe Phosphorous Offsetting Policy
LSRCA	-	Lake Simcoe Region Conservation Authority
PGL	-	PGL Environmental Consultants
TMIG	-	The Municipal Infrastructure Group Ltd.

1.0 INTRODUCTION

Rockap Holdings Inc. retained PGL Environmental Consultants (PGL) to conduct a phosphorous budget assessment for the proposed residential development at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario (the Site). The investigation was conducted to estimate the phosphorous loads that would result from development of the Site.

As per the Lake Simcoe Phosphorous Offsetting Policy (LSPOP), all new development within the Lake Simcoe Region Conservation Authority (LSRCA) must control 100% of the phosphorous leaving from the development property (i.e., 0kg/year). This is also called the “Zero Export Target” by LSPOP that ensures redevelopment or new development activities within the LSRCA do not contribute phosphorous loading to Lake Simcoe. Stormwater phosphorus load that cannot be controlled requires an offset to achieve a net zero target. LSPOP implements an offset ratio of 2.5kg of phosphorus per year to be removed for every 1kg required to be offset with an offset value of \$35,770/kg/year.

1.1 Site Description

The Site is an 8,853m² property at the northwest corner of the intersection of Bayfield Street and Sophia Street West in Barrie, Ontario. The Site is improved with a five-storey commercial building on the northeast part, a two-storey commercial building on the southwest side, and large parking areas. The surrounding area is primarily commercial, with some multi-storey residential developments.

1.2 Proposed Development

The proposed development consists of a 12-storey condominium tower with two 9-storey and one 3-storey podium, and two 3-storey townhouses. There are no underground levels. Parking for the development is provided on Levels 1 to 3. Existing buildings will be removed as part of the development.

2.0 SCOPE OF WORK

To meet the objectives noted above, PGL:

1. Reviewed and evaluated the existing Site information, including:
 - a. The existing land use on the Site;
 - b. Proposed Drainage Area Plan by The Municipal Infrastructure Group Ltd. (TMIG), (Appendix 1); and
 - c. Controlled and uncontrolled runoff areas of the proposed development (email from Caitlin Beaudoin of TMIG, June 7, 2021; Appendix 2).
2. Conducted a phosphorous budget assessment with respect to current and proposed post-development Site conditions using the database application “Lake Simcoe Phosphorous Loading Development Tool (MECP, 2012).

3.0 PHOSPHORUS BUDGET

The purpose of the phosphorus budget is to evaluate the anticipated changes in phosphorus loadings between pre-development and post-development of a major development in the Lake Simcoe Region.

The Phosphorus Budget was completed using the Lake Simcoe Phosphorus Loading Development Tool (MECP, 2012). The results of the tool are shown in Appendix 3.

3.1 Pre-Development Phosphorus Load

The Site has a total area of 0.8853ha (8,853m²). For the purposes of using the Phosphorus Loading Tool, the Site is entirely high-intensity commercial development. PGL is not aware of any best-management practices (BMPs) or low-impact development measures at the existing Site.

Using the above area and assumptions, the Phosphorus Loading Tool (MECP, 2012) calculated the total pre-development phosphorus load to be **1.61kg/year** (see Appendix 3).

3.2 Post-Development Phosphorus Load and Best Management Practices

According to information received from TMIG Ltd., architects, the post-development Site will consist of 8,028m² of impervious surfaces and 825m² of pervious surfaces. Per LSRCA comments dated September 6, 2022, the full area of the Site is to be considered high-intensity residential development. .

A stormwater management vault (tank dimensions 15.2m x 5.3m x 3.65m) is proposed to be installed at the southwest corner of the Site on the first level of the building. The design identifies an active storage volume of 231m³ and dead storage volume of 25m³ with a controlled outlet rate of 49.38L/s from the tank to the storm service¹. The tank is to receive roof (rain) water only. Therefore, it will not be permitted to have any phosphorous reduction efficiency and is not included in the calculations.

PGL understands best management practices (BMPs) and/or low impact development (LID) measures are not proposed for the development due to insufficient space to incorporate into the design. Therefore, BMPs/LIDs have not been included in this analysis.

Using the above areas and assumptions, the Phosphorus Loading Tool (MECP, 2012) calculated the total post-development phosphorus load to be **1.17kg/year** (see Appendix 3).

3.3 Construction Phase Phosphorus Load

The Phosphorus Loading Tool (MECP, 2012) also considers the phosphorus load contributed by the construction phase of a new development. From the Erosion and Sediment Control Plan² (Appendix 4) the following erosion control measures will be implemented during construction.

¹ Functional Servicing and Stormwater Management Report (version 4), October 2022, TGIM

² Erosion and Sediment Control Plan (E1), September 2022, TMIG

These are:

- Installing construction hoarding with silt fencing along the perimeter of the property line to ensure that sediment does not migrate offsite;
- Stockpiles left inactive more than 30days will be stabilized with hydroseed and perimeter silt fence will be installed;
- Installing sediment control (inlet sediment control) on all new and existing manholes and catch basins until decommissioned / removed or at the conclusion of construction works;
- Installing sediment control (inlet sediment control) on existing manholes and catch basins in the adjacent roadways; and
- Installing a mud mat at the construction entrance of the Site, from Maple Avenue, to reduce mud tracking and sediment leaving the Site via construction traffic.

We used the following input parameters related to the Site:

- Soil type can be classified as a sandy loam, based on available borehole logs from PGL and V.A. Wood Associates Ltd which show silty across the Site;
- The Site slopes about 3% down to the south towards Sophia Street West over 120m;
- The Site can be considered as two areas:
 - o **Unrestricted** – parts of the Site, and the west, south and east boundaries, where water could flow overland off the Site. This area is equal to 1,931m² and will be managed using silt fences; and
 - o **Restricted** – parts of the Site where water flows to catch basins. This area is equal to 6,922m² and will be managed using inlet protection measured (i.e., silt sacks);
- The total construction period will be 24 months, and soil will be exposed for eight of these months.

Inputting these values in the Phosphorus Loading Tool results in a Construction Phosphorus load of 1.79kg with BMPs and a load of 5.82kg without BMPs. The construction phase temporary phosphorus load is amortized over eight years before being included in the Development Summary calculations. The Phosphorus Loading Tool (MECP, 2012) concluded that the construction phase contributed a total of **0.22kg/year** to the total post-development phosphorus load. The total post-development phosphorus load leaving site is **1.39kg/year**.

Table 1 - Phosphorus Loads

	Total Phosphorous (kg/year)
Pre-Development	1.61
Post Development	1.17
Construction - Post Development (no BMPs)	5.82
Construction - Post Development (with BMPs)	1.79
Ammortized Construction (with BMPs)	0.22
Total Phosphorous	1.39

Calculations are in Appendix 3.

4.0 CONCLUSIONS

PGL evaluated the Phosphorous Budget for the proposed development. Although there is a reduction in Phosphorous loading, any remaining phosphorus load that cannot be controlled would need to be offset to achieve the net zero target (0kg/year of Phosphorous leaving Site). The required fee for the proposed development is:

$$\text{LSPOP Fee} = \$35,770 \times 2.5 \text{ ratio} \times \text{Phosphorous Load}$$

For this Site, the post-development Phosphorus load is **1.39kg/year**, resulting in a calculated offset value of **\$124,300.75**. A one-time fee, to be paid to the LSRCA to support offsite phosphorus reduction activities.

5.0 STATEMENT OF LIMITATIONS AND CONDITIONS FOR REPORT

5.1 Complete Report

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to PGL by the Client, communications between PGL and the Client, and any other reports, proposals or documents prepared by PGL for the Client relative to the specific site described herein, all of which together constitute the Report.

In order to properly understand the suggestions, recommendations and opinions expressed herein, reference must be made to the whole of the Report. **PGL is not responsible for use by any part of portions of the Report without reference to the whole report.**

5.2 Basis of Report

The Report has been prepared for the specific site and purposes that are set out in the contract between PGL and the Client. The findings, recommendations, suggestions, or opinions expressed in the Report are only applicable to the site and purposes in relation to which the Report is expressly provided, and then only to the extent that there has been no material alteration to or variation from the information provided or available to PGL.

5.3 Use of the Report

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. No other party may use or rely upon the Report or any portion thereof without PGL's written consent, and such use shall be on terms and conditions as PGL may expressly approve. Ownership in and copyright for the contents of the Report belong to PGL. Any use which a third party makes of the Report, is the sole responsibility of such third party. **PGL accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report.**

We trust this meets your needs. If you have any questions or require clarification, please contact Salima Jaffer at 905-430-5502.

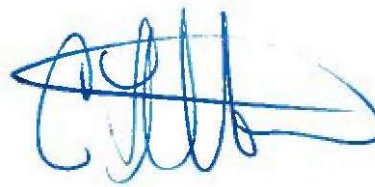
Respectfully submitted,

PGL ENVIRONMENTAL CONSULTANTS

Per:



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SAJ/CET/ncb
\\PGLONFILE1\ON Project Files\5600-5699\5689 - Rockap Holdings Inc\02-02_Client Docs\Phosphorous Budget\5689-02-02-Phosphorous Budget-v4.doc

References

LSRCA. (2021) *Phosphorus Offsetting Policy*. Lake Simcoe Region Conservation Authority, July 2021.

Hutchison. (2012). *Phosphorus Budget Tool in Support of Sustainable Development for the Lake Simcoe Watershed, prepared for the Ontario Ministry of Environment*, Hutchison Environmental Sciences Ltd., version 2, March 2012.

APPENDIX D

Excerpts of Water Balance Report

136 Bayfield Street and 14 Sophia Street West
Barrie, ON

Water Balance Study

PREPARED FOR:
Rockap Holdings Inc.
701 St. Nicolas Court
Mississauga, ON L5H 4M5

PREPARED BY:
PGL Environmental Consultants
250 Water Street, Unit 102
Whitby, ON L1N 0G5

PGL File: 5689-02.02

October 2022 v4



solve and simplify

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Appendix 2 Site Plan by TMIG Ltd.
Appendix 3 Pervious and Impervious Land Cover Areas provided by TMIG Ltd.
Appendix 4 LSRCA Regulated Area
Appendix 5 Water Balance Calculations

List of Acronyms

bgs	-	below ground surface
IF	-	infiltration factor
LID	-	low-impact development
LSRCA	-	Lake Simcoe Region Conservation Authority
MECP	-	Ministry of the Environment, Conservation and Parks
PGL	-	PGL Environmental Consultants

1.0 INTRODUCTION

Rockap Holdings Inc. retained PGL Environmental Consultants Limited (PGL) to conduct a Water Balance Study for the proposed development at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario (the Site; Figure 1). This Water Balance Study was conducted to assess the hydrologic conditions at the Site both prior to and following the proposed development to evaluate the changes to infiltration and runoff.

The proposed development consists of a 12-storey condominium tower, with two 9-storey and one 3-storey podium, and two 3-storey townhouse blocks. There are no underground levels. Current commercial buildings exist at the Site and will be removed as part of Site redevelopment. Development will also include landscaping and paved features at the Site.

Several previous investigations have been completed at the Site, including a geotechnical investigation by V.A. Wood Associates Ltd., which included advancing five boreholes across the Site and completing them as monitoring wells. PGL has also completed separate hydrogeological and environmental investigations at the Site.

2.0 SCOPE OF WORK

PGL reviewed the following documents for this Water Balance Study:

- *Preliminary Geotechnical Investigation, by V.A. Wood Associates Limited*, dated October 2022. Particle Size analysis results are included as Appendix 1;
- *Proposed Drainage Area Plan, by The Municipal Infrastructure Group Ltd (TMIG Ltd)*, version date September 21, 2022 (Appendix 2); and
- *Pervious and impervious land cover areas provided by TMIG Ltd*, June 7, 2021 (Appendix 3).

We also reviewed available Ministry of the Environment, Conservation and Parks (MECP) well records and Ministry of Natural Resources and Forestry Heritage maps.

3.0 SITE BACKGROUND

3.1 Site Location

The Site is a rectangular property on the northwest corner of Bayfield Street and Sophia Street West. It is bounded to the west by Maple View Drive, to the north by a commercial property, to the east by Bayfield Street, and to the south by Sophia Street West.

The Site is improved with a five-storey commercial building on the northeast side, and a two-storey commercial building on the southwest side. Most of the remaining Site area is asphalt-covered for parking. The surrounding area is a mix of commercial and residential uses.

3.2 Physical Setting

The 8,853m² Site is improved with two commercial buildings and surface parking. The Site and area slope south to southeast towards Lake Simcoe, which is about 665m southeast of the Site. Sophia Creek flows westwards in a concrete culvert within the road allowance of Sophia Street West. The creek is daylighted in sections about 300m east of the Site, about 40m west of the Site, and about 250m southwest of the Site.

The Town of Barrie Official Plan Schedule H shows a Natural Heritage Area at the southern part of the Site. The southern part of the Site is classified as 'Level 1 with Existing Development'.

Based on a review of the Lake Simcoe and Couchiching/Black River Source Protection Plan the Site is within a Significant Groundwater Recharge Area (SGRA) and Highly Vulnerable Aquifer Area (HVAA). As such, it is subject to Designated Policy 6.40 of the Lower Simcoe Protection Plan (LSPP) and may be subject to compensation fees if development activities reduce recharge at the Site relative to pre-development conditions.

The southern part of the Site is regulated by the Lake Simcoe Region Conservation Authority (LSRCA), as shown in Appendix 4; therefore, a development permit application will be required.

No further Natural Resources Heritage Sites, Area of Natural and Scientific Research sites, Oak Ridges Moraine, Niagara Escarpment or Environmentally Sensitive areas were identified within 250m of the Site.

Geological maps show the surficial soils near the Site are expected to comprise glaciofluvial ice deposits consisting of gravel and sand, minor till including esker, kame, end moraine and ice-marginal delta, and subaqueous fan deposits (OGS, 2000). Overburden at the Site is underlain by Shadow Lake Formation bedrock consisting of limestone, dolostone, shale, arkose, and sandstone (OGS, 2010). Bedrock is expected to be at a depth of greater than 88.4m based on review of the MECP well records.

Per the geotechnical report provided by V.A. Wood, boreholes were extended to a maximum depth of 15.6m below ground surface (bgs). Soil stratigraphy was observed to include asphalt, gravelly sand, sand till, silt till followed by silt. Particle size analysis results are included as Appendix 1.

A hydrogeological report by PGL (submitted under separate cover) found that springtime water levels at the Site were generally between 0.88m and 2.11m bgs. Groundwater elevation data suggests that local groundwater flow is to the southeast towards Lake Simcoe.

4.0 WATER BALANCE ASSESSMENT

PGL completed water balance calculations for the pre-development conditions compared with a post-development scenario. TGMI confirmed on June 7, 2021, that low-impact development (LID) measures, such as permeable pavements, infiltration trenches, etc., are not being included in the development. This is largely due to the presence of a high water table at the Site (i.e., groundwater within 1m of the surface), which limits the effectiveness of many LID measures.

A stormwater management vault (tank dimensions 15.2m x 5.3m x 3.65m) is proposed to be installed at the southwest corner of the Site on the first level of the building. The design identifies an active storage volume of 231m³ and dead storage volume of 25m³ with a controlled outlet rate of 49.38L/s from the tank to the storm service¹. The tank is to receive roof (rain) water only. It is not an LID.

¹ Functional Servicing and Stormwater Management Report (version 4), October 2022, TGMI

The water balance calculations are included as Appendix 5.

4.1 Pre-Development Conditions

The Site is currently developed. PGL measured a total of 755m² of pervious cover at the Site, and 8,098m² of impervious cover. PGL is not aware of any LID measures at the existing Site.

4.2 Proposed Development

The proposed development includes a 12-storey condominium tower, with two 9-storey and one 3-storey podium, and two 3-storey townhouse blocks. There are no underground levels. Development will also include landscaping and paved features at the Site.

Information received from TMIG Ltd. (Appendix 3) indicates that the developed Site will consist of a total of 8,028m² of impervious cover (parking lots, buildings, sidewalks) and 825m² pervious cover (gardens, landscaping).

4.3 Water Balance Methodology

The annual water budget represents the hydrologic cycle, and can be stated as:

$$\text{Flow in} - \text{flow out} = \text{Change in groundwater storage } (\Delta S)$$

Using long-term estimates or averages for precipitation, evapotranspiration, runoff, and infiltration, there is little to no annual groundwater storage net change on the Site in steady-state conditions. As such, we have assumed ΔS is zero. The flow-in accounts for precipitation (e.g., rain, snow). The flow out considers water runoff to lakes and streams, infiltration to the groundwater table, and evaporation from surface water or vegetation. Groundwater flow into and out of the Site is assumed to balance and is not included in the calculation.

$$P - ET - R - I = \Delta S$$

Where:

- P = Precipitation (mm/year)
- ET = Evapotranspiration (mm/year)
- R = Runoff (mm/year)
- I = Infiltration (mm/year)
- ΔS = Change in groundwater storage annually (mm/year)

The Site water balance was calculated for pre- and post-development to determine the change in runoff and infiltration after development. The Site-level water balance calculations are provided in Appendix 5.

4.4 Climate, Precipitation and Evapotranspiration

Climate data was obtained from the MECP historical climate records and available LSRCA information.

Precipitation data was gathered from the Government of Canada historical climate data. Barrie WPCC, about 1.8km from the Site, was the nearest station with available climate data over a significant period. The provided value for 1981 to 2010 Climate normals was used for pre- and post-development infiltration, which was equal to **933mm/year**.

Evapotranspiration was calculated using the Thornthwaite-Mather method based on available climate data from Barrie WPCC from 1981 to 2010. The calculated evapotranspiration rate was 556mm/year. A previous report prepared for the LSRCA (AquaResource Inc., 2012) shows simulated evapotranspiration rates in the area of 400–500mm/year. This simulated value is likely lower due to the presence of impervious surfaces in the area, and therefore 565mm/year is considered a reasonable approximation of evapotranspiration on pervious surfaces. Pre- and post-development evapotranspiration rates on pervious areas was therefore equal to **556mm/year**.

Evapotranspiration on impervious areas was assumed to be equal to 10% of precipitation (i.e., 93mm/year). As there is no infiltration on impervious areas, the surplus and runoff in these areas are both equal to 840mm/year.

Based on the above data, there is a water surplus at the Site, as annual precipitation exceeds annual evapotranspiration. The surplus for the Site is calculated as precipitation minus evapotranspiration, which is equal to **377mm/year for pervious areas**. This value applied to pre- and post-development conditions at the Site.

4.5 Infiltration and Runoff

4.5.1 Infiltration Factors

Based on the above water budget equation, the surplus water equals the combined infiltration and runoff components. The infiltration factor (IF) was calculated for pervious areas pre- and post-development based on the topography, soil type, and land cover, as per the MECP's Stormwater Management Planning and Design Manual (2003). The calculations are presented in Appendix 5.

The pre-development IF was calculated based on the following factors:

- Topography at the Site is steep, hilly land;
- Borehole logs and grain-size distribution curves for the Site show mostly sand and sandy silt; and
- Land cover is cultivated land.

The pre-development IF is therefore equal to 0.5.

The post-development IF was calculated based on the following factors:

- Topography at the Site will remain steep;
- Borehole logs and grain-size distribution curves for the Site show mostly sand and sandy silt; and
- Land cover will be cultivated land.

The post-development IF is therefore equal to 0.5.

4.5.2 Pre-Development Infiltration and Runoff

Runoff was calculated as follows:

$$R \text{ (pervious)} = S * (1 - IF) * \text{area} = 377\text{mm/year} * (1 - 0.5) * 755\text{m}^2 * (1\text{m}/1,000\text{mm}) = 142\text{m}^3/\text{year}$$

$$R \text{ (impervious)} = S * \text{area} = 840\text{mm/year} * 8,098\text{m}^2 * (1\text{m}/1,000\text{mm}) = 6,799\text{m}^3/\text{year}$$

$$R \text{ (total)} = 142\text{m}^3/\text{year} + 6,802\text{m}^3/\text{year} = 6,941\text{m}^3/\text{year}$$

Infiltration was calculated as follows:

$$I = S * IF * \text{area} = 377\text{mm/year} * 0.5 * 755\text{m}^2 * (1\text{m}/1,000\text{mm}) = 142\text{m}^3/\text{year}$$

Therefore, total pre-development runoff and infiltration volumes are 6,941m³/year and 142m³/year, respectively.

4.5.3 Post-Development

The post-development drainage conditions were broken down by TMIG Ltd. into the following four areas (Appendix 3):

Runoff Location	Area (m ²)		
	Total	Impervious	Pervious
Bayfield (Unrestricted)	507	336	171
Sophia (Unrestricted)	640	512	128
Maple (Unrestricted)	784	258	526
Maple (Restricted to tank)	6,922	6,922	0

PGL calculated the runoff and infiltration volumes from each of these areas using the same methods as the pre-development conditions.

Based on the above calculations, the post-development runoff and infiltration volumes at the Site were calculated as 6,524m³/year and 263m³/year, respectively.

4.5.4 Net Changes in Infiltration and Runoff

The following tables summarize the change in runoff and infiltration volumes from the pre-development and post-development scenario.

Table A: Annual Pre-Development Water Balance

Drainage Area	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Runoff (m ³)	Infiltration (m ³)
Entire Site	8,853	8,259	1,175	6,941	142
TOTAL	8,853	8,259	1,175	6,941	142

Table B: Annual Post-Development Water Balance

Drainage Area	Area (m ²)	Precipitation (m ³)	Evapotranspiration (m ³)	Runoff (m ³)	Infiltration (m ³)
Bayfield (Unrestricted)	507	473	126	314	32
Sophia (Unrestricted)	640	597	119	454	24
Maple (Unrestricted)	784	731	317	316	99
Maple (Restricted to tank)	6,922	6,458	646	5,812	0
TOTAL	8,853	8,259	1,208	6,896	155

Table C: Comparison of Pre-Development and Post-Development Water Balance

Development Stage	Precipitation (m ³)	Evapotranspiration (m ³)	Runoff Volume (m ³)	Infiltration Volume (m ³)
Pre-development	8,259	1,175	6,941	142
Post-development	8,259	1,472	6,896	156
Change from pre- to post-development			- 46	+ 13
%			- 0.7%	+9.3 %

5.0 CONCLUSIONS

PGL completed a water balance assessment for the proposed development at 136 Bayfield Street and 14 Sophia Street West, Barrie, Ontario. The assessment was completed according to LSRCA and Toronto and Region Conservation Authority guidelines. The assessment compared pre-development and post-development conditions to estimate changes in infiltration and runoff due to the proposed development with no inclusion of LID measures.

After development, we anticipate that there will be a 0.7% decrease in average annual runoff from the Site (-46m³/year) and an 9.3% increase in infiltration (+13m³/year). The decrease in runoff and increase in infiltration were due to the addition of more pervious surfaces at the Site.

Based on the calculated infiltration volumes, PGL does not anticipate any net loss of infiltration at the Site due to the proposed development.

If the development plan changes or any of the assumptions stated in this report are otherwise violated, re-evaluation of the water balance calculations will be required.

6.0 STATEMENT OF LIMITATIONS AND CONDITIONS FOR REPORT

6.1 Complete Report

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to PGL by the Client, communications between PGL and the Client, and any other reports, proposals or documents prepared by PGL for the Client relative to the specific site described herein, all of which together constitute the Report.

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We trust this meets your needs. If you have any questions or require clarification, please contact Salima Jaffer at 905-430-5502.

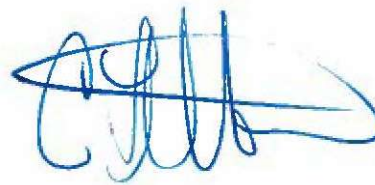
Respectfully submitted,

PGL ENVIRONMENTAL CONSULTANTS

Per:



Salima Jaffer, B.Sc.
Environmental Consultant



Christina Trotter, M.Sc., P.Geo.
Senior Hydrogeologist

APPENDIX E

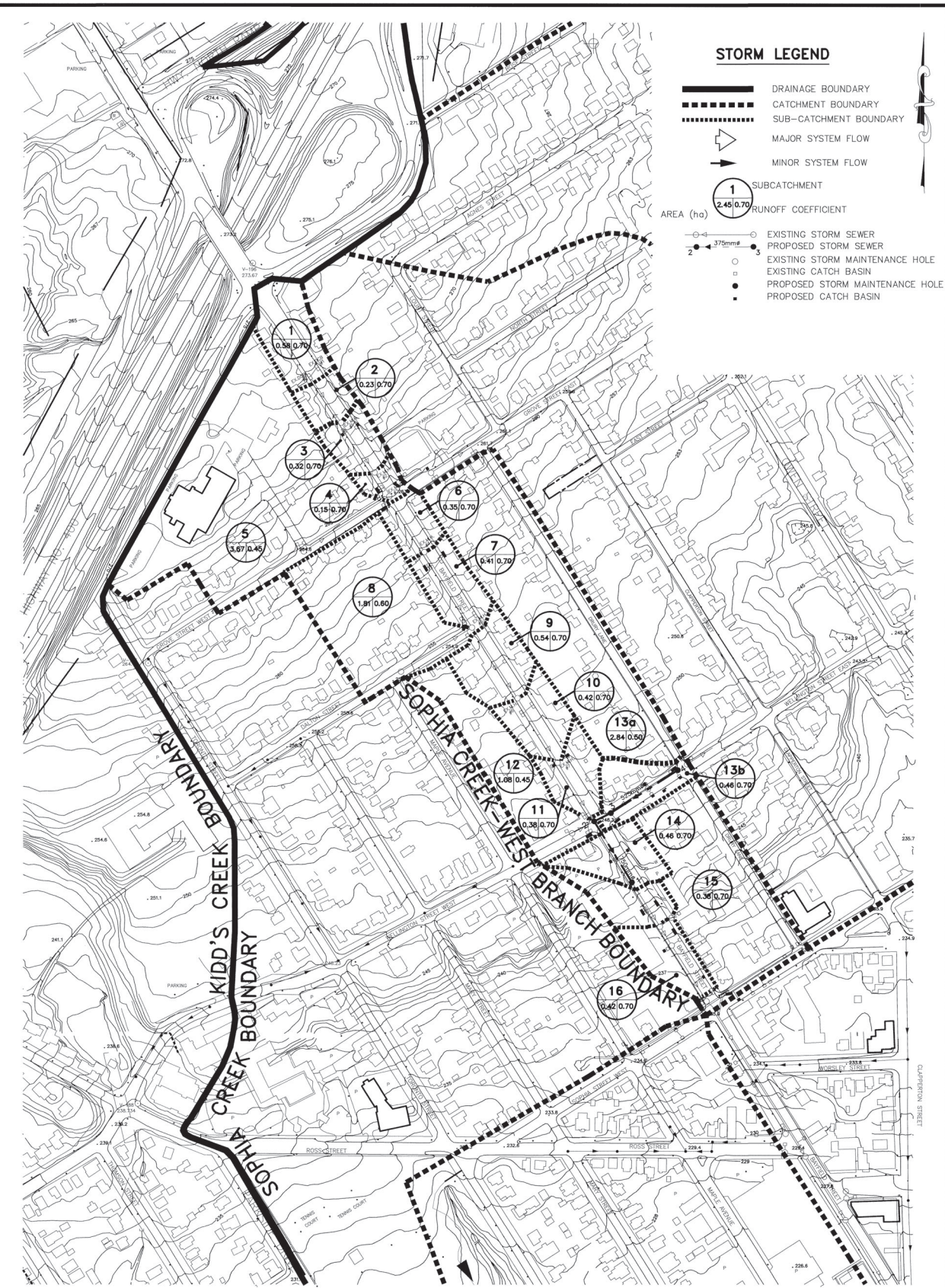
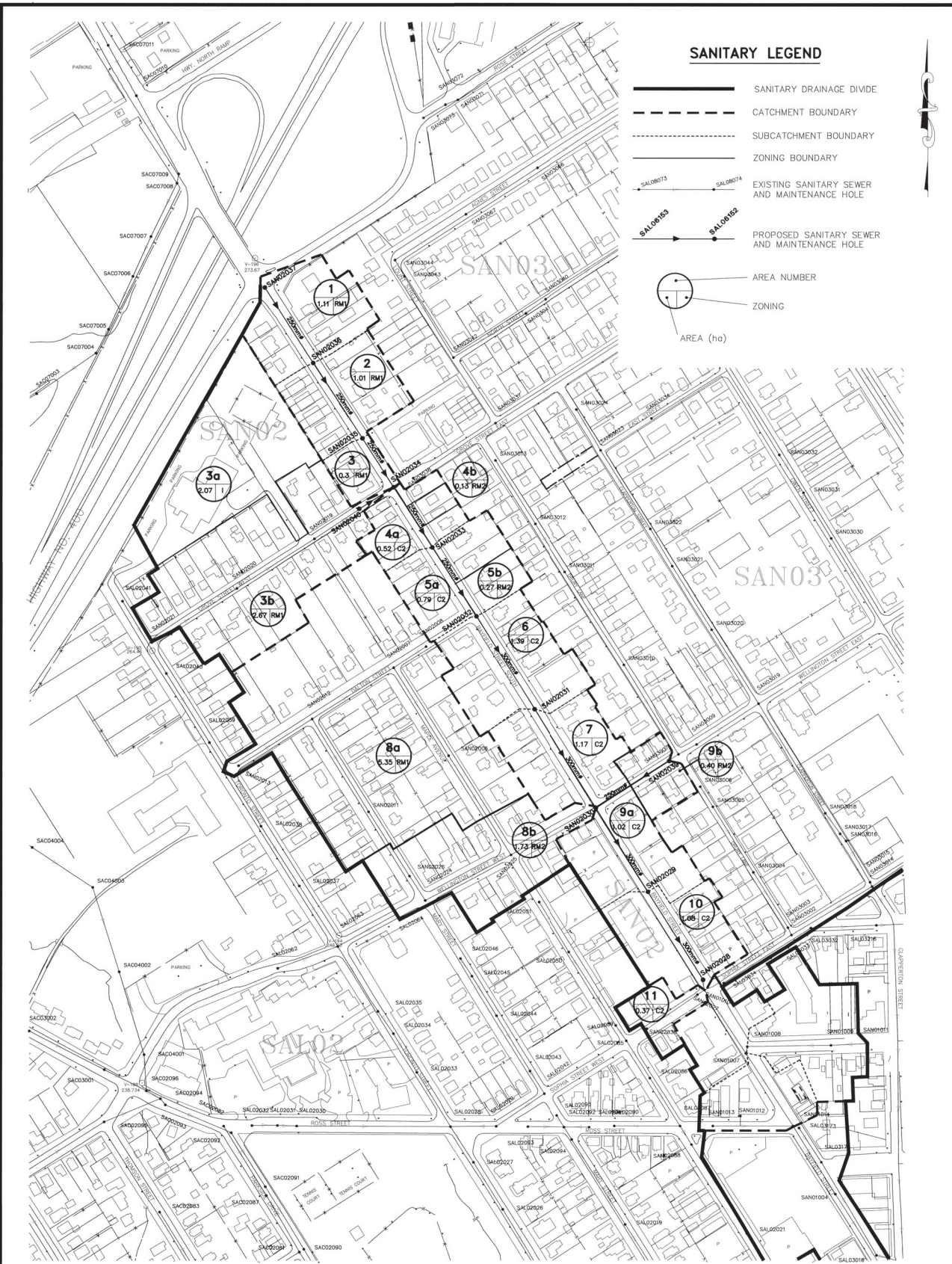
Sanitary Design Calculations

Project Name: 136 BAYFIELD		
Project #: 19501		Prepared by: C.B.
Date: April 2022		Checked by: B.D.

					EXISTING CONDITIONS	PROPOSED RESIDENTIA	PROPOSED COMMERCIAL
Residential	Unit Type	Apartment	Persons/unit:	1.67		292	
		Townhouse	Persons/unit:	2.34		8	
		Low Density	Persons/unit:	3.13	1		
	Population			3	506	0	
	Average Daily Flow (Lpcd)			225	225	225	
Average Flow (L/s)			0.01	1.3	0.0		
Retail	Gross Floor Area (m ²)					477	
	Population Equivalent Density (per 100m ²)					1.1	
	Population Equivalent					5	
Office	Gross Floor Area (m ²)			5,956			
	Population Equivalent Density (per 100m ²)			3.3			
	Population Equivalent			197			
	Total Population Equivalent			197	0	5	
Per Capita Flow (Lpcd)			225	225	225		
Average Flow (L/s)			0.51	0.00	0.01		
Total Building	Total Average Flow (L/s)			0.52	1.32	0.01	
	Peaking Factor			4.15	3.97	4.44	
	Residential Peak Flow (L/s)			2.16	5.24	0.06	
Wet-Weather	Site Area (m ²)			8,860		8,860	
	Infiltration Allowance (L/ha/s)			0.1	0.1	0.1	
	Infiltration Flow (L/s)			0.09	0.00	0.09	
TOTAL DESIGN FLOW (L/s)			2.25	5.24	0.15		

Service Connection	Design Flow (L/s)	Diameter (m)	Slope (%)	Velocity (m/s)	Capacity (L/s)	Total Usage (%)
Residential	5.24	150	2.00	1.22	21.54	24.3
Commercial	0.15	150	2.00	1.22	21.54	0.7

From	To	Additional Site Flow (L/s)	Diameter (m)	Slope (%)	Velocity (m/s)	Capacity (L/s)	Percent Usage (%)
MH 02029	MH 02028	5.39	300	5.00	3.06	216.2	2.5
MH 02028	MH 01010	5.39	250	16.85	4.97	244.1	2.2
MH 01010		5.39	600	3.08	3.81	1077.6	0.5



GENERAL NOTES

MONUMENT # 84U119
232.450 - DEEP BM IN 0.2m DIA. MH. IN QUEEN'S PARK NEAR INTERSECTION OF TORONTO & ROSS STREET; 10.8m SOUTH OF SOUTH EDGE OF SOUTH SIDEWALK ON ROSS STREET; 44m FROM NORTHEAST CORNER OF SIDEWALK INTERSECTION AT ROSS & TORONTO STREET.

BEARINGS ARE UTM GRID BEARINGS AND ARE REFERRED TO THE CENTRAL MERIDIAN IN ZONE 17 (NAD27) AND ARE DERIVED FROM OBSERVATIONS ON MNR CONTROL MONUMENTS 001673109 (N=4915476.882, E=604467.616) AND 010860477 (N=4916740.176, E=603674.365).

DISTANCES SHOWN HEREON ARE GROUND DISTANCES AND CAN BE CONVERTED TO GRID DISTANCES BY MULTIPLYING BY THE COMBINED SCALE FACTOR OF 0.999694.

NO.	REVISIONS	DATE	APPROVED

CITY OF BARRIE
APPROVED

DATE: *Mar. 14, 2002*

R. W. McArthur, P. Eng.
DIRECTOR OF MUNICIPAL WORKS

LICENSED PROFESSIONAL ENGINEER
R. J. FORWARD
March 14, 2002
PROVINCE OF ONTARIO

BAYFIELD STREET
RESURFACING AND INTERSECTION
IMPROVEMENTS

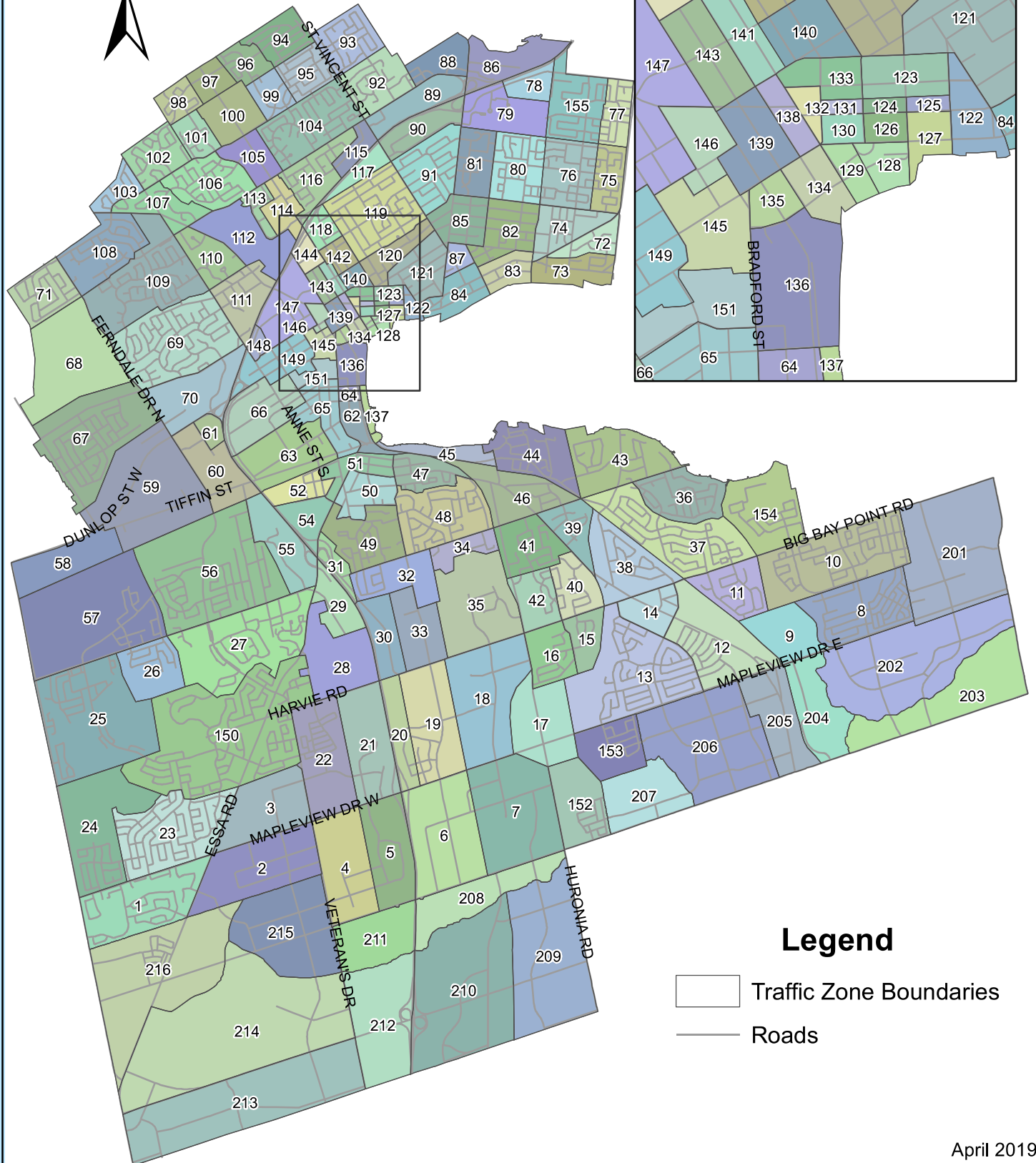
SANITARY AND STORM DRAINAGE PLAN

CITY OF BARRIE
MUNICIPAL WORKS DEPARTMENT

SCALE HOR. 1:2500 VERT. ---
DESIGN M.D.N./A.J.S. DRAWN M.D.N.
REVIEWED R.J.F. DATE 2002.02.15

DRAWING NO. 2002-02
SHEET NO. SANSTM

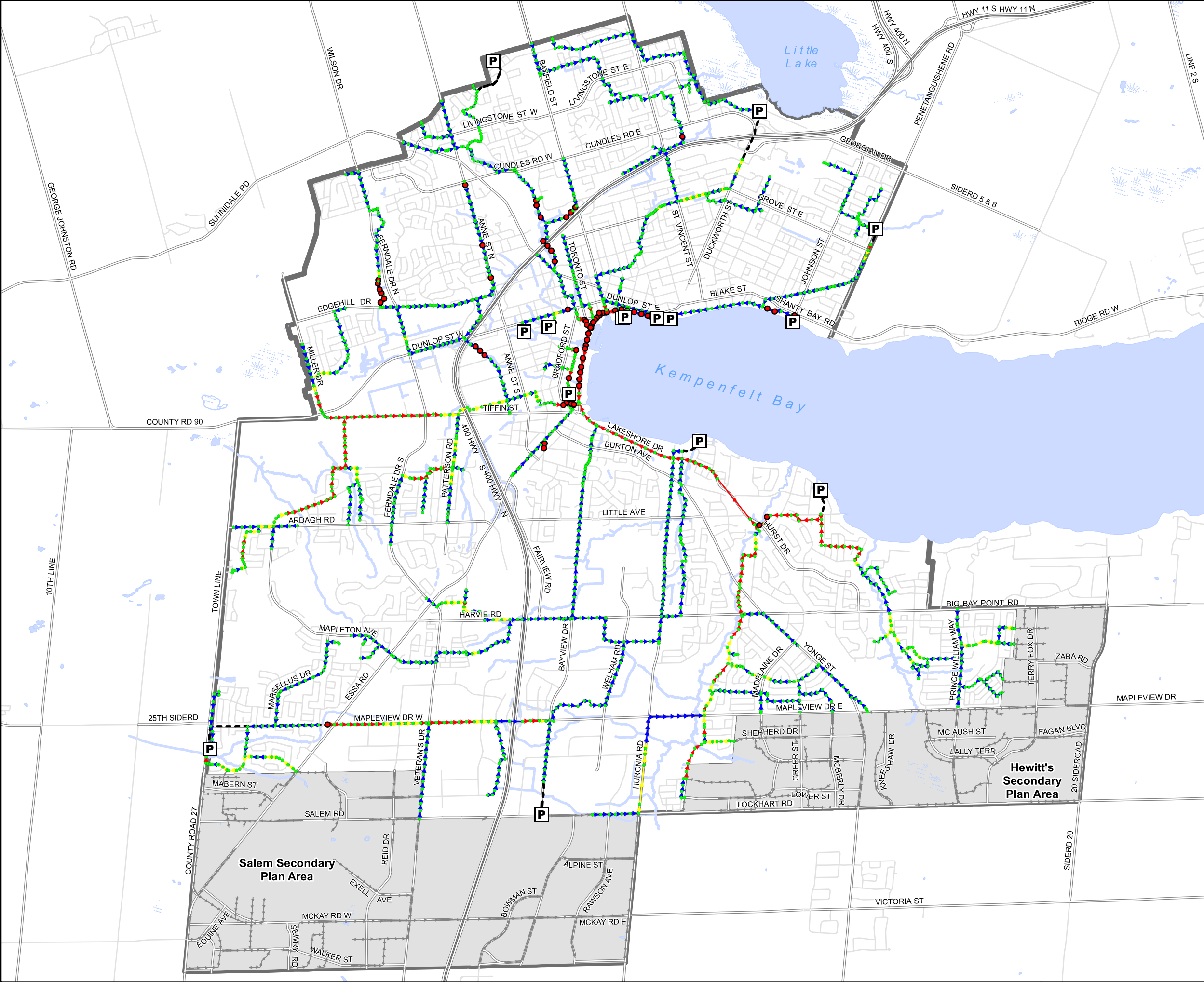
Population and Employment Projection - Traffic Zones



2041 Employment							
Traffic Zone	Primary	Industrial	Commercial	Institutional	Work at Home	No Fixed Place of Work	Total
87	0	4	0	25	8	16	53
88	0	6	6	0	7	14	33
89	0	13	761	859	0	0	1,633
90	0	308	525	505	9	19	1,366
91	0	25	177	170	61	127	560
92	0	3	77	150	48	93	371
93	0	8	6	0	58	119	191
94	0	0	7	55	49	96	207
95	0	4	30	12	57	113	216
96	0	4	12	1	26	49	92
97	0	60	909	60	2	3	1,034
98	0	0	107	46	24	49	226
99	0	0	16	66	28	58	168
100	0	123	3,430	229	27	52	3,861
101	0	0	1	0	46	88	135
102	0	6	8	98	55	109	276
103	0	1	6	2	25	54	88
104	1	25	9	58	112	226	431
105	0	63	989	117	30	59	1,258
106	0	2	40	177	80	157	456
107	0	10	81	129	43	85	348
108	0	14	19	47	87	171	338
109	0	4	104	60	120	244	532
110	0	0	6	89	20	38	153
111	0	0	32	5	46	93	176
112	0	0	0	0	0	0	0
113	0	6	11	1	31	65	114
114	0	12	1,353	203	20	40	1,628
115	0	6	318	516	8	17	865
116	0	13	39	33	61	120	266
117	6	49	137	5	0	0	197
118	0	1	9	61	19	38	128
119	0	4	24	216	87	183	514
120	0	4	118	56	46	93	317
121	0	5	75	3	69	134	286
122	0	0	149	36	25	52	262
123	0	0	116	931	22	46	1,115
124	0	0	106	995	0	0	1,101
125	0	0	74	2	0	0	76
126	3	117	486	102	12	23	743
127	0	4	371	89	21	42	527
128	0	21	180	20	1	2	224
129	0	0	258	3	11	22	294
130	0	42	679	20	3	5	749
131	0	4	219	0	0	0	223
132	0	7	304	7	2	5	325
133	0	15	262	187	31	60	555
134	0	116	276	13	19	37	461
135	0	5	70	640	27	54	796
136	0	31	396	122	122	244	915
137	0	0	0	0	0	0	0
138	0	11	236	13	8	17	285
139	4	20	600	220	17	34	895
140	0	4	18	71	14	28	135
141	0	18	377	76	23	46	540
142	0	8	29	14	16	31	98
143	0	2	36	25	11	19	93
144	0	0	152	30	72	144	398
145	0	8	130	306	18	33	495
146	0	5	0	5	2	4	16
147	0	33	323	674	47	91	1,168
148	0	7	236	23	1	2	269
149	0	34	312	20	51	101	518
150	0	52	602	308	318	641	1,921
151	0	58	1,292	265	5	11	1,631
152	0	52	22	10	36	69	189
153	0	8	0	94	32	67	201
154	0	0	11	105	48	98	262
155	0	82	151	303	79	161	776
201	0	0	35	243	219	437	934
202	0	0	91	153	235	469	948
203	0	0	61	77	78	157	373
204	0	0	0	0	82	164	246
205	0	0	1,287	97	152	303	1,839
206	0	0	53	148	250	500	951
207	0	0	47	78	87	174	386
208	0	286	190	70	0	0	546
209	0	722	481	178	0	1	1,382
210	0	1,465	979	364	0	1	2,809
211	0	282	173	59	0	1	515
212	0	1,034	544	154	0	0	1,732
213	0	0	300	378	265	530	1,473
214	0	53	113	477	210	420	1,273
215	0	1,276	672	188	0	0	2,136
216	0	6	201	80	204	408	899
Total	45	23,565	50,337	28,509	8,832	17,710	128,998

Traffic Zone	Population 2041 (Including Undercount)				Medium Density				High Density				Total Households				Population 2046 (Including Undercount)				Medium Density				High Density				Total Households				Population 2051 (Including Undercount)				Medium Density				High Density				Total Households																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total	Low Density	Medium Density	High Density	Total																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Figure 8-6
Existing Barrie Wastewater
Collection System Performance
with 2041 Wet Weather
Conditions (25-Year Storm)



- P** Pumping Stations
- Forcemain
- Secondary Plan Boundaries
- City of Barrie Limits
- Future Annexed Lands Sewers
- Freeboard (m)**
- ≤ 1.8m
 - > 1.8m
- Peak Conduit Depth Ratio (d/D)**
- < 0.5
 - 0.5 - 0.7
 - > 0.7

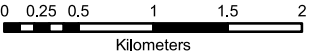
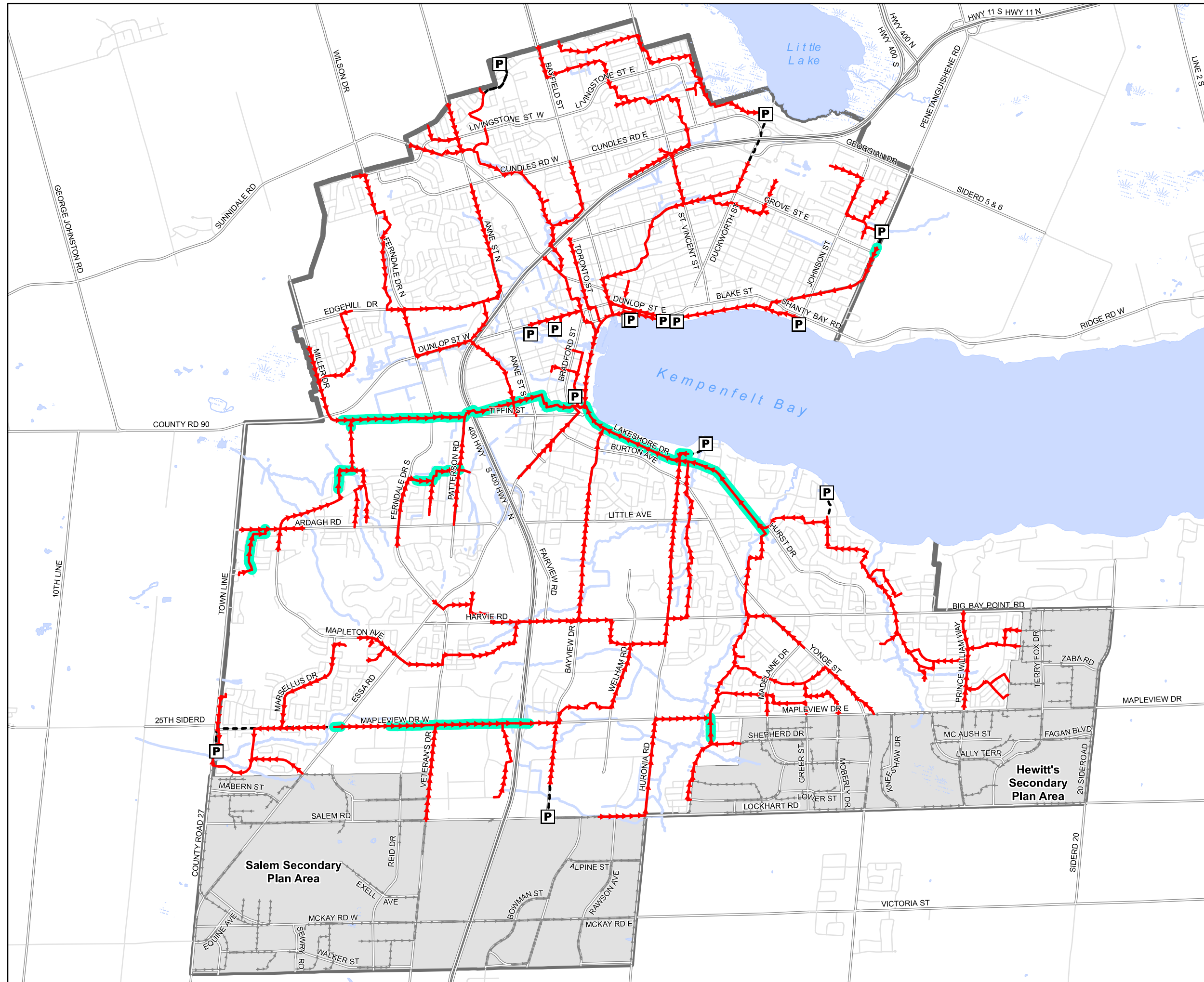


Figure 10-1
City of Barrie
Location of System
Improvements
(Sanitary Sewers
>375mm Diameter)



- Sewer Upgrades
- - - Forcemain
- Sanitary Trunk Sewer
- P Pumping Stations
- Secondary Plan Boundaries
- Future Annexed Lands Sewers
- City of Barrie Limits

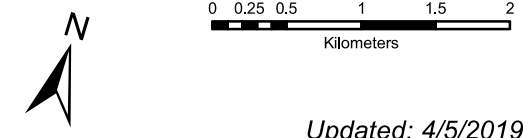
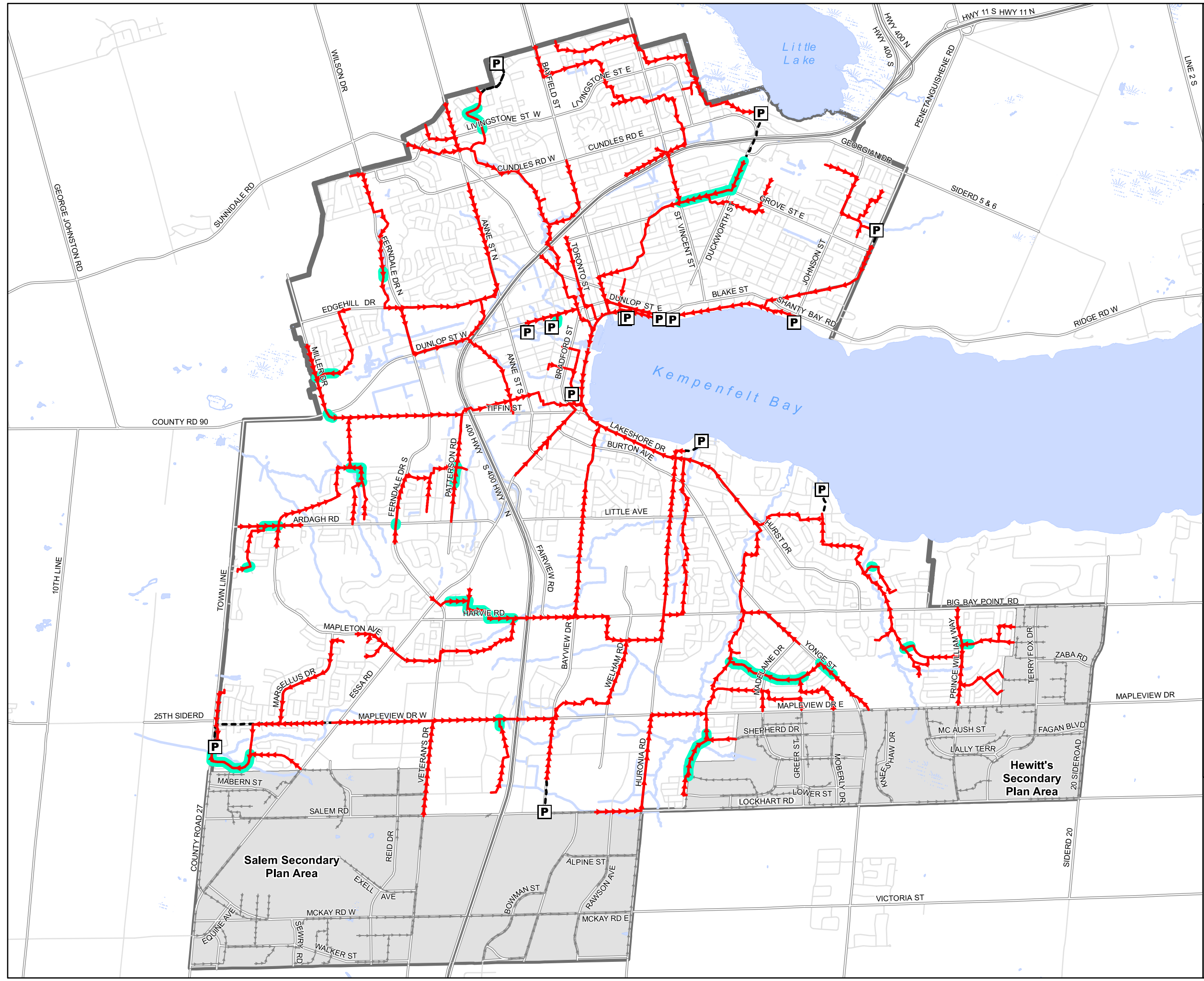
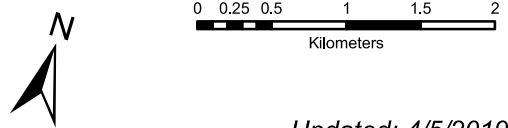


Figure 10-2
City of Barrie
Location of System
Improvements
(Sanitary Sewers
≤375mm Diameter)



- Sewer Upgrades
- Forcemain
- Sanitary Trunk Sewer
- Pumping Stations
- Secondary Plan Boundaries
- Future Annexed Lands Sewers
- City of Barrie Limits



APPENDIX F

Water Design Calculations



136 Bayfield Street
19501

Prepared by: L.P.

Checked by: L.P.

Required Fire Flow

Date: **October 25, 2022**

as per Fire Underwriters Survey Water Supply for Public Fire Protection, 2020

1. Initial Required Fire Flow (Step A, B, C)

Construction Type = Type I Fire Resistive Construction
Construction Coefficient, C = 0.6
Total Effective Area, A = 24,080 m²

Required Fire Flow, RFF = 20484 LPM
RFF, rounded = 20000 LPM

2. Occupancy and Contents Adjustment Factor (Step D)

Contents = Noncombustible contents
Adjustment Factor = -25%
RFF = 15000 LPM

3. Automatic Sprinkler Protection (Step E)

Sprinkler Design	Designed	Building Coverage	Credit
Automatic sprinkler protection designed and installed in accordance with NFPA 13	Yes	100%	30%
Water supply is standard for both the system and Fire Department hose lines	Yes	100%	10%
Fully supervised system	No	100%	0%
Total Sprinkler Credit =			40%

Reduction = 6000 LPM

4. Exposure Adjustment Charge (Step F)

Direction	Distance	Charge
North	10.1m to 20m	15%
South	20.1m to 30m	10%
East	Greater than 30	0%
West	Greater than 30	0%

Total Charge = 25%

Charge = 3750 LPM

5. Final Required Fire Flow (Step G)

RFF = 15000 LPM
Reduction = 6000 LPM
Charge = 3750 LPM
RFF = 12750 LPM

Final RFF, rounded = 13000 LPM
3434 GPM
217 L/s



136 Bayfield Street
19501
Domestic Demand

Prepared by: **L.P.**
Checked by: **L.P.**
Date: **October 25, 2022**

Population = 511
Per Capita Demand = 174 L/cap/day
Average Daily Demand = 88914 L/day **(Zone 1 as per Water Supply Master Plan)**
62 L/min
1.03 L/s

	<u>Average Day</u>	
Peaking Factor	2.30	(Zone 1 as per Water Supply Master Plan)
Demand	2.37	L/s
	37.52	GPM

APPENDIX G

Water Modelling Analysis



To: City of Barrie

From: Vardhini Parvatham

Date: October 26, 2022

Address:

CC:

Re: Water System Analysis

MEMORANDUM

INTRODUCTION

TYLin has been retained by Rockap Holdings c/o One Space Architecture + Interior Design to prepare a detailed Functional Servicing and Stormwater Management Report along with a corresponding grading and servicing design in support of a rezoning and site plan approval application. The subject property is located at the northwest corner of Bayfield Street and Sophia Street W., civic address of 136 Bayfield Street. The recommended servicing has been developed in accordance with the applicable design criteria and requirements of the City of Barrie (the City), Simcoe County (the Region), and the Lake Simcoe Region Conservation Authority (LSRCA).

The subject property is 8,853 m² in area and is bound by Bayfield Street to the east, Sophia Street W. to the south, Maple Avenue to the west, and an existing 3-storey office building to the north.

A topographical survey completed of the area indicate that there is watermain infrastructure available in the vicinity of the site, including:

- 300mm watermain along Maple Avenue to the west of the site (Queen's Park Renewal Project)
- 300mm watermain along Sophia Street W. to the south of the site (Queen's Park Renewal Project)
- 200mm watermain along Bayfield Street to the east of the site
- The existing office building is serviced by a 100mm water service from Bayfield Street and the house is serviced from Sophia Street W. (size unknown).
- Two existing hydrants are located adjacent to the site on the east side of Bayfield Street.
- Two new hydrants are to be constructed on Maple Avenue as part of the Queen's Park Renewal Project.

The proposed water service connections will be made to the 300mm diameter watermain located within Sophia Street, south of the subject site.

This memo provides the summary of the water servicing analysis undertaken by TYLin for the proposed development. The City provided their water distribution system model (2021 Update) for this purpose.



WATER SYSTEM ANALYSIS

Under proposed conditions the development is anticipated to have a maximum required fire flow demand of 217L/s (based on the Fire Underwriters Survey). The anticipated domestic flow for the development under proposed conditions has been calculated as 2.3L/s (Table 1). The domestic flow was based on the average daily demand and peaking factor as per the Water Supply Master Plan Update, completed by WSP, dated July 2019.

Table 1 – Water Supply Requirements

Gross Site Area (ha)		0.89
No. of Residential Units (Apt)		292.00
No. of Residential Units (Townhouse)		7.00
Total Residential Population	1.67ppu (APT) 2.57 ppu (TH)	506.0
Commercial Area (ha)		0.048
Comm. Water Consumption rate	m3/ha/day	28
Average Comm Demand		0.015
Per-Capita Demand	Lpcd	174
Average RES Demand	L/s	1.02
Max Day Factor		2.3
Max Day Demand	L/s	2.3
Fire Protection Demand	L/s	217
Design Demand	L/s	219.3

Tylin

WATER SYSTEM MODELLING

The proposed water distribution system for the development was simulated for development using the InfoWater water model.

The proposed distribution system was modelled for the following scenarios:

1. 2021 Average Day Demand
2. 2021 Maximum Day Demand
3. 2021 Maximum Day Demand plus Fire Flow Requirement
4. 2041 (future) Average Day Demand
5. 2041 (future) Maximum Day Demand
6. 2041 2041 (future) MDD plus Fire Flow Requirement.

The residual pressures under Average day, Maximum day scenarios and available fire flow at nodes for maximum day demand with Fire flow scenario is shown in the summary of modelling results is provided in Table 1.

Table 2 Modelling Results Summary

Water Demand Modeling Scenario	Minimum Water System Requirements	Modeling Results near development	Development Node Pressure*
2021(QPNR) Average Day Demand	Recommended Normal Pressures within System = 40 psi to 100 psi	System Pressure = 50 psi to 80 psi	J260 – 60 psi
2021 (QPNR) Maximum Day Demand	Recommended Normal Pressures within System = 40 psi to 100 psi	System Pressure = 50 psi to 70 psi	J260 – 58 psi
2041 (future) Average Day Demand	Recommended Normal Pressures within System = 40 psi to 100 psi	System Pressure = 50 psi to 80 psi	J260 – 63 psi
2041 (future) Maximum Day Demand	Recommended Normal Pressures within System = 40 psi to 100 psi	System Pressure = 50 psi to 80 psi	J260 – 63 psi
2021 Maximum Day Demand plus Fire Flow Requirement	Required Fire Flow to be provided at a residual pressure of no less than 20 psi		Development Node Flow*
	Employment Fire flow requirements per FUS, $Q_f = 217$ L/s	Entire neighbourhood has Available Fire Flow greater than 217 L/s	J260 – 226 L/s
2041 2041 (future) MDD plus Fire Flow Requirement	Employment Fire flow requirements per FUS, $Q_f = 217$ L/s	Entire neighbourhood has Available Fire Flow greater than 217 L/s	J260 – 419 L/s



CONCLUSION

For all the Scenarios, the pressures range from 345 – 551 kPa (50 – 80 psi). The model results indicate that pressure requirements set out by the City are satisfied.

With the fire flow analysis, the development node can achieve the minimum fire flow requirement of 217 L/s identified as per the FUS requirements. The 2021 Maximum day and fire flow condition analysis identified that a fire flow of 226 L/s can be obtained at the critical node while maintaining a fire flow pressure of 20 psi. And under 2041 Maximum day and fire flow condition analysis a fire flow of 419 L/s can be obtained at the critical node while maintaining a fire flow pressure of 20psi.

TYLin

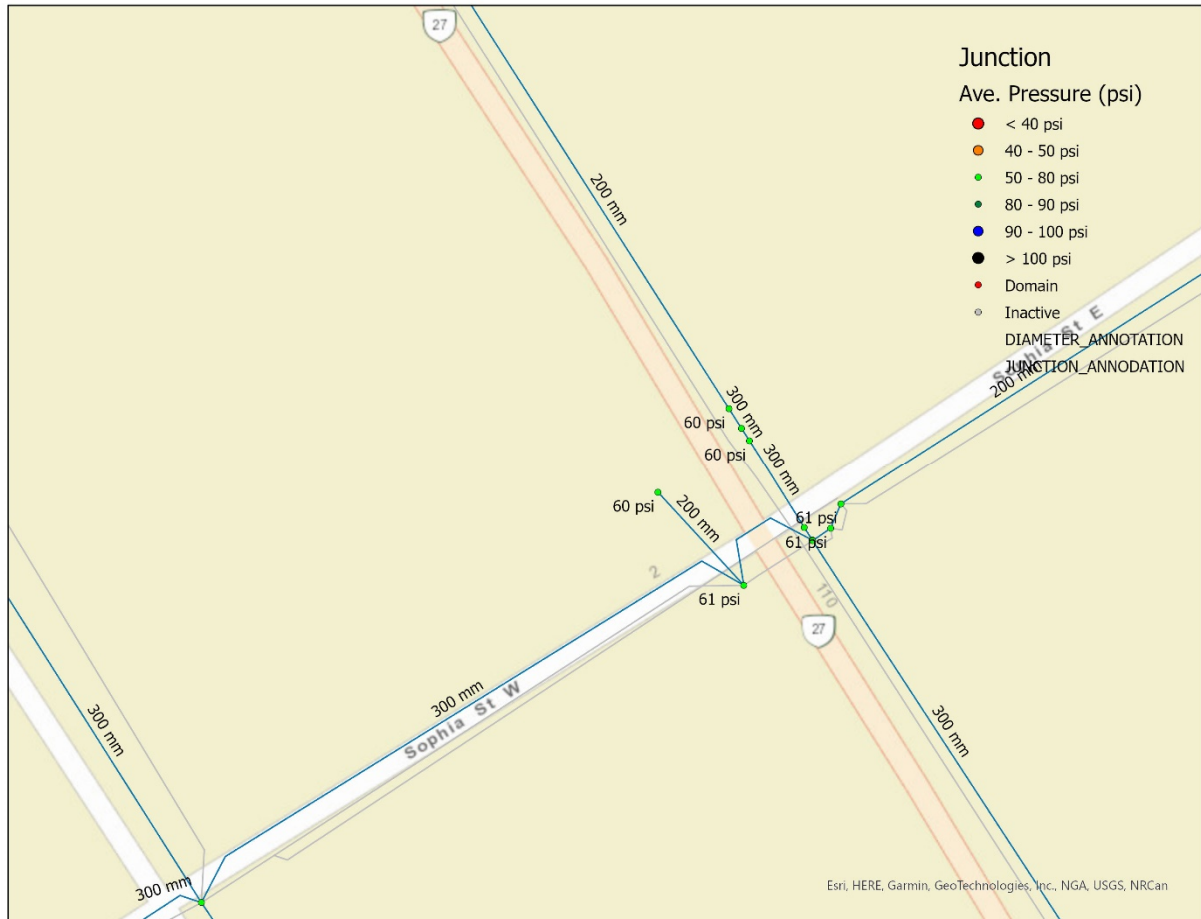


Figure 1 2021 Average Day Demand – Residual Pressure

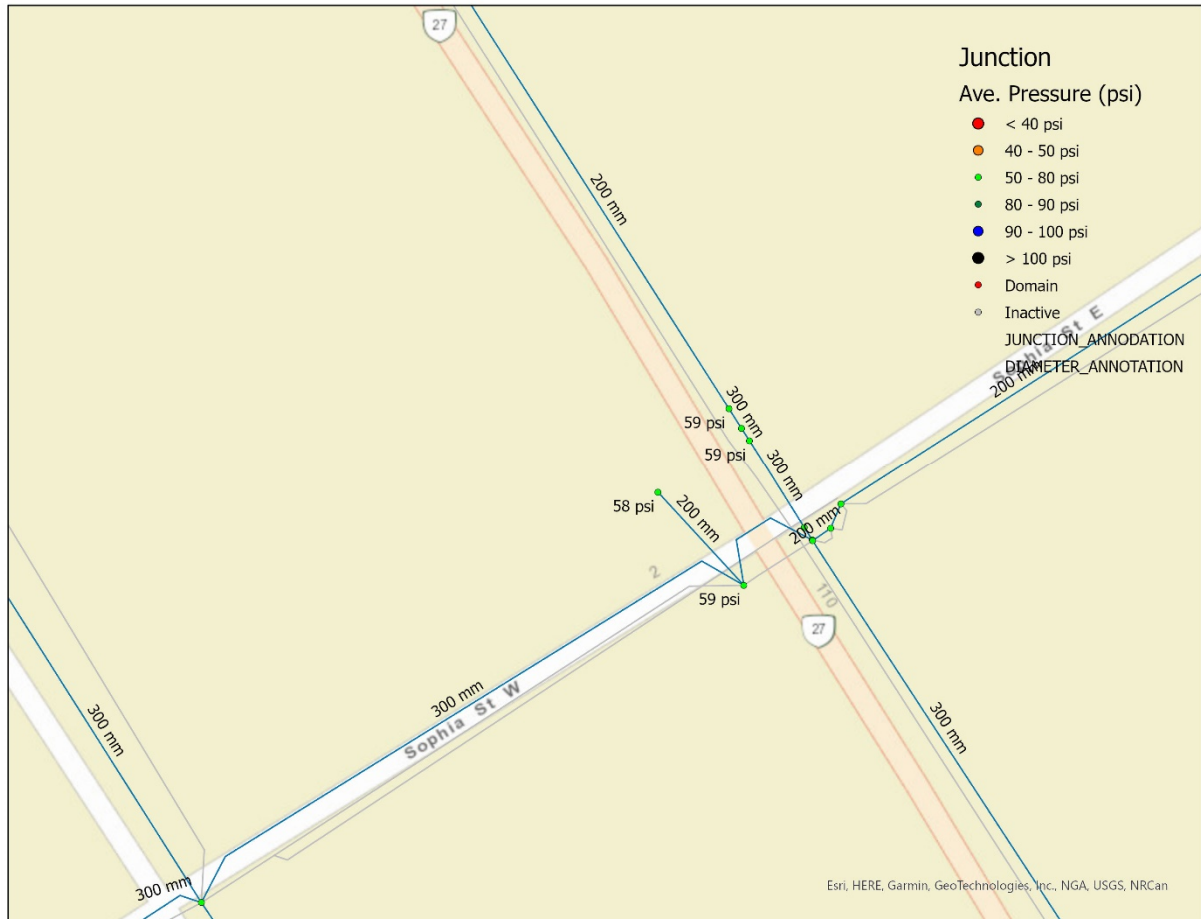


Figure 2 2021 Maximum Day Demand – Residual Pressure

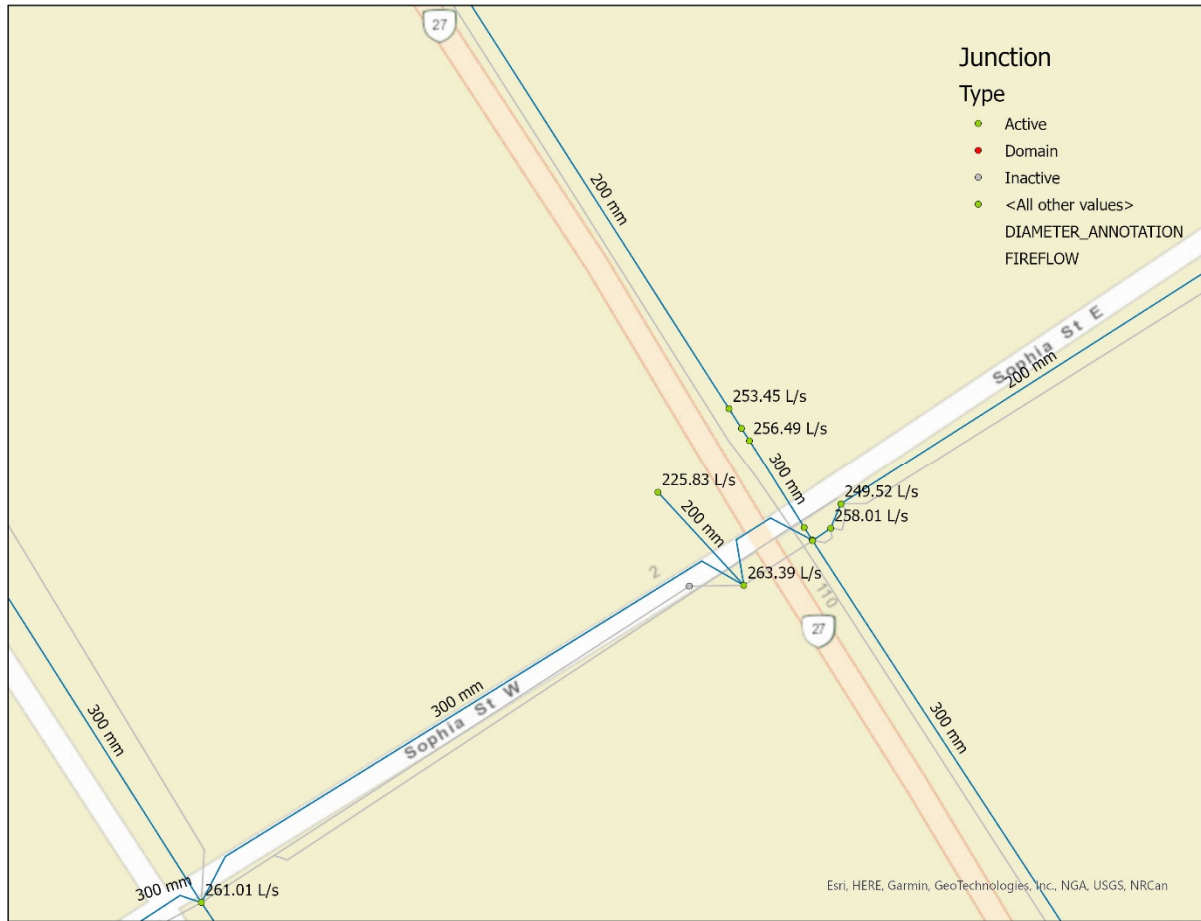


Figure 3 2021 Maximum Day Demand + Fire Flow Demand – Available Flow Capacity

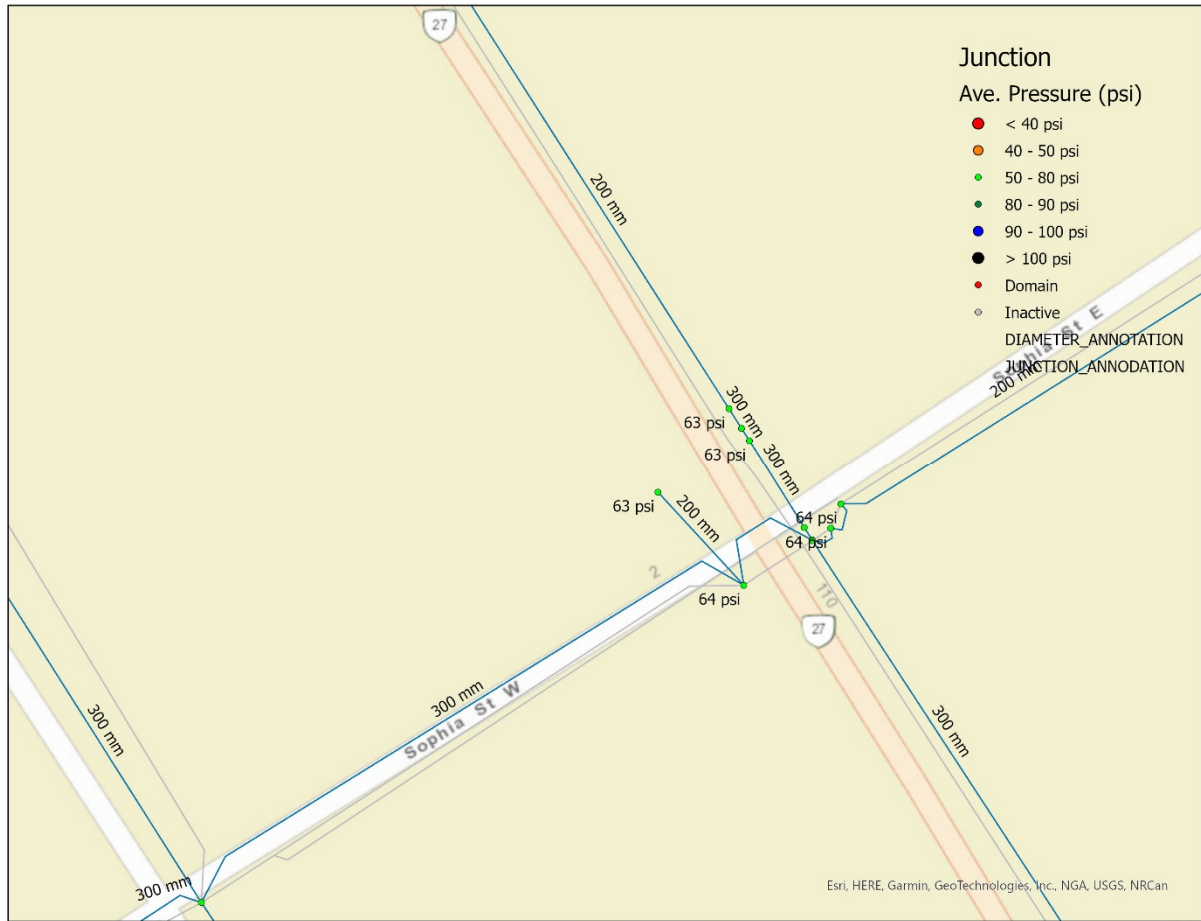


Figure 42041 Average Day Demand – Residual Pressure

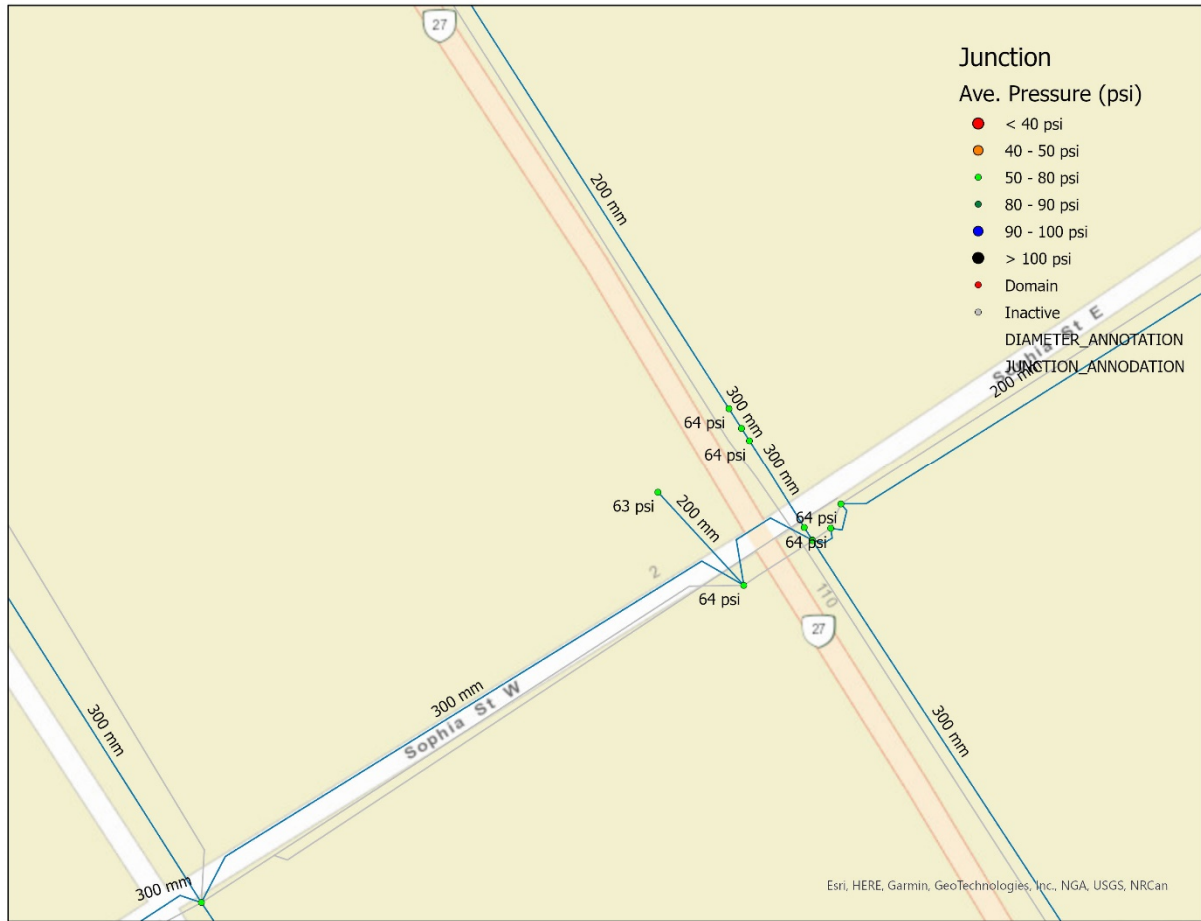


Figure 5 2041 Maximum Day Demand – Residual Pressure

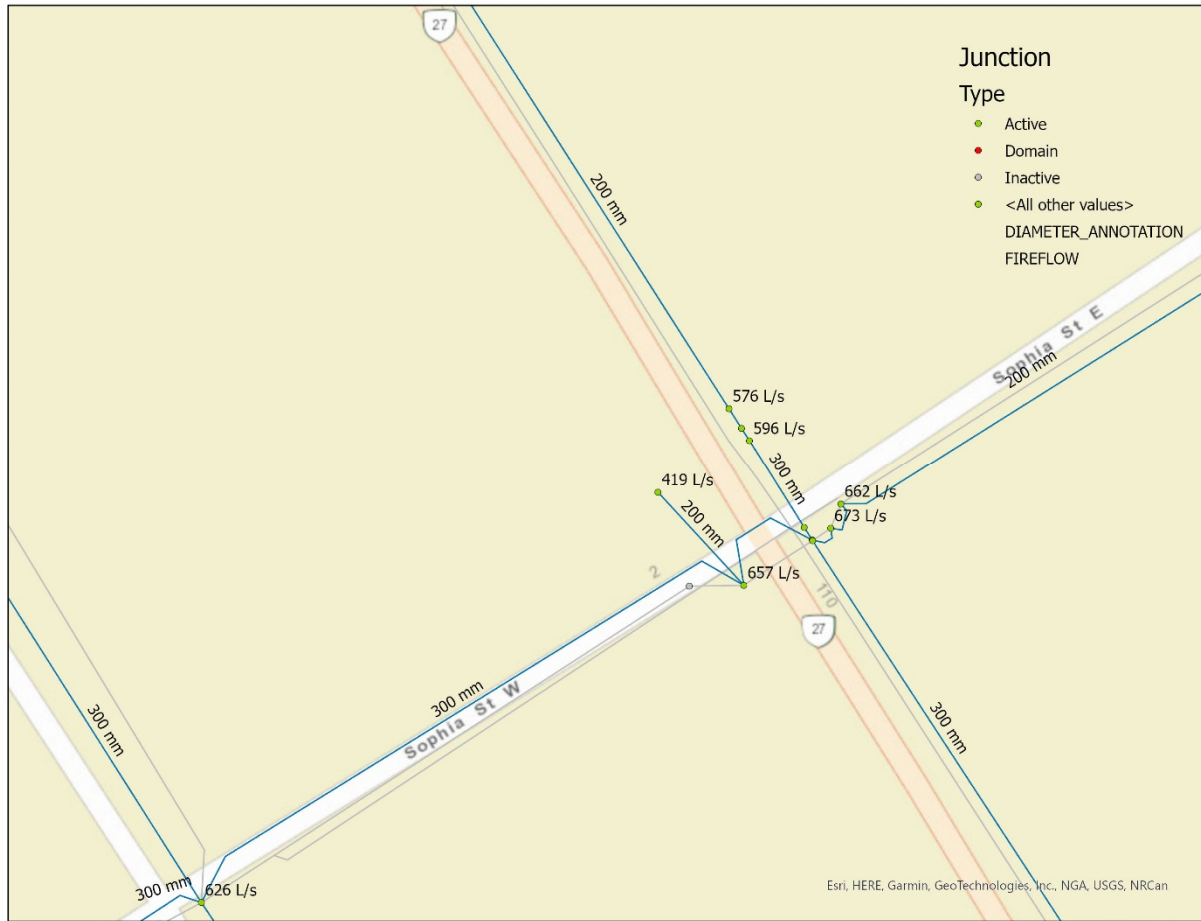


Figure 6 2041 Maximum Day Demand + Fire Flow Demand – Available Flow Capacity