GSPrimo

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Residential development
at 130 Beech Street, Strathroy, Ontario

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1.0 Introduction

Mr. Brody Luis (the 'client') retained the services of GSPrimo Design Inc. ('GSPrimo'), to prepare a Functional Servicing and Stormwater Management Report in support of the Site Plan Application for the proposed development at 130 Beech Street, Strathroy, Ontario. The purpose of this report is to provide a conceptual framework for water supply, sanitary sewage, and storm services required to support the proposed development.

In preparing this report, GSPrimo personnel reviewed the available City of Strathroy (the 'City') drawings to confirm existing infrastructures.

2.0 Site, Topography, and Subsurface Conditions

2.1 Site Description

The subject site is a 1203.85 m^2 parcel of land on the south side of Beech Street in the City of Strathroy, County of Middlesex, with approximate UTM coordinates of Zone 17T; 449071 m Easting; 4755757 m Northing. The property is zoned 'R3 –High Density Residential' according to the Municipality of Strathroy-Caradoc Zoning By-law. The property is situated in an area of single-family dwellings and small multiplexes. The site is bounded to the north by Beach Street, and to the south, west, and east by residential properties as shown in Figure 1. The area inspected is rectangular in shape. The site currently consists of a 2-story residential building, a driveway, and a vegetated yard area.

2.2 Topography

The survey map shows the subject site at an elevation of 225.7 meters above sea level (masl) to the northeast to 225.4 masl to the southwest as shown in Figure 2. The topography of the subject site indicates a perceived general slope towards the west-southwest of the site.

Within a broader area, a topographic map provided by Natural Resources Canada on the Geological Survey of Canada identified the inferred slope in the subject study area to be west towards Sydenham River (Figure 3). The area around the subject site ranges from approximately

225 masl west to 226 masl east. The surface water is expected to infiltrate the permeable green yard area or flow toward the natural slope of the ground surface through a ditch towards a catch basin on the western side of the subject site.

2.3 Subsurface Conditions

A geotechnical report was prepared by EXP Services Inc. (EXP) dated August 31, 2022, to investigate the soil and groundwater conditions at the site. Based on the observations during excavation, a 0.3-0.4 m thick topsoil is underlaid by a sand deposit. The sand deposit was described as compact, moist, brown to grey, fine to medium grained with trace silt. Detailed stratigraphy encountered in the test holes can be found in Appendix A of the geotechnical report.

Three monitoring wells were installed on site for the hydrogeological study. Attempts were made by EXP personnel during the period of May 6 to July 21, 2022, to measure the wells for the determination of the water level. Groundwater was measured between 1.5 m and 1.7 m below ground surface. It was also noted that the depth of the groundwater table may vary in response to climatic or seasonal conditions, and, as such, may differ at the time of construction, with higher levels in wet seasons. Capillary rise effects should also be anticipated in fine-grained soil deposits.

Based on the grain size distribution, the estimated hydraulic conductivity (K) of the sand ranged between 1.0×10^{-2} and 2.9×10^{-2} cm/s. Unfactored infiltration rates ranging between 75 mm/hour and 150 mm/hour were calculated using the grain size distribution data and single well response tests as part of the geotechnical and hydrogeological assessments carried out at the site. A conservative unfactored infiltration rate of 110 mm/hour should be assumed for the sand soils at the site (refer to the geotechnical report for further details).

3.0 Proposed development

It is our understanding that the proposed site development will consist of the following:

- One 2-stories townhouse building consisting of 4 units with a total gross floor area of 468.2 m^2. The building's ground floor area will be 234.1 m^2.
- There will be two separate driveways to the subject site, off of Beech Street to the north

of the property.

- A landscape open space will be 66.6% of the total lot area.

The site will be serviced by existing local municipal sewers and watermains within the adjoining municipal right-of-way. The proposed service connections for the proposed two-story building will be connected to the City's existing sanitary sewer. The general arrangement of the proposed development is illustrated in Figure 4.

4.0 Scope of Work

The scope of work for the Functional Servicing & Stormwater Management investigation of the proposed development is as follows:

- Provide an overview of the existing and proposed conditions for sanitary, water, and storm services.
- The domestic water demand will be calculated based on the City's Design Specifications & Requirements Manual. The flow pressure required for the proposed development will also be determined and the City's requirements will be outlined.
- The sanitary sewage discharge from the site, will be determined based on the City's criteria and the site statistics as supplied by the design team. The calculated values provide the peak sanitary flow discharge required for the design of the sanitary sewer system.
- The stormwater management (SWM) system will be designed to meet the standards of the Province of Ontario as set out in the Ministry of Environment and Climate Change (MOECC), Stormwater Management Planning and Design Manual (SWMPD), and the City's Design Specifications & Requirements Manual.
- Provide a Functional Servicing & Stormwater Management Report for the subject development in support of the Site Plan Application.

5.0 Water Supply System and Appurtenances

5.1 Existing Water Supply

GSPrimo obtained plan and profile drawings of the existing underground utilities from the City of Strathroy. There is a 150 mm diameter watermain running along Beech St. as shown in Figure 5. A fire hydrant is located approximately 40 m from the subject property to the west, in the front area of Lot No. 142 on Beech St.

5.1 Proposed Water Supply

The domestic water requirements for the proposed site were calculated using the City's Engineering Manual and the site statistics. Table 1 shows a summary of the assumptions used for the calculation of the domestic water demand. Refer to Appendix A for details.

Table 1 – Summary of assumptions used for domestic water demand calculations

Parameter	Value
Number of Units	4 units
Population	20 people
Average water demand from site	255 lit/capita/day
Peak Hour Water Demand from site	4.13
Max Day Demand from site	2.75

According to the fire flow requirements specified by the Ontario Building Code ("OBC"); the required fire-flow (RFF) can be calculated using the following equation:

$$Q = KVS_{tot}$$

Where

Q = Minimum supply of water in liter

K = Water supply coefficient

V = Total building volume, m^3

S_{tot} = Total spatial coefficient values from property line exposure on all sides

The residential occupancies for the proposed building are categorized as class "C". For buildings of non-combustible construction with fire separation and fire resistance rating (including walls, columns, and arches), the suggested value for water supply coefficient, k, is 10. The volume of the proposed buildings is less than 2500 m^3. The total spatial coefficient value from property line exposure on all sides, S_{tot}, is assumed 2 that is the maximum possible value. The calculated minimum supply of water, Q, was found to be 50,000 liters (Q < 108 000), hence, the required fire flow demand will be 45 lit/s based on the OBC code and the City's standard.

According to the OBC requirements, all buildings should be serviced by a fire hydrant that is located no more than 45 m away from the building's Siamese connection. For the subject site, the closest hydrant is approximately 40 m from the proposed building, located in the front area of Lot 142 on Beech Street, as such, there is no need to install a new fire hydrant adjacent to the site.

Note the total water demand was calculated as a summation of the maximum daily residential and fire flow requirements. The total water demand was found to be 45.2 lit/s for the proposed development (refer to Appendix A for further details).

6.0 Sanitary Sewage System

6.1 Existing Sanitary Sewage System

According to the available records provided by the City of Strathroy, a 250 mm sanitary sewer pipe with an approximate soil cover of 1.1 m runs along Beech Street on the northern side of the subject property. The sewer main runs east with a slope of 0.40 % towards an existing manhole located at the intersection of Beech-Adelaide Street (see Figure 6).

6.2 Proposed Sanitary Connections

The sanitary flow generated by the proposed development is calculated based on the City Design Criteria and the site statistics. The assumptions used to calculate the generated sanitary flow are as follows:

- Number of residential units = 4

- Harmon's Peaking Factor = 4.2
- Total Area of the subject site = 1203.85 m^2

The proposed development will discharge 0.68 lit/s into the City's sanitary infrastructure. A summary of the calculation assumptions is presented in Table 2.

Table 2 – Summary of calculations for generated sanitary flow

Population (People)	Peaking Factor	per Capita Flow (lit/day)	Infiltration (lit/s/ha)	Uncertainty Factor	Total flow (lit/s)
20	4.4	275	0.25	1.1	0.68

The size of the Private Drain Connection (PDC) to convey the generated sanitary sewer flow was calculated using Manning formula based on the City's design Criteria and the site statistics. The required pipe diameter is found to be 47 mm; however, a minimum diameter of 200 mm will be proposed to adhere to the City's criteria. The required length of the proposed flexible PDC is approximately 21.51 m from the edge of the proposed building to the sanitary PDC on Beech Street as shown in Figure 7. Refer to Appendix A for detailed calculations.

The size and location of the proposed sanitary sewer pipe and corresponding sanitary service connections for the proposed development are shown on the site servicing drawings. The drawings will be submitted as part of the Site Plan Application for this project.

7.0 Stormwater Management

7.1 Existing Conditions

GSPrimo obtained the City's drawings for the existing stormwater management facilities within the subject area. According to available records, no storm sewer pipe exists on Beech Street in proximity of the subject site. There is a ditch on the northern side of the property that conveys the surface runoff towards a catch basin located at the west side of the site on Beech Street (refer to Figure 6).

7.2 Stormwater Management and Drainage

The site is subjected to the stormwater management criteria as laid out by the Design Specifications & Requirements, Manual, and supplemental information provided by the City. As per the Drainage By-law, the stormwater flow rate is to be managed for the flow rate of 2 through 100-year return period storms.

The proposed development consists of one (1) townhouse building with a total ground floor area of 234.12 m^2, and a concrete sidewalk and two separate asphalt driveways with a total area of 168.07 m^2. The remaining portion of the subject area will be landscaped with a total area of 801.66 m^2 (see Figure 4). Stormwater runoff generated by the building's sloped roof will be directed toward the roof downspouts at the rear side of the building.

7.2.1 Water Balance

The water balance analysis was performed for the entire parcel area as per the City's standards and guidelines. The flow from the site will be discharged at a rate equal to or less than that of the existing condition.

The maximum intensity for ten (10) minutes time of concentration for various return periods is presented in Table 3 (Refer to Appendix A for details). As mentioned earlier, the infiltration rate of the sandy soil was estimated to be 110 mm/hr. Based on the results of the water balance analysis, a maximum storage volume of 14.2 m^3 will be required to manage the stormwater runoff within the site for the proposed development (Refer to Appendix A for details).

Table 3 – Rainfall intensity for the subject site

Variable	2–year	5–year	100–year
i (mm/hr)	83	109.3	181

7.2.2 Quantity Control

As per Ontario Stormwater Management Planning and Design Manual, the peak excess discharge rate from the site to any drainage facility should be limited to the pre-development return period.

The calculated peak flow for the proposed development was found to be larger than the allowable stormwater flow.

As mentioned earlier, there is no storm sewer pipe on Beech Street to convey the excess runoff to the City's stormwater management facilities. The soil in the subject site mainly consists of fine sand material with a high percolation rate, hence, the infiltration chamber is proposed as the Best Management Practice (BMP) to manage the stormwater for the proposed development.

The proposed chamber system will be embedded in the rear yard area to infiltrate the captured runoff into the ground (refer to figure 7). The specifications of the proposed system are provided in the drawings as shown in Figure 8.

7.2.3 Quality Control

The overland runoff mainly flows over the landscaped areas and the proposed building's roof. No quality control is required onsite for the runoff that is captured by roof drains. Based on Ontario Stormwater Management Planning and Design Guideline, the released water can be considered "clean".

8.0 Sediment and Erosion Control Procedures

Sediment and erosion control measures will be implemented onsite during construction in accordance with the "Erosion and Sediment Control Guidelines for Urban Construction" and the City's standards. Erosion and sediment control strategies will be implemented for all construction activities including topsoil stripping, foundation excavation, and stockpiling of material. The erosion and sediment control measures include the following:

- Siltation from surface runoff from the site shall be prevented with the use of a temporary sediment control fence, placed along the boundaries, where runoff will accumulate. The silt fence will be placed around the perimeter of all areas to be disturbed prior to grading.
- Construction of a 6m x 10m mud mat at the exit from the site to Beech Street to minimize offsite tracking of sediments to the surrounding roads.

- Catchbasin sediment traps will be provided on new installed catchbasins within the subject site. It will also be necessary to prevent silt from entering the storm sewer system via street catchbasins. A silt sack or equivalent shall be inserted under the grate of each street catch basin.
- Regular inspection, monitoring, and repair (if necessary) of all temporary erosion and sediment control measures during construction to ensure that the erosion and sediment controls remain effective; and,
- Removal of temporary controls once the areas they serve are restored and stable.

9.0 Site Grading

The proposed development will be graded and drained internally in compliance with the Drainage By-Law. Grades will be maintained along the property lines and the grading design will be completed to direct stormwater flow towards the proposed chambers, as such, the drainage is self-contained. The grading plan is illustrated in Figure 9.

10.0 Conclusion and Recommendations

Based on the information provided herein, it is concluded that the development can be constructed to meet the requirements of the City of Strathroy. The recommendations and conclusions of this report concerning sanitary sewers, storm sewers, stormwater management, grading, and sediment and erosion control measures for the development are provided below.

10.1 Water Supply

It is anticipated that a total design flow of 45.2 lit/s (including domestic demand and fire flow) will be required to support the proposed development. A 150 mm watermain exists within Beech Street with adequate capacity to provide the required domestic and fire flows for the proposed development. A fire hydrant is located approximately 40 m away from the site to the west in the front area of Lot No. 142 on Beech Street. A 50 mm water service will be proposed from the

existing 150 mm watermain on Beech Street. The existing water services on site shall be abandoned per City of Strathroy guidelines.

All internal plumbing will meet Ontario Building Code standards.

10.2 Sanitary Sewers

A 250 mm main sanitary sewer is available on Beech Street to the north of the subject site. The total peak sanitary discharge generated by the proposed development is 0.68 lit/s. A 200 mm private service will be proposed from the existing 250 mm sanitary sewer to provide a sanitary outlet for the site. The existing sanitary services on site shall be abandoned per City of Strathroy's guidelines.

10.3 Storm Drainage

Stormwater management will be required to control 100-year post-development peak flows to match 2-year pre-development conditions. No stormwater sewer main exists on Beech Street in the proximity of the subject area. The required stormwater quantity control can be provided by an Infiltration chamber. The proposed chamber system is considered the most feasible solution for the proposed development due to the high percolation rate of the sandy soil and the lack of storm sewer pipe within Beech Street around the site. No quality control is required due to the runoff being collected by roof drains.

10.4 Site Grading

Grading will be carried out in accordance with the City of Strathroy engineering design standards.

10.5 Erosion and Sediment Control

Erosion and sediment control measures are proposed to ensure that the amount of silt eroded from the subject development during rainfall events is kept to a minimum.

11.0 Liaison During Construction

On-going liaison with GSPrimo during the construction phases of the project is recommended to confirm that they are in keeping with the intentions of this report.

12.0 Limitation of report

GSPrimo has carefully assessed all information provided to them during this investigation but makes no guarantees or warranties as to the accuracy or completeness of this provided information. Professional judgment was exercised in gathering and analyzing the information obtained and the formulation of the conclusions and recommendations. Like all professional persons rendering advice, we do not act as absolute insurers of the conclusions reached but commit ourselves to care and competence in reaching those conclusions. No warranty, whether expressed or implied, is included or intended in this report.

Contractors bidding on or undertaking the work, should in this light, decide that further field investigations and interpretations of the factual results are necessary to draw their conclusions as to how the conditions may affect them. Should the conditions during construction activities prove to be different than what has been described in this report, the author of this report should be notified as soon as possible. No liability or claims may be made by owners or third parties against GSPrimo for factors outside (GSPrimo's) control. Further dissemination of this report is not permitted without GSPrimo's prior written approval

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Reviewed by:

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References

1. Ontario Stormwater Management, Planning and Design Guideline. (2019), Ontario, Canada. OBC. (2012). *Ontario Building Code.*

2. Ministry of Environment*. (2020) Guidelines for environmental protection measures at chemical and waste storage facilities.*

3. Greater Golden Horseshoe Area Conservation Authorities (GGHA CAs) (December 2006) *Erosion and Sediment Control Guidelines for Urban Construction.*

Figure 1 – Satellite image of the subject site

Figure 2 – Survey map of the subject site.

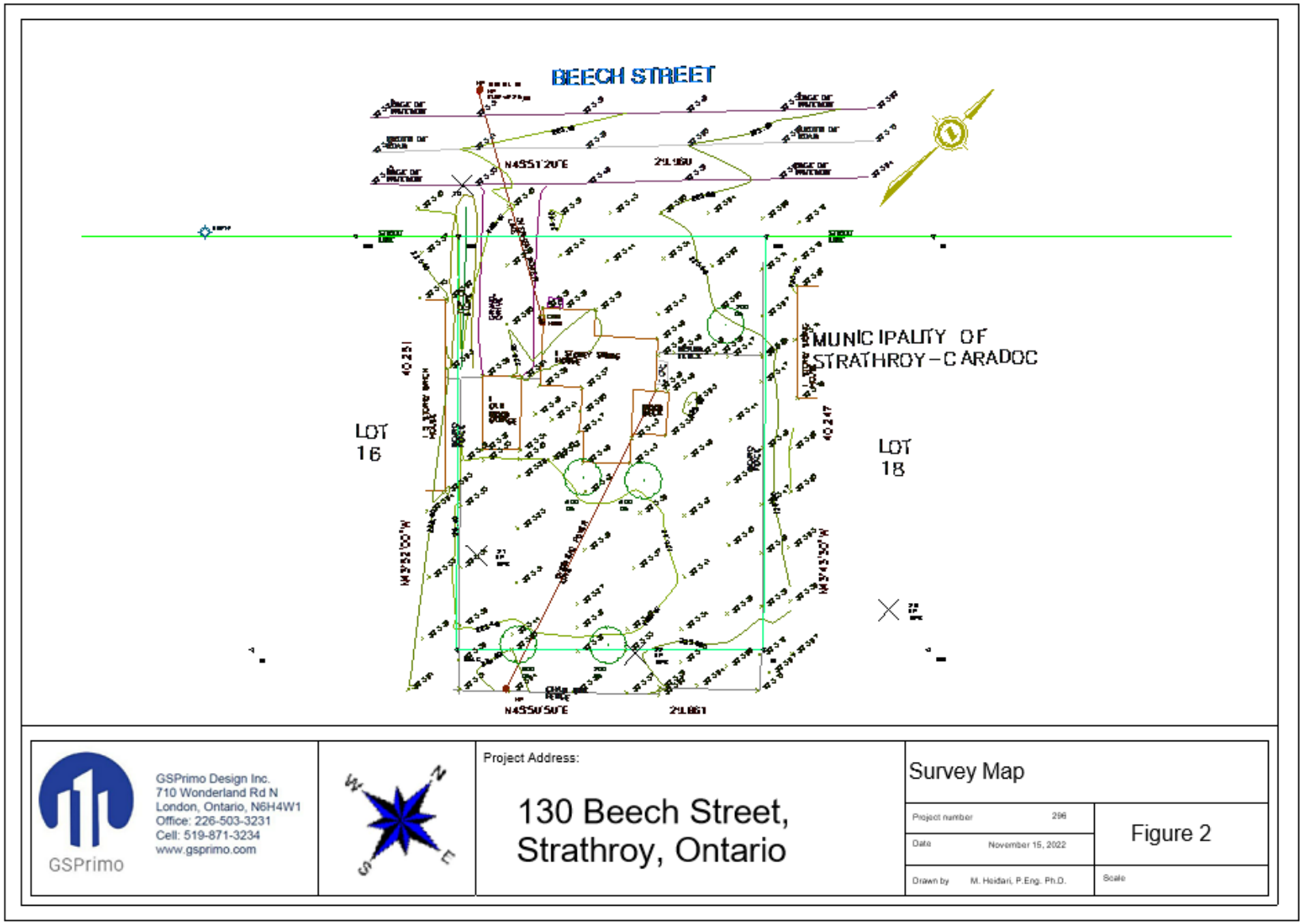


Figure 3 – Topographic map of the subject study area

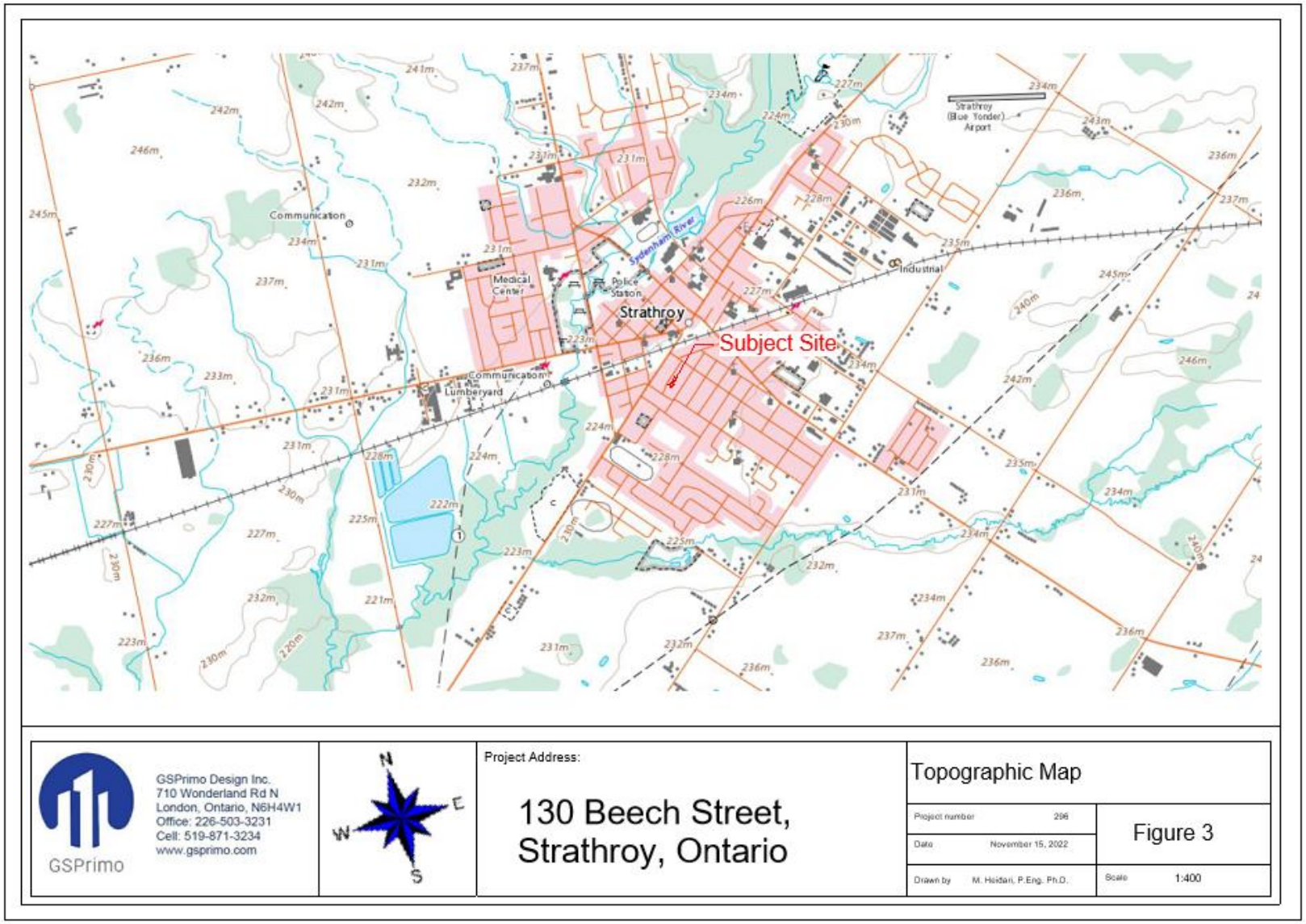


Figure 4 – Proposed development for the site plan

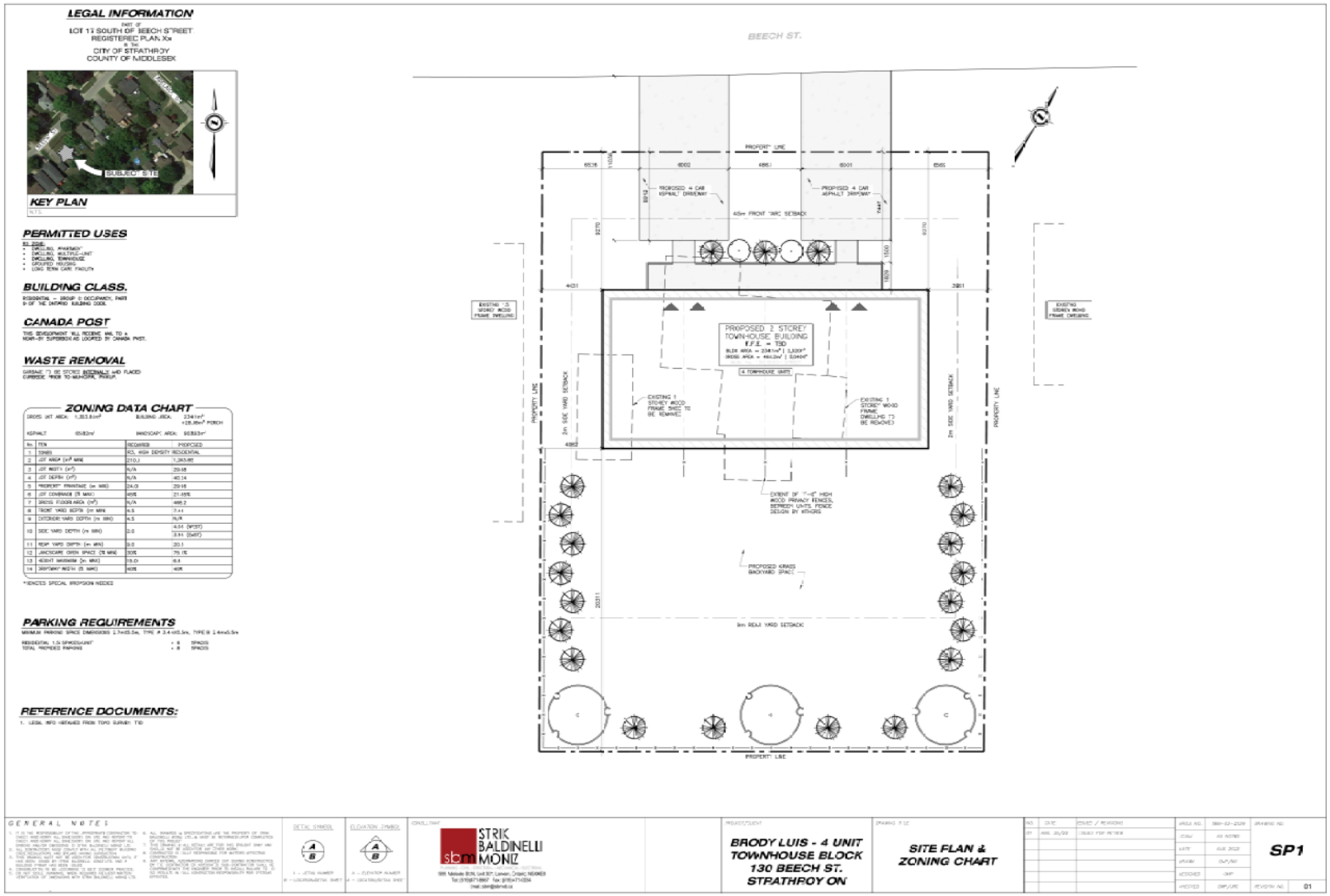


Figure 5 – Details of existing watermain provided by the City

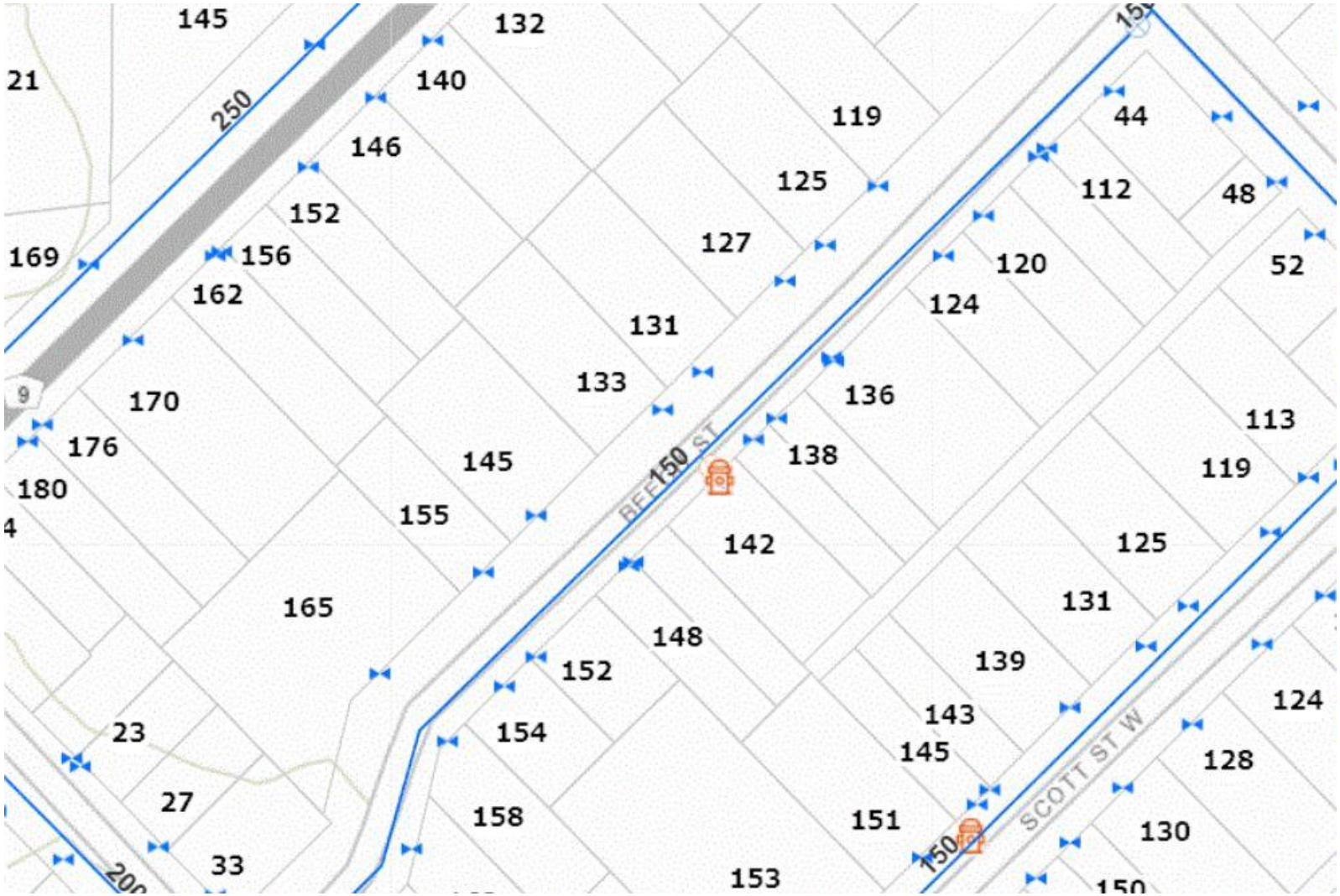


Figure 6 – Details of existing sanitary sewer system provided by the City

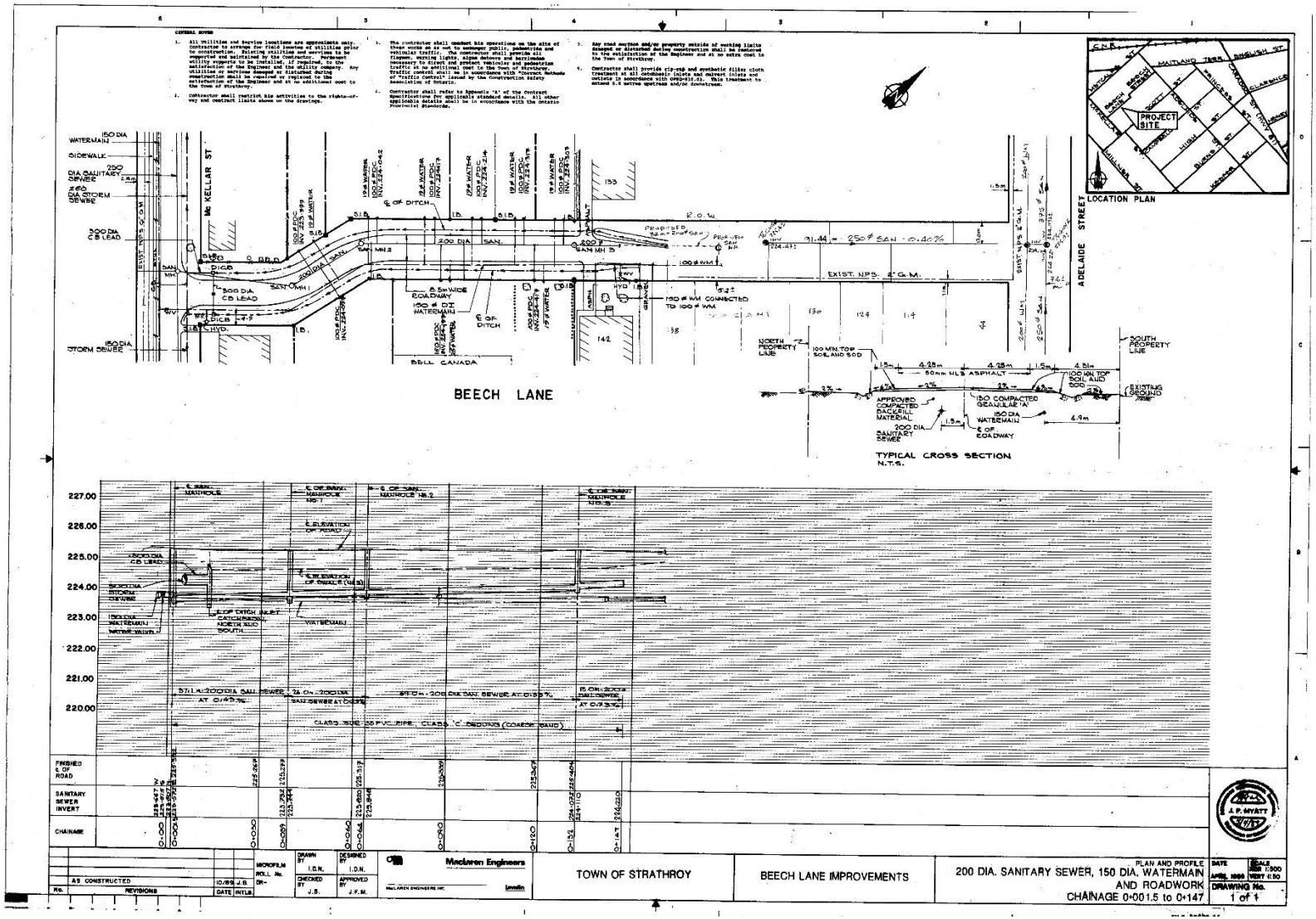


Figure 7 – Proposed sanitary and stormwater sewers.

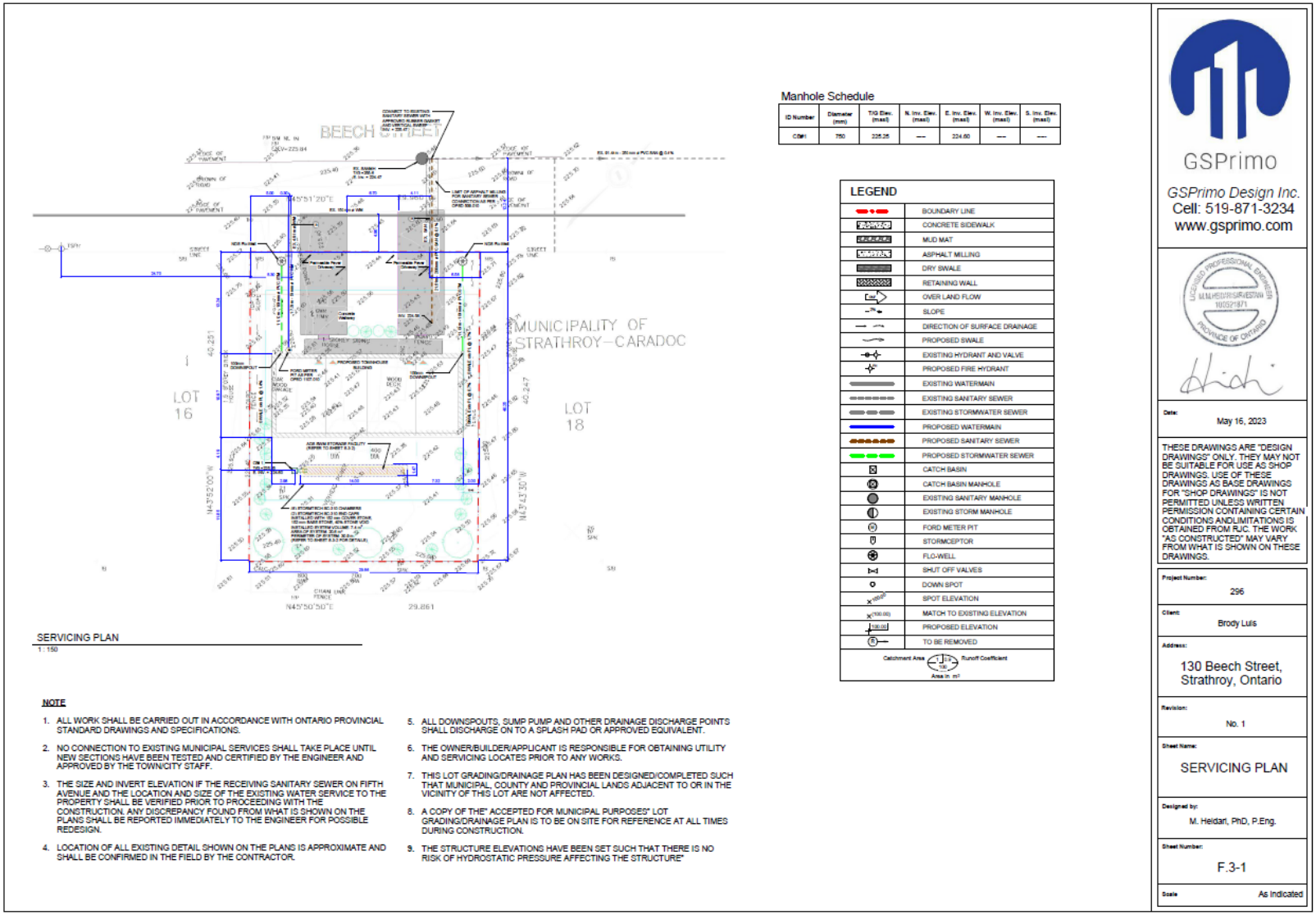


Figure 8 – Proposed ADS SWM storage facility system

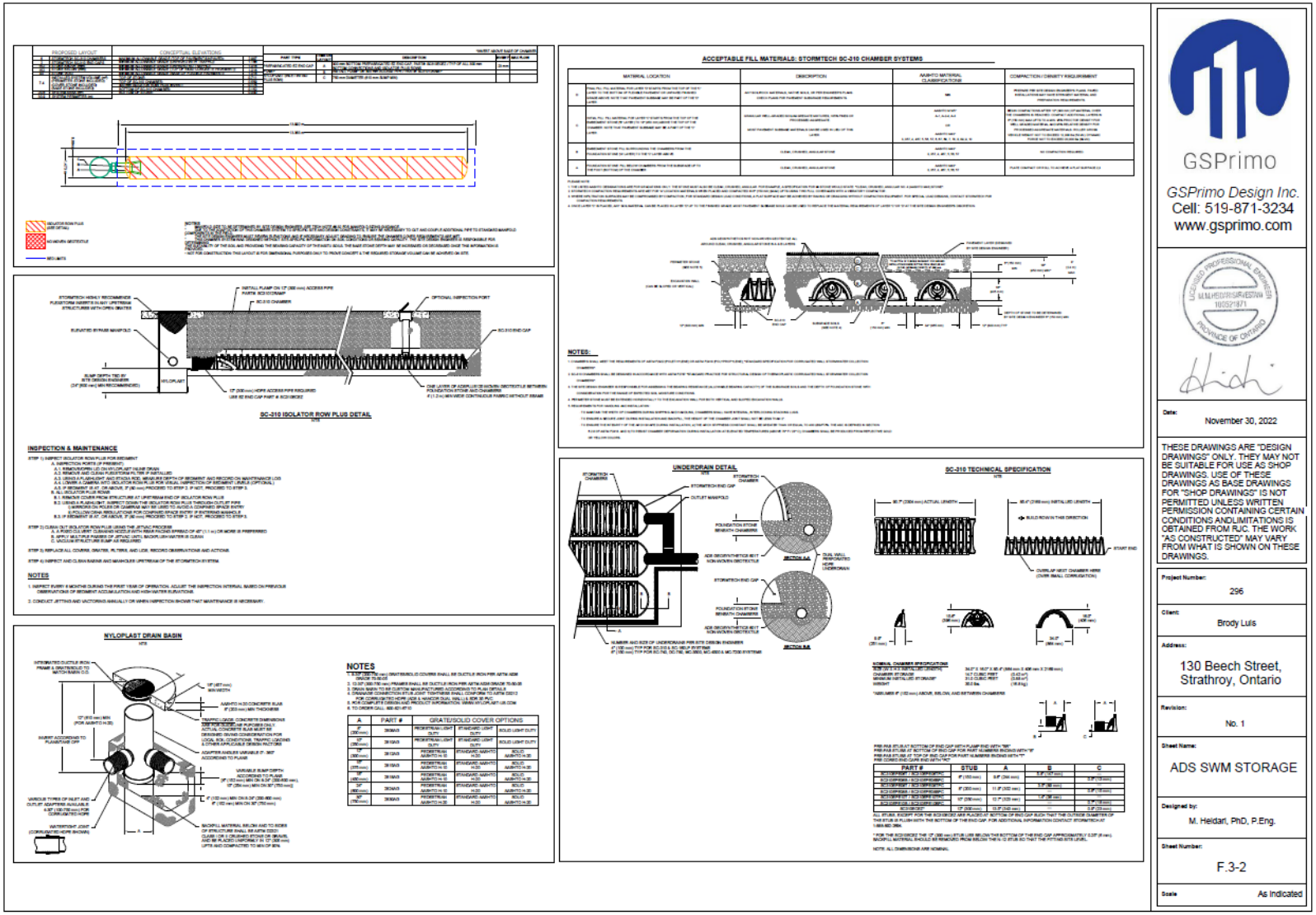
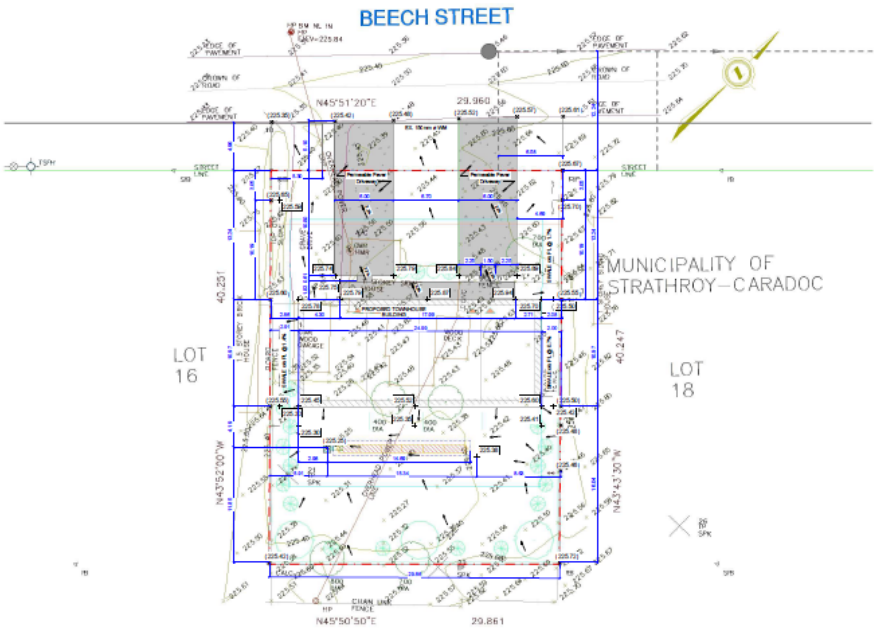


Figure 9 – Proposed site grading



GRADING PLAN
1 : 150

NOTE

1. EXISTING DRAINAGE OF ABUTTING LANDS IS NOT TO BE DISTURBED.
2. LOCALIZED SURFACE DRAINAGE FROM ABUTTING PROPERTIES TO BE DEVELOPED IN FUTURE MAY BE DISCHARGED ONTO THE PROPOSED LOTS IN THIS SUBDIVISION.
3. BASEMENT OPENINGS TO BE MINIMUM 300MM ABOVE THE CENTERLINE OF ROAD UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER.
4. GROUND ELEVATIONS AT HOUSES ABUTTING OVERLAND FLOW ROUTES ARE TO BE 225MM ABOVE OVERLAND FLOW ROUTE ELEVATIONS.
5. RETAINING WALLS, 1.0M HIGH OR GREATER, ARE TO BE DESIGNED BY AND CONSTRUCTED TO THE SPECIFICATIONS OF A REGISTERED PROFESSIONAL ENGINEER IN ACCORDANCE WITH THE ONTARIO BUILDING CODE.
6. BOULEVARD AREAS AND CONCRETE SIDEWALKS DISTURBED DURING INSTALLATION OF SERVICES SHALL BE RESTORED TO MATCH EXISTING CONDITION OR SURFACE WORKS NOTES ON SHEET C1, WHICHEVER IS GREATER, ALL AT NO COST TO THE CITY.
7. ALL CLEARANCES TO ELECTRICAL CONDUCTORS AS SET OUT IN THE CURRENT OBC DIV. B-3.1.19.1 'ELECTRICAL CONDUCTOR CLEARANCES TO BUILDINGS SHALL BE MAINTAINED.
8. THE OWNER'S CONTRACTOR SHALL PROVIDE TRAFFIC CONTROL MEASURES IN COMPLIANCE WITH THE ONTARIO TRAFFIC MANUAL BOOK 7 FOR ALL WORKS WITHIN THE CITY RIGHT-OF-WAY. THE OWNER'S CONTRACTOR SHALL SUBMIT TRAFFIC CONTROL PLANS TO THE CITY/ENGINEER FOR REVIEW PRIOR TO PROCEEDING WITH CONSTRUCTION.

LEGEND

	BOUNDARY LINE
CONC SW	CONCRETE SIDEWALK
MUD MAT	MUD MAT
MILLING	ASPHALT MILLING
	DRY SWALE
	RETAINING WALL
OLF	OVER LAND FLOW
	SLOPE
	DIRECTION OF SURFACE DRAINAGE
	PROPOSED SWALE
	EXISTING HYDRANT AND VALVE
	PROPOSED FIRE HYDRANT
	EXISTING WATERMAIN
	EXISTING SANITARY SEWER
	EXISTING STORMWATER SEWER
	PROPOSED WATERMAIN
	PROPOSED SANITARY SEWER
	PROPOSED STORMWATER SEWER
	CATCH BASIN
	CATCH BASIN MANHOLE
	EXISTING SANITARY MANHOLE
	EXISTING STORM MANHOLE
	FORD METER PIT
	STORMCEPTOR
	FLO-WELL
	SHUT OFF VALVES
	DOWN SPOT
	SPOT ELEVATION
	MATCH TO EXISTING ELEVATION
	PROPOSED ELEVATION
	TO BE REMOVED

Catchment Area — Runoff Coefficient
Area in m²

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Project Number: 296
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Designed by: M. Heidari, PhD, P.Eng.
Sheet Number: F.4-1
Scale: As Indicated

APPENDIX A

Water Supply Calculations

- Water Demand Calculations

$$Q_d = \frac{P \times PC \times PF_D}{24 \times 3600} = \frac{20 \times 225 \times 2.75}{24 \times 3600} = 0.15\ lit/s$$

Q_d= $Maximum\ Daily\ Demand$

P= $Population$

PC= $Per\ Capita\ Demand$

PF_D= $Peaking\ Factor\ for\ Max.Day$

$$Q_h = \frac{P \times PC \times PF_H}{24 \times 3600} = \frac{20 \times 225 \times 4.13}{24 \times 3600} = 0.22\ lit/s$$

Q_h= $Maximum\ Hourly\ Demand$

P= $Population$

PC= $Per\ Capita\ Demand$

$$Q_d = \mathrm{Q}_d + Q_f = 0.15 + 45 \cong 45.2\ \mathrm{lit/s}$$

PF_H= $Peaking\ Factor\ for\ Max.Hour$

Q_f= $Fire\ Flow\ Demand$

Sanitary Swage Calculations

- Generated Sanitary Flow Calculations

$$PF = 1 + \frac{14}{4 + (TP)^{0.5}} = 1 + \frac{14}{4 + (\frac{20}{1000})^{0.5}} \cong 4.4$$

PF= Peaking Factor

TP= $Tributary\ Population\ in\ Thousands$

$$Q_S = \frac{P \times PC \times PF \times Un}{24 \times 3600} + In = \frac{20 \times 275 \times 4.4 \times 1.1}{24 \times 3600} + 0.25 \times \frac{1203.9}{10000} = 0.68\ lit/s$$

Qs= $Maximum\ Generated\ Sanitary\ Flow$

P= $Population$

PC= $Per\ Capita\ Genetated\ Flow$

Un= $Uncertainty$

In=Infiltration

- Sanitary Flow Pipe Design

$$Q = \frac{1}{n_{Manning}} R^{\frac{2}{3}} S^{\frac{1}{2}} A$$

Q = Design flow (m³/sec.)

$n_{Manning}$= Manning's Roughness Coefficient

R = Hydraulic Radius (m)

S = Slope of Pipe

A = Cross Sectional Area of Flow (m²)

Substituting the value for each parameter in the above equation, the required pipe diameter is calculated 70 mm.

Stormwater Flow Calculations

- Rainfall Intensity

Rainfall intensities for the subject site are summarized in the following table.

Table 4 – Rainfall Intensity (mm/hr) presented by MOT

Duration	10-min	15-min	30-min	1-hr	2-hr	6-hr
2-yr	80.9	61	37.6	23.2	14.3	6.7
5-yr	106.4	80.2	49.5	30.5	18.8	8.8
50-yr	160.6	121	74.6	46	28.4	13.2
100-yr	176.4	132.9	81.9	50.5	31.1	14.5

Based on the in-situ test results obtained from the geotechnical and hydrogeological studies conducted by EXP, it was recommended to assume a conservative unfactored infiltration rate of 110 mm/hour for the sand soils at the site (refer to geotechnical report for further details).

Table 5 includes the required storage volume for different rainfall intensities. As shown, the maximum storage volume required for the proposed development is 14.2 m^3. An infiltration chamber system was proposed as the storage facility to manage the stormwater runoff within the subject site (refer to drawings for further details).

Table 5 – Required storage (m^3)

Duration	10-min	15-min	30-min	1-hr	2-hr	6-hr
2-yr	0	0	0	0	0	0
5-yr	0	0	0	0	0	0
50-yr	11.0	4.3	0	0	0	0
100-yr	14.2	7.9	0	0	0	0

Explanation of Terms and Symbols

Q_V	The minimum supply of water for fire
K	Water supply coefficient
V	Volume
S_{tot}	Total spatial coefficient values from property line exposure on all sides
ppu	population per unit
ha	hectare
Q	Flow rate
C	Runoff coefficient
i	Rainfall intensity
A	Area
n	Manning's roughness coefficient
S	Slope
h	Height from catchbasin grate to center of orifice
g	Gravitational acceleration