DECEMBER 2024

ACADIA ENGINEERING

PARK MEADOW COURT FUNCTIONAL SERVICING REPORT

Table of Contents

Appendices

1 Introduction

Acadia Engineering Inc. has been retained by Andy Geerstma of GCL Developments Ltd. and is contracted to prepare and submit a Functional Servicing Report and a Stormwater Management Brief for the property located at a farming field along Farnham Road, within the City of Belleville, Ontario.

1.1 Background

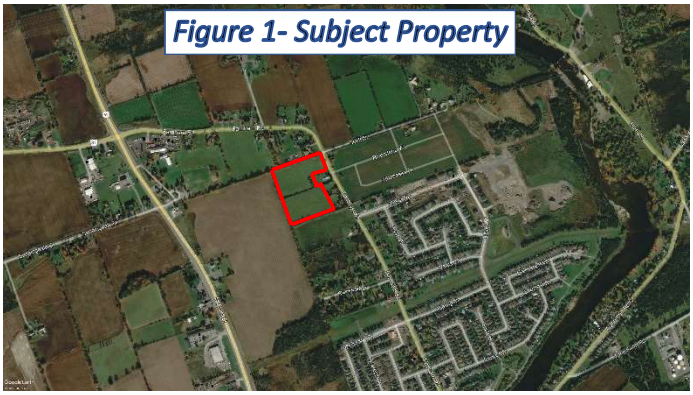


Figure 1- Subject Property

The subject site, referred to as the 'Park Meadow Court' herein, has its proposed entrance road located approximately 60 metres north of Riverstone Way on Farnham Road and is accessed from the west side of Farnham Road in Belleville.

The subject site consists of open field that has a west-east ridge that splits the northeast and southeast sloping lands. The lands are vacant with no existing structures. There are signs of agriculture farming use, which is acceptable use under the Corporation of the City of Belleville Zoning By-Law 2024-100, dated March 11, 2024. The Subject Property and every abutting property is zoned DC, Development Control, not including the properties directly east of Farnham Road.

The subject property is bordered by DC zoned farm fields to the west and south, and by Rural Residential properties to the north. The Riverstone Subdivision is directly on the other side of Farnham Road to the east, with higher density units.

It is Acadia's understanding that the present legal description is "Part of Park Lots 8 & 9 Plan 124 Thurlow as in QR298449 Except Parts 1, 2, 3, 4, 5 & 6, 21R26096; City of Belleville; County of Hastings".

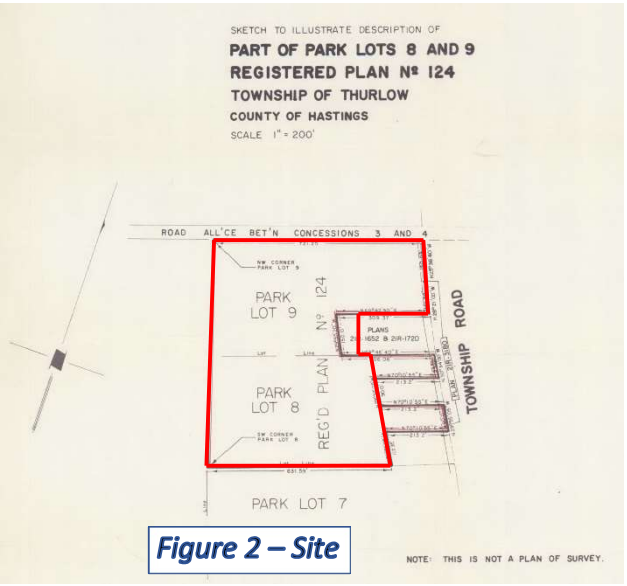


Figure 2 – Site

As seen in the detailed engineering drawings by Acadia (available separately), the proposed subdivision does suggest a severance acquisition from 208 Farnham Road, taking approximately 22m of their back yard from its west boundary, being 979m^2, which will allow better use of the land. This proposed severance area is accounted for in this report. See Section 3.1.2(4) for further information.

1.2 Purpose of the Functional Servicing Report

This Functional Servicing Report (FSR) has been prepared in support of a Preliminary Engineering Review to ensure the sanitary and watermain services are satisfactory prior to moving forward with a formal subdivision application.

The Preliminary Storm Water Management (SWM) Brief will also be attached to this report as a separate PDF document. The purpose of that Brief is to demonstrate that the property can be serviced for storm water management purposes in accordance with the City of Belleville design criteria and Provincial standards as it relates to ensuring there is enough room on the property for the pond. J.F. Sabourin and Associates Inc. produced the Preliminary SWM Brief, dated June 28, 2023.

1.3 Guidelines and Source Drawings

In preparation for site servicing, the following design guidelines and standards were used:

- City of Belleville Zoning By-Law 2024-100 – March 11, 2024
- Draft City of Belleville Development Manual: Manual Respecting Procedures, Policies, Standards – September 15, 2023
- City of Belleville Design Standards and Specifications for Engineering and Development Services – February 1, 2013
- City of Belleville Site Plan Guidelines – January 31, 2005
- City of Belleville Cannifton Secondary Plan Sanitary Sewer Servicing Study – January 2001
- City of Belleville Municipal Servicing Review and Study Update, Cannifton Secondary Plan – February 2, 2014
- City of Belleville Environmental Compliance Approval for a Municipal Sewage Collection System – ECA Number 151-W601 – October 6, 2022
- MOECC 2008 Design Guidelines for Drinking-Water Systems
- MOECC 2008 Design Guidelines for Sewage Works
- Fire Underwriter's Survey (FUS): Water Supply for Public Fire Protection – 2020
- IPEX Municipal Product Catalogue – September 22, 2023

2 Existing Services

There is an existing 200mm diameter PVC sanitary sewer, as well as a 400mm diameter PVC watermain located at the intersection of Riverstone Way and Athabaska Drive, as shown in Figure 3. This sanitary network ultimately leads down to the Moira Lea Sanitary Pumping Station (SPS), located at 9 Moira Lea Court. The existing watermain is capped at the intersection of Riverstone Way and Farnham Road. It is understood that Farnham Road is planned to have a 400mm diameter PVC line installed in its new right-of-way. However, Acadia is not planning on taking into account that realignment for the purposes of this report. The realignment of Farnham Road will be designed by others and does not form part of this report and subsequent subdivision design at this time.

A hydrant test at the southwest corner of Athabaska Drive and Riverstone Way was conducted by the city in May 2023, which produced a static pressure of 52psi (358.5kPa, 36.569m of head). The results are in Appendix B.

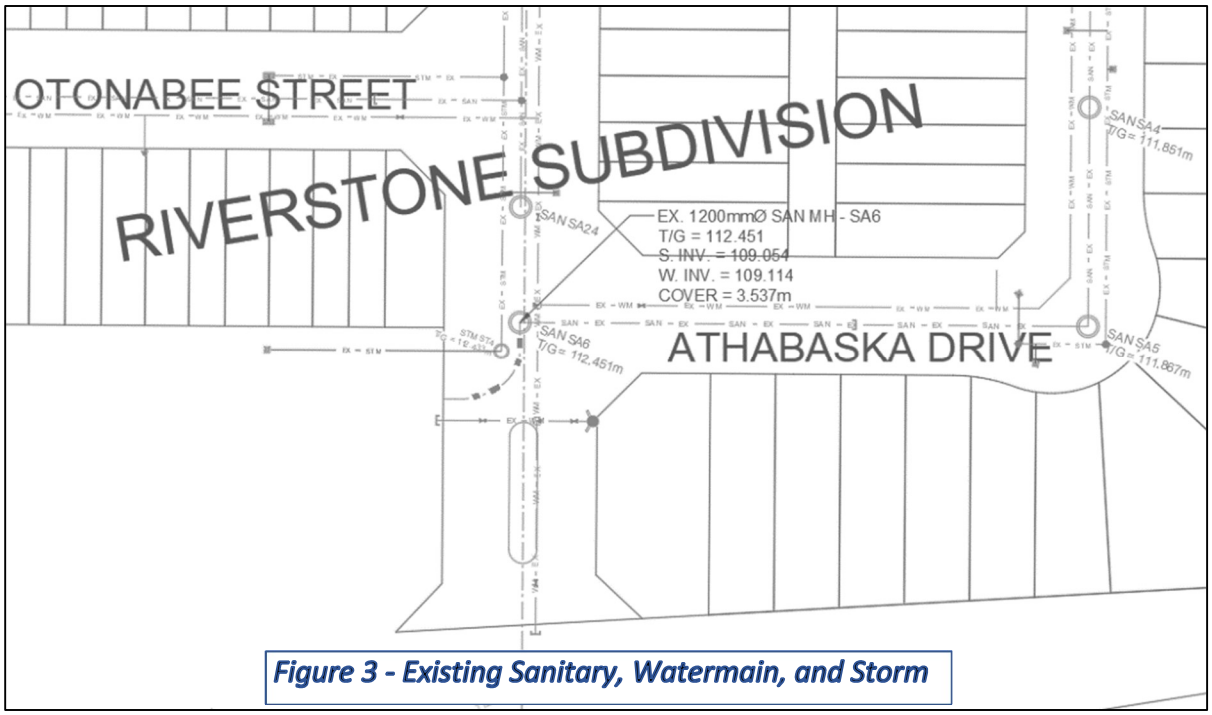


Figure 3 - Existing Sanitary, Watermain, and Storm

3 Overview of Proposed Subdivision

The Subject Property is proposed to have three (3) phases of development – 35 units, 74 units, and 4 units, totalling 113 residential units. Phase 1, of 35 units, is what Acadia is proposing to develop at this time, whilst Phase 2, of 74 units, and Phase 3, of 4 units, are both proposed for future development.

The 35 units were based off the allotment of sanitary flow left over from the development of the Riverstone Subdivision, as explained in Section 4.

74 units mainly resulted from the guidelines set out in the NFPA, which has a maximum of 100 units permitted within a dead-end road. Then the four (4) additional units are prospective lots which form part of Block 2 and 208 Farnham Road. (See Section 3.1.2(4) for further explanation.) Additionally, the layout and number of units were also controlled by the proposed zones from the Zoning By-Law.

Furthermore, the entirety of Phases 2 and 3 are proposed to have the zoning changed from DC to their new zones, with the '-H' symbol added to denote that the properties are under a hold until such time that the Sanitary Pumping Station is upgraded to accept the needed capacity, or if the sanitary flow is redirected westerly along Maitland Drive, as the case may be.

The total area for the complete subdivision is 4.63 hectares. For Phase 1, it is 1.72ha, 2.77ha for Phase 2, and 0.14ha for Phase 3. This includes the severance, Stormwater Pond, and parkland.

The proposed development of 113 units comprises of 19 one-unit detached dwellings, 8 one-unit semi-detached dwellings, 68 multi-storey one-unit townhouses, 3 four-unit dwelling, 2 eight-unit stacked townhouses, 1 stormwater pond, and 1 park. See Table 3.0 below for the units spread out over the three phases:

Table 3.0: 113 Dwelling Units by Zones and Phase

Phase	R2-2 / R2-2-H					OS
	One-Unit Detached	**One-Unit Semi-Detached**	**Multi-Storey One-Unit Townhouse**	**Four-Unit Dwelling**	**Eight-Unit Stacked Townhouse**	**Stormwater Pond & Parkland**
1	10	*(None)*	13 *(3 Townhouses)*	12 *(3 dwellings)*	*(None)*	*One Pond and One Park (2)*
2	5	8	45 *(11 Townhouses)*	*(None)*	16 *(2 Townhouses)*	*(None)*
3	4	*(None)*	*(None)*	*(None)*	*(None)*	*(None)*
Total	**19**	**8**	**58** ***(19 Townhouses)***	**12** ***(3 Townhouses)***	**16** ***(2 Townhouses)***	**One Pond and One Park** ***(2)***

The preliminary drawing set for the proposed subdivision is attached alongside this FSR.

3.1 Explanation of Select Drawing Pages

3.1.1 ENG-PH

The red area delineates the 35 units for Phase 1, whilst the green area denotes Phase 2, and blue for Phase 3.

3.1.2 ENG-GSL

Since Zoning By-Law 2024-100 has recently come into effect on March 11, 2024, Acadia has abided by the new changes from the previous Thurlow Zoning By-Law 3014. Accordingly, the decision to use the chosen zones are based off what is in the Riverstone Subdivision for given permitted uses.

From this, the explanation of the proposed zones are as follows:

(1) Zone R2-2: One-Unit Detached Dwelling, One-Unit Semi-Detached Dwelling, Multi-Storey One-Unit Townhouse, Four-Unit Dwelling and Eight-Unit Stacked Townhouse

This zone was previously known as R3-2 in the Thurlow Zoning By-Law 3014. The smallest lot area for an individual unit in a townhouse in our development is 181.8m^2, which is above the minimum of 180m^2, but below the regular R2 minimum of 225.0m^2.

In an email correspondence between the City and Mr. Geertsma, dated 25th March 2024, the City recognises “a technical omission made during the drafting of the new site-specific provision”, in which the R2-2 zone was inherently supposed to include a provision that will now be included in the future revision of the Consolidated Zoning By-Law:

g) Interior Side Yard Width (minimum):

i) One-unit detached dwellings: 1.2 metres, and 0.6 metres on the other side.

(2) Zone OS: Open Space

The proposed parkland naturally fits within the permitted uses of the Open Space zone, along with the Stormwater Pond, despite Stormwater Ponds not explicitly stated.

(3) Zone DC: Development Control & Block 2

Pertaining to the zoning by-law, the area west of Farnham Road is designated for Development Control zoning, which was a change from the previous Rural Residential zones. This rezoning potentially enhances the subdivision potential of the western part of 208 Farnham Road compared to its current Rural Residential zoning classification. Acadia suggests the rezoning of approximately 420m^2 of land, identified as Block 2 and situated directly behind 208 Farnham Road, to R2-2-H.

Additionally, it is proposed to sever approximately 979m^2 from the rear yard of 208 Farnham Road. This severance is intended to increase the size of Block 2, thereby enabling the development of four (4) single-detached dwelling units, solely as part of Phase 3. The completion

of this severance would likely be subject to a subsequent application process and hinges on the agreement of the owner(s) of 208 Farnham Road to the proposed severance.

3.1.3 ENG-003 & ENG-004: Servicing Layout

In the southeast area of the Subject Property, a grey hatch is denoted as the proposed fill area. This approximate area was created in order to permit adequate flow and pipe slope requirements in the sanitary network. The rest of these two pages denote the proposed sanitary and watermain networks.

4 Proposed Sanitary Servicing

As shown in our detailed engineering drawings (namely ENG-005), we are proposing to extend the existing sanitary sewer from the intersection of Riverstone Way and Athabaska Drive to the intersection of Riverstone Way and Farnham Road. Next, it travels northward along Farnham Road, where it will then intersect with Street 'Park Meadow Court' and forms a loop around. Being that the existing sanitary network in Riverstone Way is 200mm dia. SDR35 PVC in size, that will be the material type for the proposed subdivision. The following subsection will show that the Park Meadow Court Subdivision has allowances in place to support the development in a three (3) Phase approach.

4.1 Riverstone Subdivision Allotment

According to correspondence with the City of Belleville, the Riverstone Subdivision was allotted 22.8L/s for their design flow. In the 'Sanitary Sewer Design Sheet' produced by Ainley Group for the Riverstone Subdivision, they calculated the Riverstone Subdivision network will only use 20.3L/s, thus leaving 2.5L/s available for excess use.

Other requirements for the design came from the MOE Design Guidelines for Sewage Works, which are mainly the velocity in the pipes and the slopes. For minimum and maximum velocities in the sanitary piping system, the MOE stipulates a required range of 0.6m/s and 3.0m/s, as per MOE Section 5.7.6. Then for pipe slopes, MOE Section 5.7.5 and Table 5-4, gives the minimum slope according to each nominal diameter pipe.

Accordingly, the proposed 200mm dia. pipe can be as low as a 0.40% grade; however, Belleville's Draft Development Manual requires 0.70% grades at the most upstream sections of the sanitary network, as per Section F.2.3.1.7. Therefore, our first upstream pipes, have a slope of 0.70%, while the remainder of the proposed network has 0.40% grade. The pipe between SA36 and SA37 is also 0.70% because it was found to be optimal for our design calculations.

Placing the MOE equations and parameters into an Excel sheet produces a Design Flow of 2.49L/s at Sanitary Manhole SA6, which is below the 2.50L/s available. This allowance permits **35 units** for Part 1 when we consider the excess flow allotted from the Riverstone Subdivision. The calculations are included in Appendix A.

Then for Phase 2 and 3, the entire proposed network is considered, and the calculations were undertaken to produce a Design Flow of 6.57L/s. As mentioned previously, Phase 2's additional 74 units and Phase 3's 4 units will have to have a Hold put over it until either the Sanitary Pumping Station is upgraded to a higher capacity or that the sanitary flow is redirected westerly along Maitland Drive.

Table 4.1 summarises the allocation of the sanitary flows for the subdivision.

Table 4.1 – Site Allocation Summary of Flows

Phase of Development	Number of Dwelling Units	Resultant Flows (L/s)
Phase 1	35	2.49
Phase 2 & 3 (HOLD)	74 + 4	4.09
Total Subdivision	113	6.58

5 Proposed Water Servicing

As shown in our detailed engineering drawings, we are proposing to extend the existing watermain from the west end of Riverstone Way and extend it northward to the proposed Subdivision. In the proposed plan, Street "Park Meadow Court" will follow the 20.0m Right of Way of an urban local road cross section (Spec. M-9).

Being that both the future alignment of Farnham Road and the existing pipe in Riverstone Way have 400mm dia. SDR35 PVC piping, it is therefore proposed to install 400mm dia. piping along the current Farnham Road alignment and tee off at the intersection of Park Meadow Court, continuing at 400mm dia. SDR18 to service the subdivision. Pipes 6 and 8 are 400mm dia. SDR18. The remaining pipes in the network are 300mm dia. SDR18 PVC. (See Map 1 in Appendix C for the map of pipe numbers.) This was sized larger to permit minimum flow and was found using trial-and-error; the diameters of the pipes at the entrance area were adjusted until minimum pressures were met. For Phase 1, the same resizing was also applied to permit Phase 2 and 3.

For Street Park Meadow Court, the watermain pipes will be 3.0m offset from the centerline of the road right of way, which is in conformity with Belleville's standard cross sections of right of ways. Additionally, the 400mm dia. and 300mm dia. pipe both have a Roughness Coefficient, C, of 120.

5.1 Demand Calculations

5.1.1 113 & 35 Units

According to the Draft Belleville Development Manual, Section F2.3.1.1.1 stipulates that single-unit dwellings consists of 3 persons, while multi-unit dwellings contain 2.5 persons per unit (e.g., townhouses and semi-detached). The Domestic Water Demand for Belleville is 350L/cap*d (taken from 'Per capita Sewage Flow', Section F.2.3.1.1.2), and the peaking factors are from Table 3-3 in the Design Guidelines for Drinking-Water Systems, MOE.

The EPANET (Version 2.2) program was used to model the water pressure and velocity throughout the proposed watermain system. With the requirements of a System Pressure being at least 40psi (275kPa, 28.130m of head) at any point in the system, 20psi (140kPa, 14.065m) with fire demand, as well as a maximum velocity of 5.0m/s, two scenarios were made to validate the subdivision unit count of 35 units – one with fire flow and one without. The same was done for the 113-unit count.

The proposed pipe networks were created in EPANET, with links and nodes to represent the pipes, junctions, and indirectly, fire hydrants. A reservoir and pump represent the existing fire hydrant on Riverstone Way, which has 36.569m (52psi, 358.5kPa) to draw from. The flow test provided by the city of was used to create our pump in EPANET. Node ID 14 (see Appendix C) represents one of the proposed fire hydrants along Park Medow Court – at which we compare against the required minimum fire flows because the units on the north side of Phase 1 are one-unit detached dwellings. For the 35-unit scenario, Node 7 has the RFF because Node 14 is only in Phase 2.

Since the Nodes of the pipe model represents junction points in the network (i.e., elbows, tees), the demand flow from the proposed residential properties are enacted upon the corresponding Nodes.

The method of calculating the Nodes' residential demands is as follows:

- $F\# = (\#\ of\ Units) \cdot (\#\ of\ Persons\ Per\ Unit) \cdot (Peaking\ Factor) \cdot \frac{350}{86400}$
- Whereas:
    - F# is the Base Demand, Litres per Second (LPS), for a given Node.
    - # of Units is the total number of residential units that have their respective water service lateral pipe attached to the pipe(s) in question for a given Node.
    - # of Persons Per Unit means the number of people designated per unit, as per the previously mentioned Section F2.3.1.1.1.
    - Peaking Factor is as per Table 3-3 from the MOE. For the 103-unit model, 4.5 was used, whilst 7.4 for the 35-unit model.
    - 350 is 350 Litres per person per day, as per Belleville's Domestic Water Demand.
    - 86400 is for the conversion of units.

Where there are cases of Nodes containing both 2.5ppu and 3.0ppu units, the types are calculated separately, then added together.

(1) Fire Flow Calculations

To confirm that the watermain system is a suitable design for our proposed development, Acadia (via the City of Belleville) completed a Fire Flow Test on the hydrants at the locations shown in Appendix B. The results of the Fire Flow Test are also summarized in Appendix B.

Utilizing the Fire Underwriters Survey, 2020, the Required Fire Flow (RFF) was calculated. We are using the worst-case scenario, which is a single-detached residential unit.

Under the "Additional Items of Note" section, sub-section vi. stipulates that we are permitted to use a timesaving method that gives us an RFF. Table 7, as shown below, was extracted from the guide.

"Table 7 Simple Method for One- and Two-Family Dwellings Up To 450 sq.m"

Exposure distances	Suggested Required Fire Flow (LPM)	
	Wood Frame	Masonry or Brick
Less than 3m	8,000	6,000
3 to 10m	4,000	4,000
10.1 to 30m	3,000	3,000
Over 30m	2,000	2,000

Given that the proposed One-Unit Detached Dwellings are planned to be zoned R2-29, the shortest exposure distance will be 2.4m. Additionally, the construction is expected to be Wood Frame. Thus, the Suggested Required Fire Flow in this subdivision is 8,000LPM (2,113.4USGPM, 133.33LPS). The RFF for the 35 units remains 133.33LPS, regardless of the number of units in the development, so long as there are One-Unit Detached Dwellings present.

From the EPANET modeling scenarios, we have 34.85m (49.56psi, 341.67kPa) without RFF included at Node 17, and 17.19m (24.44psi, 168.53kPa) with RFF included at Node 14 for 113 units.

For 35 units, the resultant pressure is 34.91m (49.64psi, 342.26kPa) without RFF, at Node 13, and 18.60m (26.45psi, 182.36kPa) with RFF included at Node 13 as well.

Therefore, since the four static pressure conditions are above the minimum pressures, the System Pressure requirements are met in both scenarios.

(2) Velocity Calculations

Next, for the Maximum Velocity requirement of 5.0m/s was also analysed. The controlling aspects for calculating the velocity for EPANET are the length, diameter (nominal), and Roughness Coefficient. Hydraulic Head and elevations are also added to the network based off the surface elevations (approximate) and the Pump Curve (See Appendix B for the Pump Curve and its equation).

Based on these inputs, the 113-unit scenario without RFF shows a velocity range from 0.00m/s to 0.04m/s, whilst 113 units, with RFF, ranges from 0.00m/s to 1.10m/s.

Likewise, for the 35 units, without RFF it is 0.00m/s to 0.04m/s, whilst with RFF it ranges from 0.00m/s to 1.09m/s.

Since the velocities are both below the Maximum Velocity and that the pressures are above their minimum requirements, the proposed watermain network is permissible.

6 Summary

This Functional Servicing Report and attached separate cover Stormwater Management Brief has been prepared in support of the Preliminary Engineering Review for the property located in a farming field along Farnham Road, Belleville. This report outlines how the property can be adequately serviced in accordance with the City of Belleville and the associated provincial design criteria and policies.

6.1 Sanitary Servicing

- The sewage network in Riverstone Subdivision only uses 20.3L/s out of the allocated 22.8L/s, providing a spare capacity of 2.5L/s. This design accommodates the first phase with 35 units, demanding 2.49L/s. Additionally, the network incorporates varying slopes, with initial upstream pipes set at a steeper 0.70% grade, while the rest maintain a 0.40% grade. In tandem with these considerations, Phase 2 and 3, which is intends another 74 and 4 units, respectively, and requiring a total flow of 6.58L/s, must be placed on hold, as it awaits further developments in infrastructure or alternative flow management solutions.

6.2 Water Servicing

- EPANET modeling was employed to evaluate the watermain design, an analysis that ensured the water pressures met the required standards, ranging from 34.91m of head (49.64psi) under normal conditions to 17.19m (24.44psi) under fire demand. The pipe diameters, varying between 300mm, and 400mm, were used in achieving these pressure levels. Additionally, the velocity within the pipes remained well under the maximum threshold of 5.0m/s, thus adhering to velocity standards.

Submitted by: Updated by:

Steve Harvey, P.Eng.
Date: **2024/12/03**
YYYY/MM/DD

Alexander Bridgett, rcji, Dipl.T.
Date: **2024/12/03**
YYYY/MM/DD

Zachary Wilson, Dipl.T.
Date: **2024/12/03**
YYYY/MM/DD

Appendix A:
Sanitary Design Calculations (35 & 113 Units)

Acadia Engineering Inc.
121 Dundas Street East, Suite 103A
Belleville, Ontario K8N 1C3
steve@acadiaeng.ca

ACADIA ENGINEERING

SANITARY SEWER DESIGN SHEET - 35 Units

Project #: 22-218 **Project:** Park Meadow Court Subdivision **Date:** December 3, 2024
Client: Geertsma Homes **Designed:** ZAW **Checked:** SGH

Proposed Building: *23 Single-Unit dwelling units & 3 Four-Unit townhouses.*

Peak Design Flow Calculation:

Persons/Unit		Where:	
Town House	2.5	q, Average daily per capita flow:	350 L/Person/Day
Single-Unit Dwelling	3.0	ℓ, Unit of peak extraneous flow:	0.28 L/s/ha
		M, Harmon peaking factor (min. = 2)	
		P, Population is in 1000's	
		A, Area is hectares	

Pipe Capacity, Manning's Equation

$$Q = \frac{1}{n} \times A \times R^{2/3} \times S^{1/2}$$

Where:

A	Area of pipe {m^2}
R	Hydraulic Radius = A/P {m}
P	Wetted Perimeter {m}
S	Slope {m/m}
n	Manning's Friction Coef.

Calculated Pipe Diameter

$$D \approx 1.5483 \left(\frac{n\,Q}{\sqrt{S}}\right)^{3/8}$$

Where:

Q	Peak Flow, Q_P {m^3/s}
S	Slope {m/m}
n	Manning's Friction Coef.

Capacity of Sanitary Sewers

$$Q_{total\ flow} \leq Q_{capacity}$$

$0.6 m/s \leq V < 3 m/s$

Actual Velocity in Pipe

$$V = \frac{4\,Q}{\pi\,D^2}$$

Where:

V	V_A
Q	Peak Flow, Q_P
D	Calc. Dia., D_C

(From IPEX Inc. "Municipal Product Catalogue", August 2024)

For PVC Sanitary Piping, DR35, dia. mm:	100, 135, 150, 200, 250, 300, 375, 450, 525, 600, 675, 750, 900, 1050, 1200, 1350, 1500

LOCATION				DESIGN FLOWS									SEWER DATA						
				INDIVIDUAL			ACCUMULATIVE			FLOWS			PIPE DIAMETER						
Area	STREET	FROM MH	TO MH	# of UNITS	POP (persons)	AREA (ha)	POP (persons)	AREA (ha)	PEAKING FACTOR (M)	RES Qp (L/s)	EXTRAN Qi (L/s)	TOTAL Qt (L/s)	NOMINAL (mm)	INNER (mm)	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	Q_{Total}/Q_{Cap}
1B	PARK MEADOW COURT	SAN 37	SAN 36	23.0	63.0	0.98	63.0	0.98	4.29	1.1	0.27	1.37	200	203.20	0.70	79.6	28.63	0.88	0.048
1C	PARK MEADOW COURT	SAN 36	SAN 32	2.0	5.0	0.51	68.0	1.49	4.29	1.2	0.42	1.60	200	203.20	0.40	81.1	21.64	0.67	0.074
1F	PARK MEADOW COURT	SAN 33	SAN 32	1.0	3.0	0.36	71.0	1.53	4.28	1.2	0.43	1.66	200	203.20	0.40	81.8	21.64	0.67	0.077
1G	PARK MEADOW COURT	SAN 32	SAN 31	9.0	27.0	0.50	98.0	2.03	4.25	1.7	0.57	2.25	200	203.20	0.40	95.9	21.64	0.67	0.104
1H	PARK MEADOW COURT	SAN 31	SAN 30	0.0	0.0	0.04	98.0	2.07	4.25	1.7	0.58	2.27	200	203.20	0.40	16.2	21.64	0.67	0.105
1I	FARNHAM ROAD, 1I	SAN 30	SAN 29	0.0	0.0	0.24	98.0	2.31	4.25	1.7	0.65	2.33	200	203.20	0.40	47.0	21.64	0.67	0.108
F	RIVERSTONE WAY, A	SAN 29	SAN 6	0.0	0.0	0.58	98.0	2.89	4.25	1.7	0.81	2.495	200	203.20	0.40	95.4	21.64	0.67	0.115

*1.53 is only including the area of lot 10 (ignore the remaing 0.320 ha)

Acadia Engineering Inc.
121 Dundas Street, Suite 103A
Belleville, ON K8N 1C3
steve@acadiaeng.ca

ACADIA ENGINEERING

SANITARY SEWER DESIGN SHEET - 113 Units

Project #: 22-218 **Project:** Park Meadow Court Subdivision **Date:** December 3, 2024
Client: Geertsma Homes **Designed:** ZAW **Checked:** SGH

Proposed Building: *19 Single detatched dwelling units, 58 single multi-storey townhouses, 8 single semi-detached dwelling units, Three (3) 4 unit dwellings & Two (2) 8 unit stacked townouses.*

Peak Design Flow Calculation:

Persons/Unit	
Town House	2.5
Single-Unit Dwelling	3.0

Where:
q, Average daily per capita flow: 350 L/Person/Day
ℓ, Unit of peak extraneous flow: 0.28 L/s/ha
M, Harmon peaking factor (min. = 2)
P, Population is in 1000's
A, Area is hectares

Pipe Capacity, Manning's Equation

$$Q = \frac{1}{n} \times A \times R^{2/3} \times S^{1/2}$$

Where:
A Area of pipe {m^2}
R Hydraulic Radius = A/P {m}
P Wetted Perimeter {m}
S Slope {m/m}
n Manning's Friction Coef.

Calculated Pipe Diameter

$$D \approx 1.5483 \left(\frac{n\,Q}{\sqrt{S}}\right)^{3/8}$$

Where:
Q Peak Flow, Q_P {m^3/s}
S Slope {m/m}
n Manning's Friction Coef.

Actual Velocity in Pipe

$$V = \frac{4\,Q}{\pi\,D^2}$$

Where:
V V_A
Q Peak Flow, Q_P
D Calc. Dia., D_C

Capacity of Sanitary Sewers

$Q_{total\ flow} \leq Q_{capacity}$

0.6m/s$\leq V <$ 3m/s

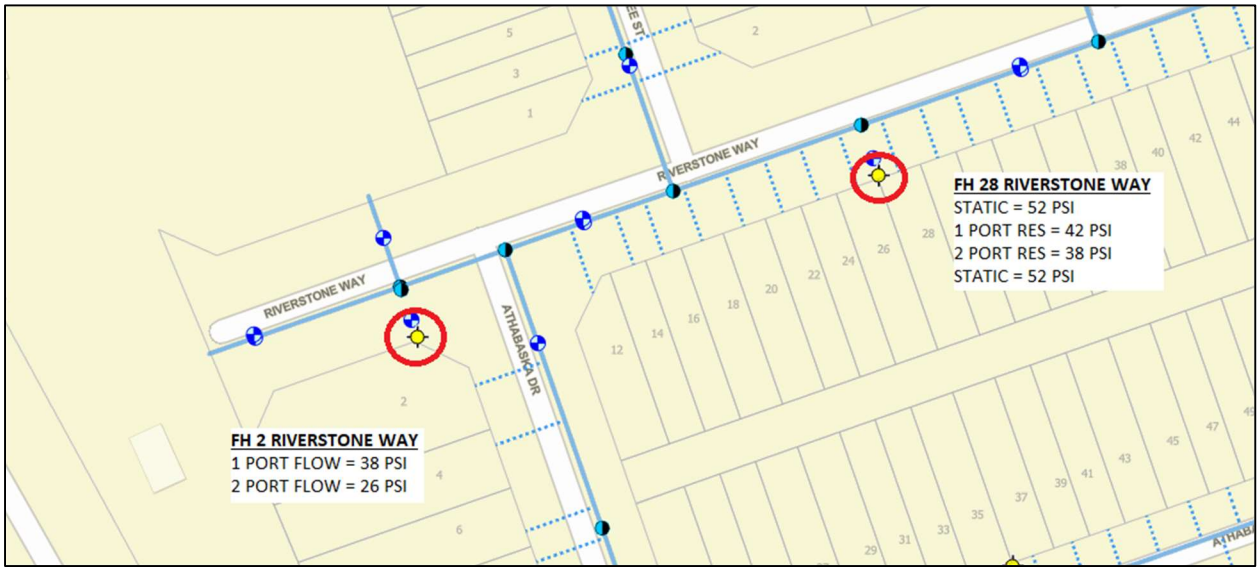
(From IPEX Inc. "Municipal Product Catalogue", August 2024)
For PVC Sanitary Piping, DR35, dia. mm: 100, 135, 150, 200, 250, 300, 375, 450, 525, 600, 675, 750, 900, 1050, 1200, 1350, 1500

LOCATION				DESIGN FLOWS									SEWER DATA						
				INDIVIDUAL			ACCUMULATIVE		PEAKING	FLOWS			PIPE DIAMETER		SLOPE	LENGTH	CAPACITY	VELOCITY	Q_{Total}/Q_{Cap}
Area	STREET	FROM MH	TO MH	# of UNITS	POP (persons)	AREA (ha)	POP (persons)	AREA (ha)	FACTOR (M)	RES Qp (L/s)	EXTRAN Qi (L/s)	TOTAL Qt (L/s)	NOMINAL (mm)	INNER (mm)	(%)	(m)	(l/s)	(m/s)	
1A	PARK MEADOW COURT	SAN 38	SAN 37	12.0	30.0	0.39	30.0	0.39	4.35	0.53	0.11	0.64	200	203.20	0.70	58.7	28.63	0.88	0.022
1B	PARK MEADOW COURT	SAN 37	SAN 36	39.0	104.0	0.98	134.0	1.37	4.21	2.28	0.38	2.67	200	203.20	0.70	79.6	28.63	0.88	0.093
1C	PARK MEADOW COURT	SAN 36	SAN 32	6.0	15.0	0.51	149.0	1.88	4.19	2.53	0.53	3.06	200	203.20	0.40	81.1	21.64	0.67	0.141
1D	PARK MEADOW COURT	SAN 35	SAN 34	25.0	74.0	0.80	74.0	0.80	4.28	1.28	0.22	1.51	200	203.20	0.70	81.5	28.63	0.88	0.053
1E	PARK MEADOW COURT	SAN 34	SAN 33	12.0	30.0	0.58	104.0	1.38	4.24	1.79	0.39	2.17	200	203.20	0.40	79.3	21.64	0.67	0.100
1J	PARK MEADOW COURT	SAN 34	SAN 33	2.0	6.0	0.24	6.0	0.24	4.43	0.11	0.07	0.17	200	203.20	0.70	79.3	28.63	0.88	0.006
1J	PARK MEADOW COURT	SAN 33	SAN 32	2.0	6.0	0.24	6.0	0.24	4.43	0.11	0.07	0.17	200	203.20	0.70	81.8	28.63	0.88	0.006
1F	PARK MEADOW COURT	SAN 33	SAN 32	6.0	18.0	0.36	134.0	1.98	4.21	2.28	0.55	2.84	200	203.20	0.40	81.8	21.64	0.67	0.131
1G	PARK MEADOW COURT	SAN 32	SAN 31	9.0	27.0	0.50	310.0	4.36	4.07	5.11	1.22	6.33	200	203.20	0.40	95.9	21.64	0.67	0.293
1H	PARK MEADOW COURT	SAN 31	SAN 30	0.0	0.0	0.04	310.0	4.40	4.07	5.11	1.23	6.35	200	203.20	0.40	16.2	21.64	0.67	0.293
1I	FARNHAM ROAD, 1I	SAN 30	SAN 29	0.0	0.0	0.24	310.0	4.64	4.07	5.11	1.30	6.41	200	203.20	0.40	47.0	21.64	0.67	0.296
F	RIVERSTONE WAY, A	SAN 29	SAN 6	0.0	0.0	0.58	310.0	5.22	4.07	5.11	1.46	6.58	200	203.20	0.40	95.4	21.64	0.67	0.304

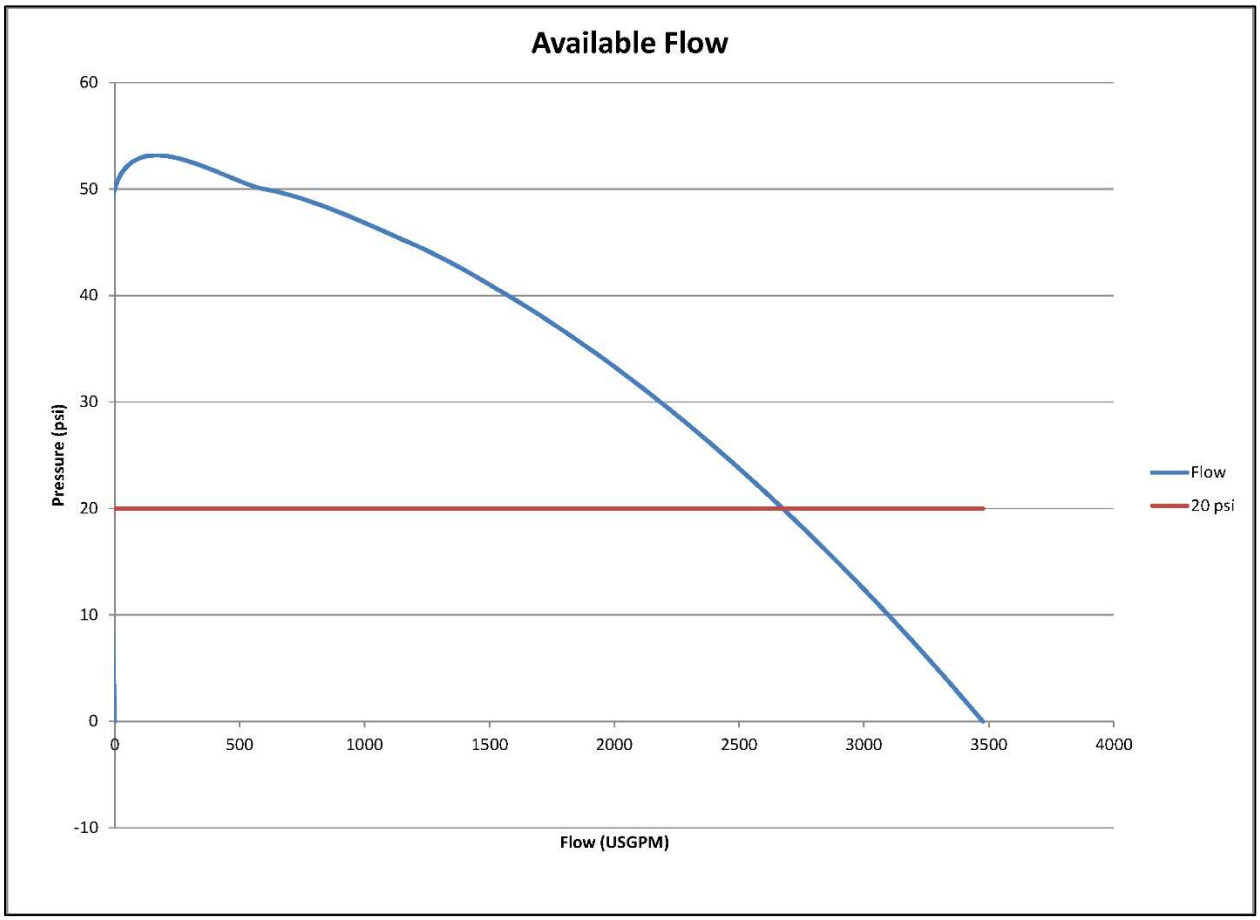
Acadia Engineering Inc.
121 Dundas Street, Suite 103A
Belleville, ON K8N 1C3
steve@acadiaeng.ca

Appendix B:
Hydrant Test Results & Pump Curve

Location of The Two Fire Hydrants Along Riverstone Way

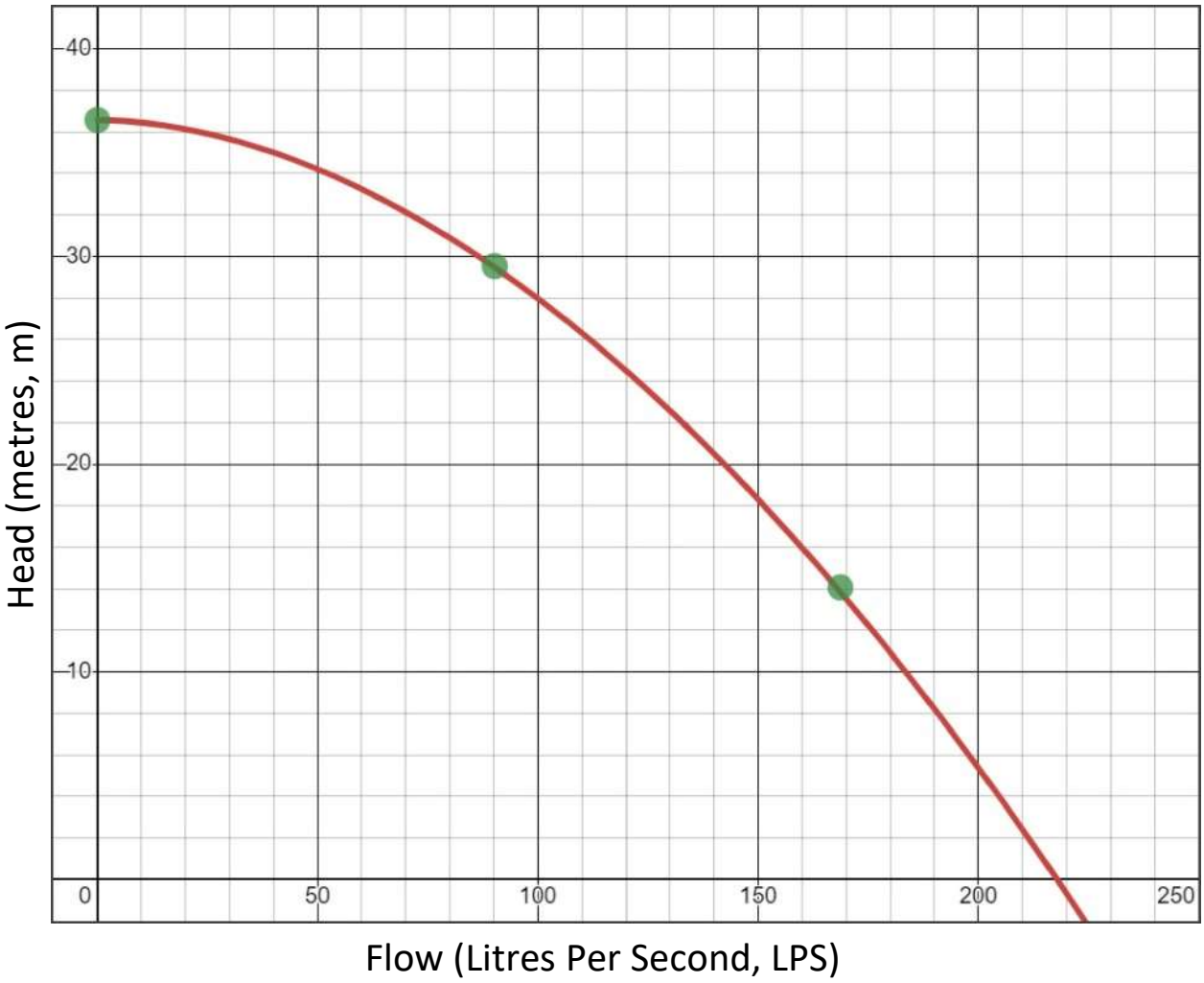


Hydrant Flow Graph – FH 28 – Riverstone Way



EPANET Pump Curve

$$Head = 36.569 - 0.001637(Flow)^{1.86}$$

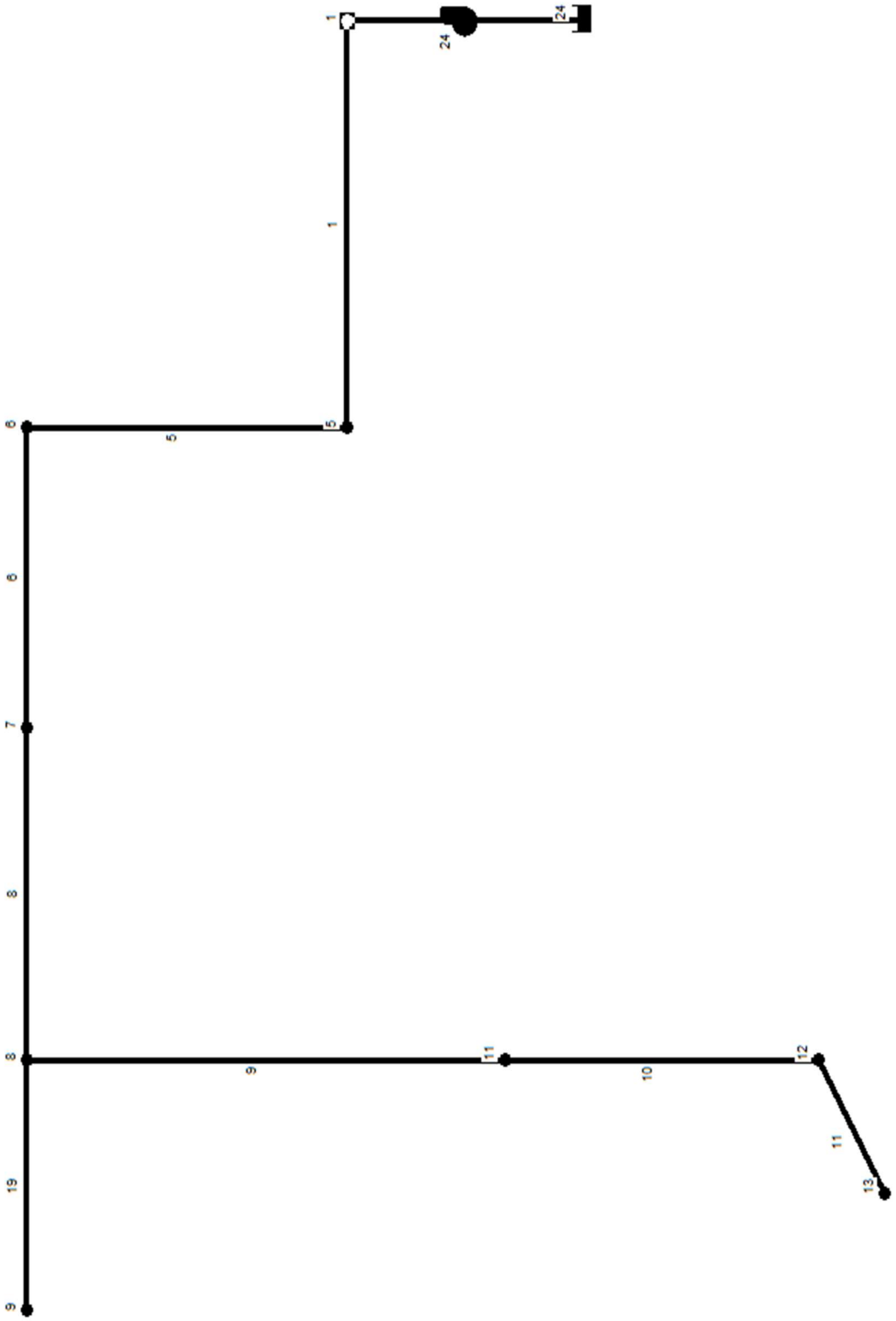


Flow, LPS	Head, m
0.000	36.569
90.200	29.537
168.690	14.065

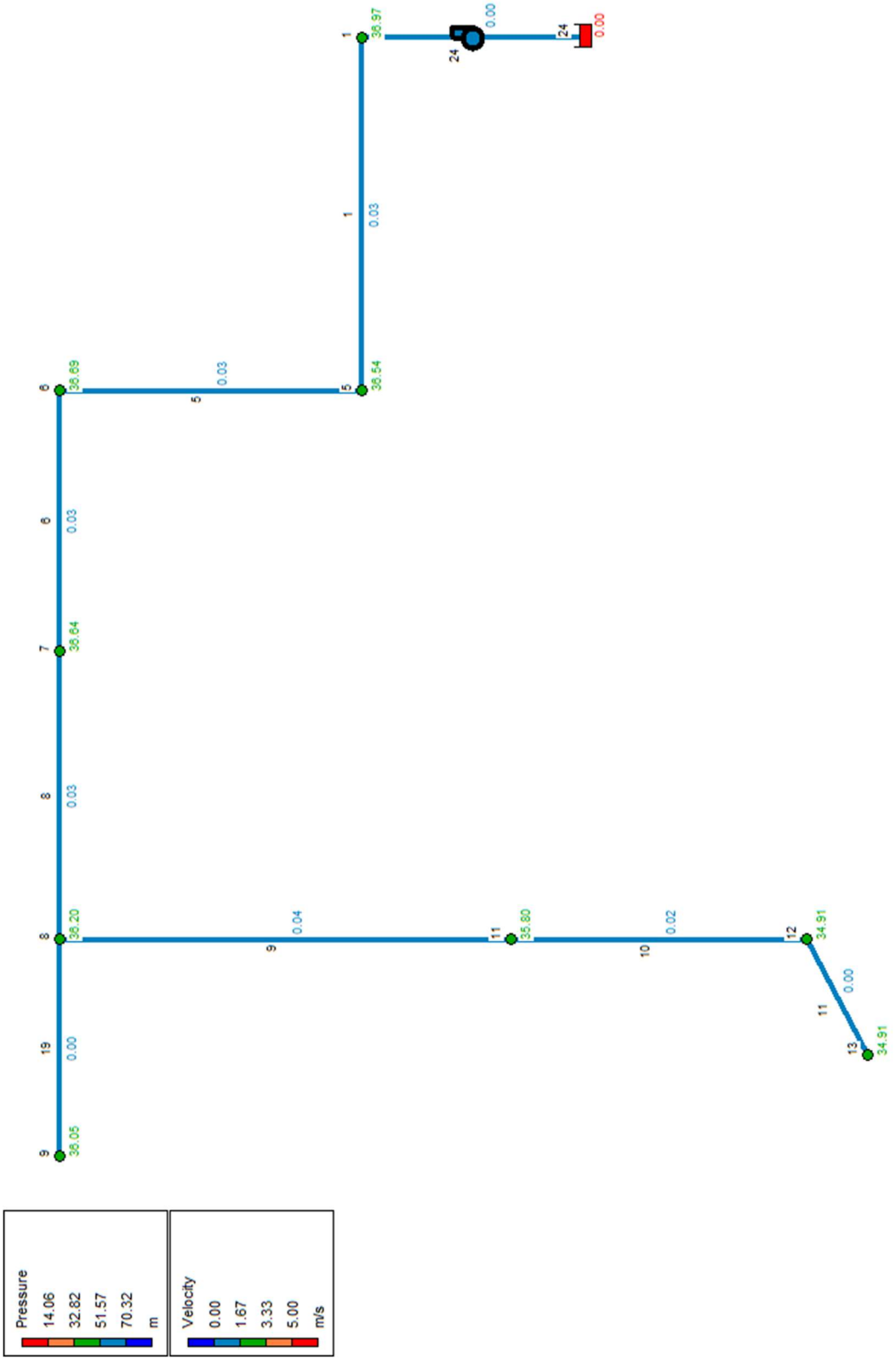
Appendix C:
Watermain Design – EPANET Modeling

Acadia Engineering Inc.
121 Dundas Street East, Suite 103A
Belleville, Ontario K8N 1C3
steve@acadiaeng.ca

Map 1: 35-Unit: EPANET – Link and Node Numbering



Map 2: 35-Unit: EPANET – Scenario without Required Fire Flow (RFF)



Map 3: 35-Unit: EPANET – Scenario with RFF

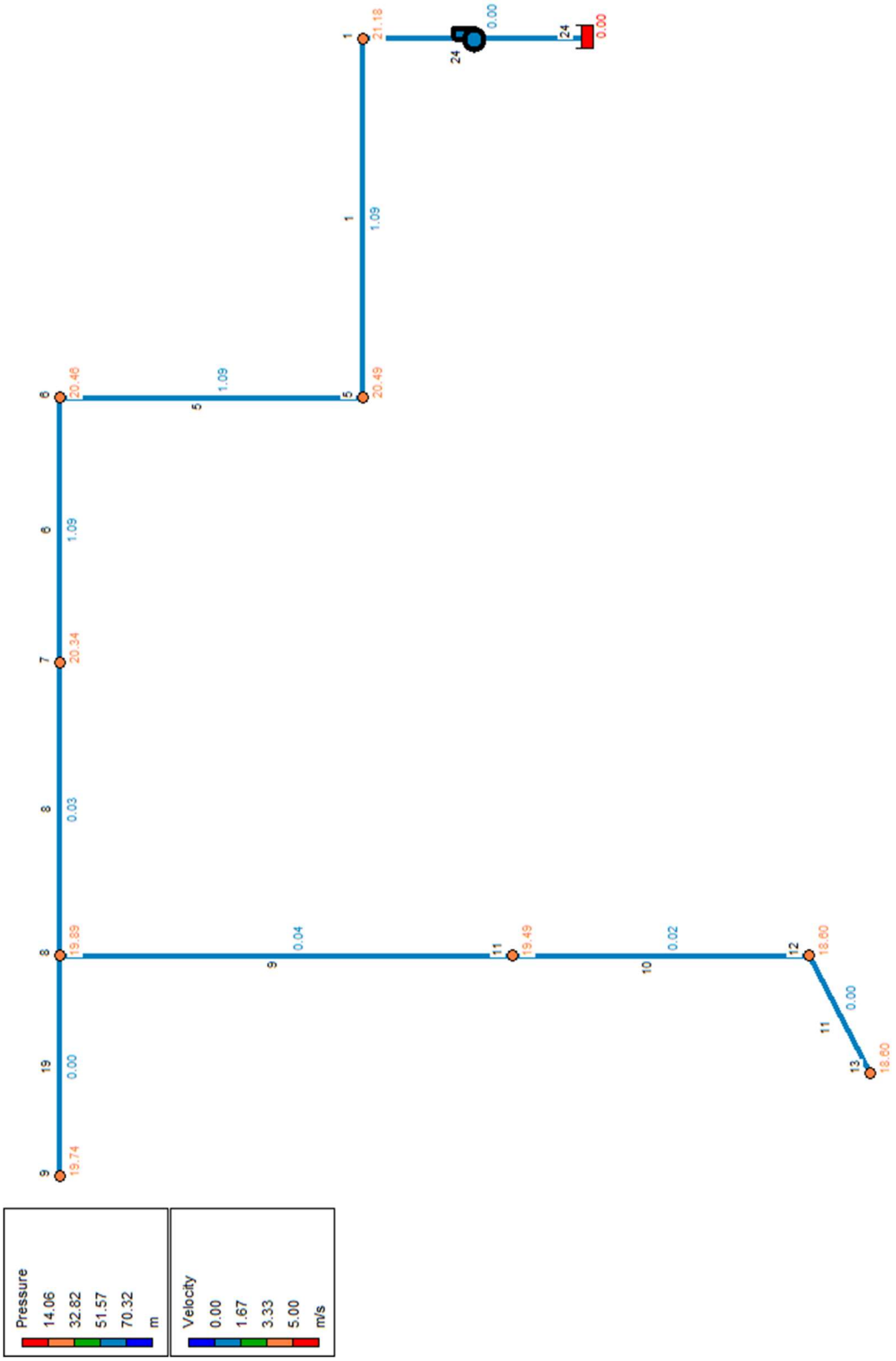


Table 1: 35-Unit: EPANET – Table without RFF – Link ID and Characteristics

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 5	56.88	400	120	3.97	0.03
Pipe 6	22.05	400	120	3.88	0.03
Pipe 8	90.58	400	120	3.16	0.03
Pipe 9	76.15	300	120	2.85	0.04
Pipe 10	70.15	300	120	1.20	0.02
Pipe 11	8.49	300	120	0.00	0.00
Pipe 19	37.91	300	120	0.00	0.00
Pipe 1	78.718	400	120	-3.97	0.03
Pump 24	#N/A	#N/A	#N/A	6.33	0.00

Table 2: 35-Unit: EPANET – Table with RFF – Link ID and Characteristics

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 5	56.88	400	120	137.27	1.09
Pipe 6	22.05	400	120	137.18	1.09
Pipe 8	90.58	400	120	3.16	0.03
Pipe 9	76.15	300	120	2.85	0.04
Pipe 10	70.15	300	120	1.20	0.02
Pipe 11	8.49	300	120	0.00	0.00
Pipe 19	37.91	300	120	0.00	0.00
Pipe 1	78.718	400	120	-137.27	1.09
Pump 24	#N/A	#N/A	#N/A	139.63	0.00

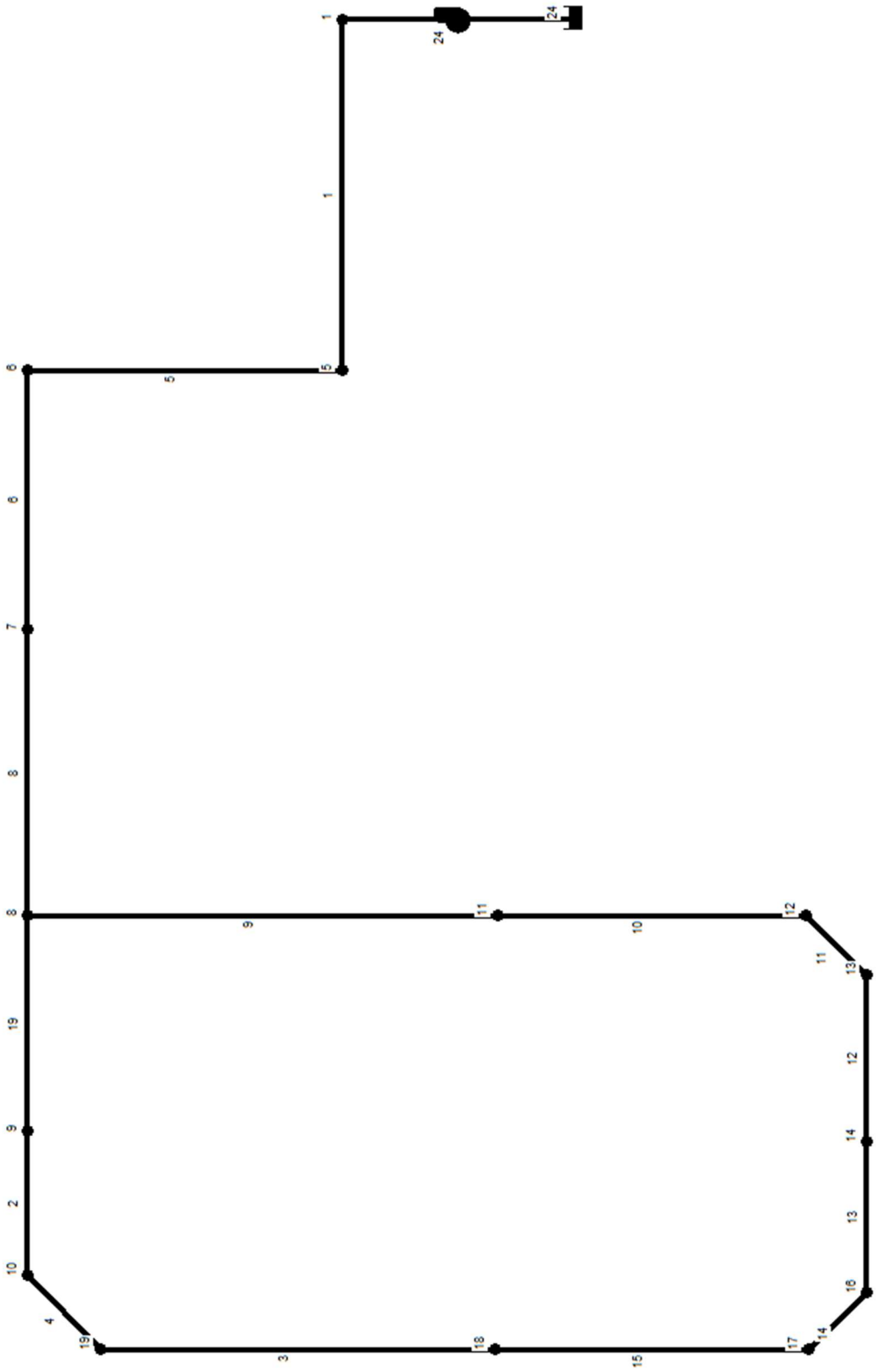
Table 3: 35-Unit: EPANET – Table without RFF – Node ID and Characteristics

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 1	112.510	2.36	2.36	149.48	36.97
Junc 5	112.946	0	0.00	149.48	36.54
Junc 6	112.791	0.09	0.09	149.48	36.69
Junc 7	112.837	0.72	0.72	149.48	36.64
Junc 8	113.283	0.31	0.31	149.48	36.20
Junc 9	113.432	0	0.00	149.48	36.05
Junc 11	113.680	1.65	1.65	149.48	35.80
Junc 12	114.569	1.20	1.20	149.48	34.91
Junc 13	114.572	0	0.00	149.48	34.91
Resvr 24	112.963	#N/A	-6.33	112.96	0.00

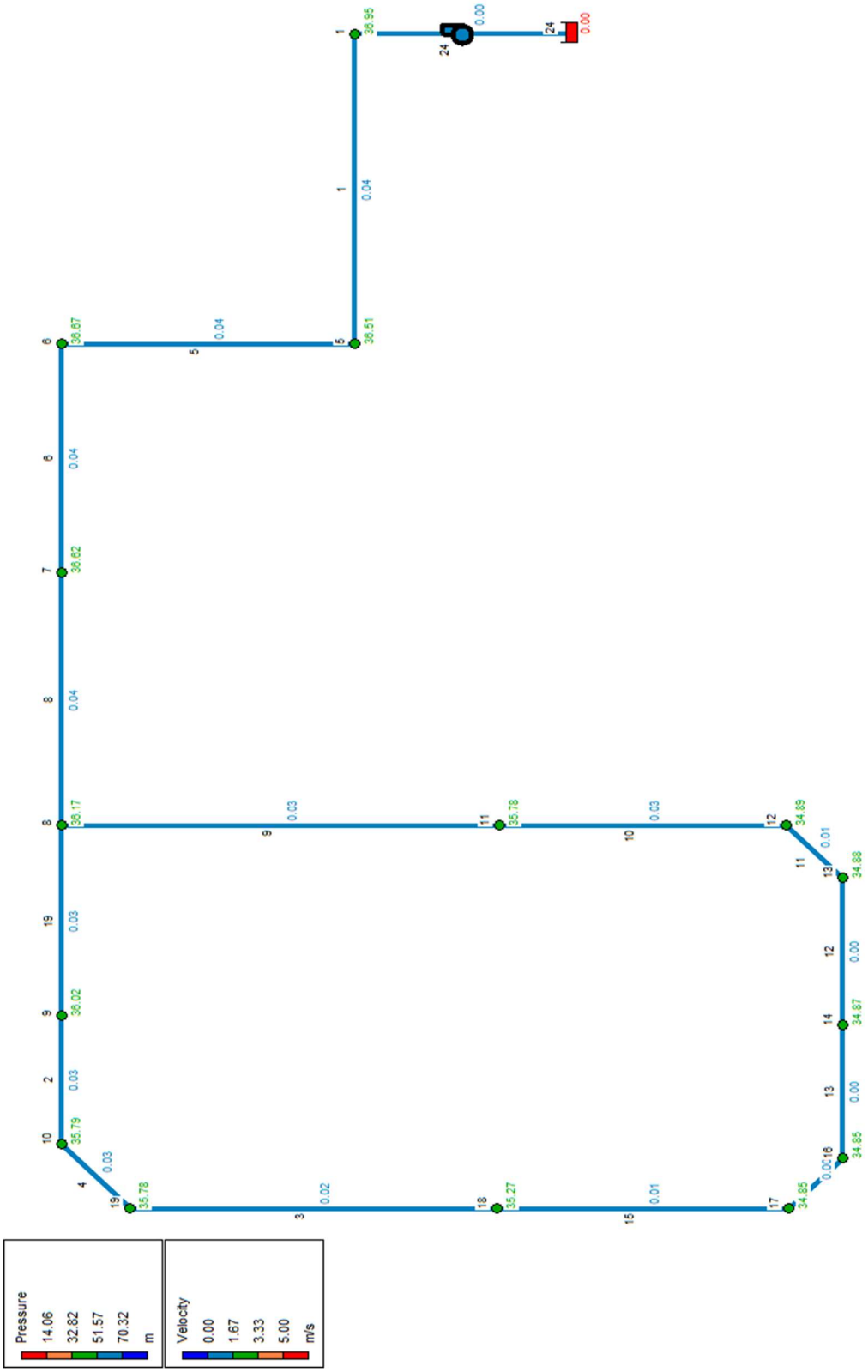
Table 4: 35-Unit: EPANET – Table with RFF - Node ID and Characteristics

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 1	112.510	2.36	2.36	133.69	21.18
Junc 5	112.946	0	0.00	133.43	20.49
Junc 6	112.791	0.09	0.09	133.25	20.46
Junc 7	112.837	134.02	134.02	133.17	20.34
Junc 8	113.283	0.31	0.31	133.17	19.89
Junc 9	113.432	0	0.00	133.17	19.74
Junc 11	113.680	1.65	1.65	133.17	19.49
Junc 12	114.569	1.20	1.20	133.17	18.60
Junc 13	114.572	0	0.00	133.17	18.60
Resvr 24	112.963	#N/A	-139.63	112.96	0.00

Map 4: 113-Unit: EPANET – Link and Node Numbering



Map 5: 113-Unit: EPANET – Scenario without Required Fire Flow (RFF)



Map 6: 113-Unit: EPANET – Scenario with RFF

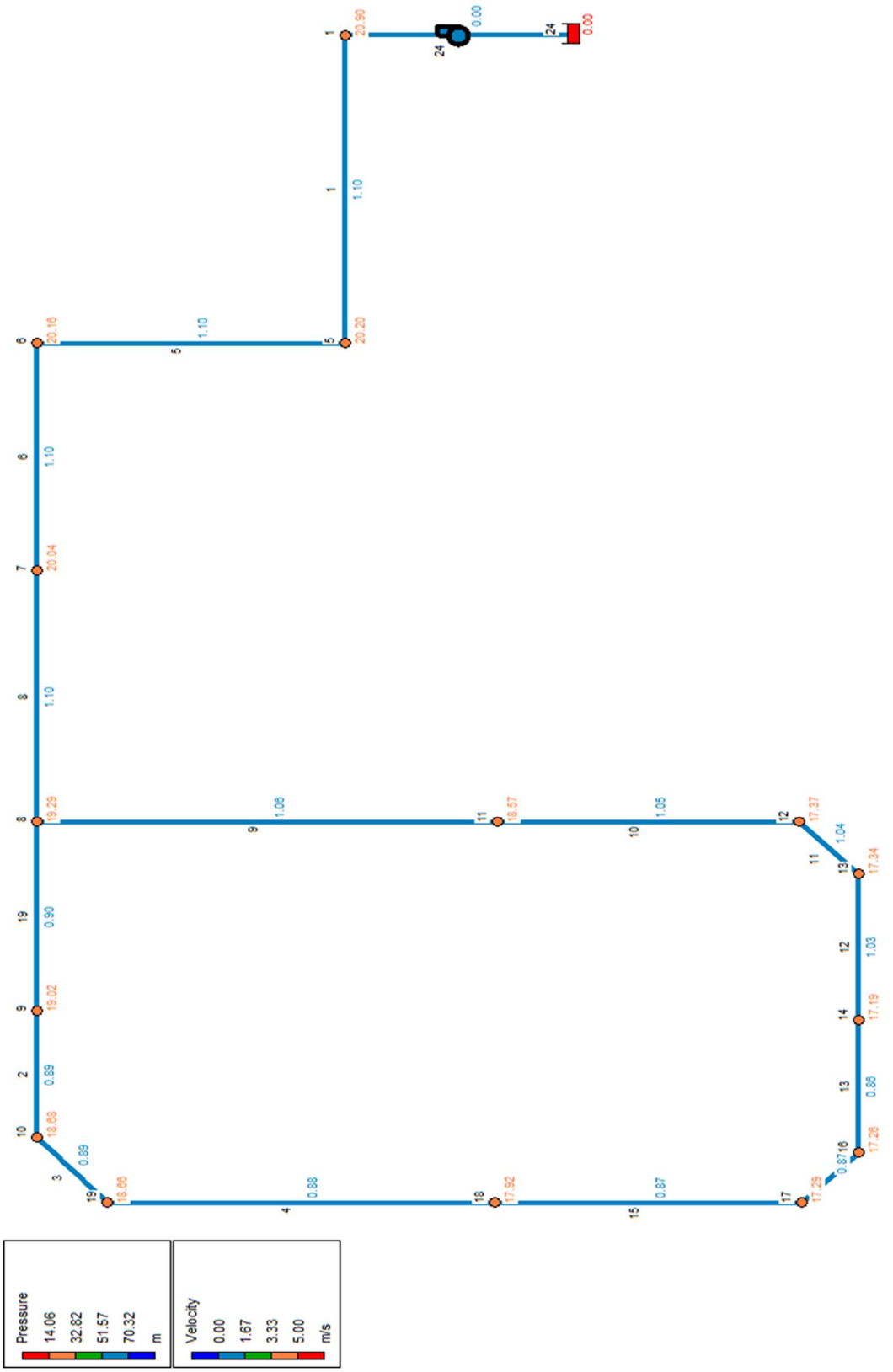


Table 5: 113-Unit: EPANET – Table without RFF – Link ID and Characteristics

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 5	56.88	400	120	5.18	0.04
Pipe 6	22.05	400	120	5.13	0.04
Pipe 8	90.58	400	120	4.69	0.04
Pipe 9	76.15	300	120	2.08	0.03
Pipe 10	70.15	300	120	1.99	0.03
Pipe 11	8.49	300	120	0.94	0.01
Pipe 12	31.91	300	120	0.12	0.00
Pipe 13	31.91	300	120	-0.11	0.00
Pipe 14	8.49	300	120	-0.34	0.00
Pipe 15	70.15	300	120	-0.56	0.01
Pipe 19	37.91	300	120	-2.45	0.03
Pipe 1	78.718	400	120	-5.18	0.04
Pipe 2	31.91	300	120	-2.29	0.03
Pipe 3	70.15	300	120	1.52	0.02
Pipe 4	8.49	300	120	-2.07	0.03
Pump 24	#N/A	#N/A	#N/A	7.80	0.00

``Table 6: 113-Unit: EPANET – Table with RFF – Link ID and Characteristic

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s
Pipe 5	56.88	400	120	138.62	1.10
Pipe 6	22.05	400	120	138.57	1.10
Pipe 8	90.58	400	120	138.13	1.10
Pipe 9	76.15	300	120	74.67	1.06
Pipe 10	70.15	300	120	74.44	1.05
Pipe 11	8.49	300	120	73.39	1.04
Pipe 12	31.91	300	120	72.57	1.03
Pipe 13	31.91	300	120	-60.96	0.86
Pipe 14	8.49	300	120	-61.19	0.87
Pipe 15	70.15	300	120	-61.41	0.87
Pipe 19	37.91	300	120	-63.30	0.90
Pipe 1	78.718	400	120	-138.62	1.10
Pipe 2	31.91	300	120	63.14	0.89
Pipe 3	8.49	300	120	62.92	0.89
Pipe 4	70.15	300	120	62.37	0.88
Pump 24	#N/A	#N/A	#N/A	140.98	0.00

Table 7: 113-Unit: EPANET – Table without RFF – Node ID and Characteristics

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 1	112.510	2.62	2.62	149.46	36.95
Junc 5	112.946	0	0.00	149.46	36.51
Junc 6	112.791	0.05	0.05	149.46	36.67
Junc 7	112.837	0.44	0.44	149.46	36.62
Junc 8	113.283	0.16	0.16	149.46	36.17
Junc 9	113.432	0.16	0.16	149.46	36.02
Junc 11	113.680	0.09	0.09	149.46	35.78
Junc 12	114.569	1.05	1.05	149.45	34.89
Junc 13	114.572	0.82	0.82	149.45	34.88
Junc 14	114.589	0.23	0.23	149.45	34.87
Junc 16	114.609	0.23	0.23	149.45	34.85
Junc 17	114.606	0.22	0.22	149.45	34.85
Junc 18	114.186	0.96	0.96	149.46	35.27
Junc 10	113.670	0.22	0.22	149.46	35.79
Junc 19	113.672	0.55	0.55	149.46	35.78
Resvr 24	112.963	#N/A	-7.80	112.96	0.00

`Table 8: 113-Unit: EPANET – Table with RFF – Node ID and Characteristic

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 1	112.510	2.36	2.36	133.41	20.90
Junc 5	112.946	0	0.00	133.14	20.20
Junc 6	112.791	0.05	0.05	132.95	20.16
Junc 7	112.837	0.44	0.44	132.88	20.04
Junc 8	113.283	0.16	0.16	132.58	19.29
Junc 9	113.432	0.16	0.16	132.46	19.02
Junc 11	113.680	0.23	0.23	132.25	18.57
Junc 12	114.569	1.05	1.05	131.94	17.37
Junc 13	114.572	0.82	0.82	131.91	17.34
Junc 14	114.589	133.53	133.53	131.78	17.19
Junc 16	114.609	0.23	0.23	131.87	17.26
Junc 17	114.606	0.22	0.22	131.90	17.29
Junc 18	114.186	0.96	0.96	132.11	17.92
Junc 19	113.672	0.55	0.55	132.33	18.66
Junc 10	113.670	0.22	0.22	132.35	18.68
Resvr 24	112.963	#N/A	-140.98	112.96	0.00