CLEARWATER SHORES
CIVIL ENGINEERING

10th Ave Estates Functional Servicing Report

Graham Design & Construction
1260 2nd. Ave. East,
Unit 2 Owen Sound, ON, N4K 2J3

Clearwater Shores Inc.
37 Alice Street
Allenford ON N0H 1A0 CANADA

September 4, 2024
24003.000

Contents

Disclaimer

Other than by the addressee, copying or distribution of this document, in whole or in part, is not permitted without the express written consent of Clearwater Shores Inc.

In the preparation of the various instruments of service contained herein, Clearwater Shores Inc. was required to use and rely upon various sources of information (including but not limited to: reports, data, drawings, observations) produced by parties other than Clearwater Shores Inc. For its part, Clearwater Shores Inc. has proceeded based on the belief that the third party/parties in question produced this documentation using accepted industry standards and best practices and that all information was therefore accurate, correct, and free of errors at the time of consultation. As such, the comments, recommendations, and materials presented in this instrument of service reflect our best judgment in light of the information available at the time of preparation. Clearwater Shores Inc., its employees, affiliates, and subcontractors accept no liability for inaccuracies or errors in the instruments of service provided to the client, arising from deficiencies in the aforementioned third-party materials and documents.

Clearwater Shores Inc. makes no warranties, either express or implied, of merchantability and fitness of the documents and other instruments of service for any purpose other than that specified by the contract.

1 Introduction

Clearwater Shores Inc. has been retained by Graham Design and Construction to prepare a Functional Servicing Report for the 10th Ave Estates development. The new development is a 2.53ha residential development on the Northeast side of Owen Sound. The proposed new development consists of a 29-unit apartment, a 34-unit apartment, two single story 3-plex residences and four single story 4-plex residences. The development will extend off of the end of 10th Ave East, where there currently exists a residential subdivision. This report provides sufficient detail to support a zoning by-law amendment.

1.1 Objectives

The objectives of this FSR are to:

- Confirm the location of existing infrastructure both internal and adjacent to the subject site.
- Evaluate and confirm adequate supply and on-site distribution of municipal water to meet domestic and fire flow requirements.
- Evaluate and confirm capacity for sanitary servicing.
- Stormwater Management has been provided under a separate cover.
- Assess future Greyfair Property's (based on a density of 150 units) ability to withstand the loss of connectivity from a servicing standpoint

1.2 Existing Conditions

The current legal description for the site is RANGE 9 EGR PT PARK LOT 7; PLAN 16M16 BLKS 35 AND 36; AND RP 16R8804 PT PART 1. The site is zoned as Medium Density Residential (R4) by the city of Owen Sound.

The approximate size of the lot is 2.53 hectares. The medium density residential lot is currently vacant with no existing structures. It is bounded on the southwest side by an existing subdivision on 10th Ave East and bounded on the east side by the Kenny Drain, a municipal drain for the City of Owen Sound. To the north of the lot is vacant medium-density residential land (R4) and to the south is Open Space (OS) and general industrial land (M1). The lot slopes from west to east and consists of no wetlands or protected areas. The existing conditions are shown on Drawing C100.

1.3 Proposed Development

The proposed development consists of a 29-unit apartment, a 34-unit apartment, two single story 3-plex residences and four single story 4-plex residences. The development will extend off of the end of the 10th Ave East cul-de-sac, where there currently exists a residential subdivision. The existing subdivision will bound the Southwest side of the proposed subdivision. The east side of the proposed development will exist adjacent to the Kenny Drain, with the northern and southern sides abutting vacant medium residential land and open space respectively. The development will have road access through the 10th Ave east cul-de-sac. The roadway for the proposed subdivision will be private. The site plan is shown on Drawing SP.

The proposed development will be graded so that the impact of the development will not adversely affect adjacent private properties, and that drainage will be directed internally as best as possible to a stormwater management system before outletting to the Kenny Drain. An emergency overland flow route will also direct runoff towards the Kenny Drain.

2 Water Supply and distribution

Water servicing for the subject site will be designed according to the MOE Design guidelines for drinking-water systems to ensure that adequate pressures and fire flows are achieved.

- Specific flow rate: 400 L/c/d
- Specific max day peaking factor: 4

2.1 Existing Water Infrastructure

Based on the available information, existing water infrastructure in proximity to the site consists of 200mm diameter watermain from the 10th Ave east subdivision that ends at the cul-de-sac and is in the municipal pressure zone. Along with a 300mm diameter watermain from 23rd street E that is in the industrial pressure zone. Based on a hydrant test completed closest to the site on the corner of 10th Ave and 23rd street A E the static pressure in the municipal pressure system is 42 psi. Hydrant Flow Test is included in Appendix A.

2.2 Proposed Water Servicing

It is proposed that a 200mm diameter watermain to be installed in the new development extending off 10th Ave East. The watermain is proposed loop back and reconnect at the tee in the development. A second connection to the industrial pressure zone on 23rd Street East is proposed to accommodate the fire flow. The water demand for the development including fire flow has been calculated to be 203.32 L/s and is proposed to be provided through an extension of the watermain on 10th Ave East and 23rd Street East. The highest point of the development is the connection to the municipal water system at 10th Ave East at a static pressure of 42psi.

The required fire flow was calculated in accordance with the Water Supply for Public Fire Protection (Fire Underwriters Survey FUS, 2020). A fire flow demand analysis was completed for each type of proposed structure (Apartment buildings and Townhouse Blocks). The townhouse buildings were assumed to be of ordinary wood-frame, brick and metal siding exterior construction. The floor area used in the analysis conservatively assumes that there are no rated fire walls subdividing units, and therefore represents the entire row unit. The apartment building were assumed to be of fire restrictive construction (fully protected frame, floors, roof). The floor area used in the analysis conservatively assumes that the vertical openings are inadequately protected. Therefore, the two largest adjoining floors plus 50 percent of each floor immediately above were taken into consideration. The contents of the buildings are considered limited combustible, as defined in the FUS guidelines, consisting of normal low-risk residential occupancy. The exposure charges are based on separation distance from adjacent buildings. Based on the above criteria, the maximum fire flow demand was calculated to be 200L/s as shown in Appendix A using the FUS method.

The water service connection to the apartment units is estimated to be 100mm in diameter. Hydraulic Load calculations are provided in Appendix A. At the time of site plan approval and final detailed design, GSS Engineering Consultants Ltd (GSS) has be engaged to confirm the final service size and water demand needs of the apartments.

The water service connection to the units in the 3-plex and 4-plex buildings will be 19mm in diameter, with a single service for each residence. Hydraulic Load calculations are provided in Appendix A.

Water demand calculations are provided in Appendix A.

Water modeling completed by GSS. Their Water Servicing report is also in Appendix A.

Refer to Drawing C102 for the site servicing layout.

2.3 Impact to Greyfair Site

The proposed water servicing does not include a connection to the 6 hectare (150 unit) residential development to the north which is currently know as the Greyfair Site. The future Greyfair site has access to 9th Avenue East and 26th Street East for servicing purposes. 9th Avenue East is serviced with two existing watermains, a 300mm dia (Industrial pressure zone) and 200mm dia. This includes an existing 200mm dia. service running into the property off of 9th Avenue East. 26th Street East has access to an existing 300mm dia. watermain stub at the intersection of 26th Street East and 18th Ave East. An estimate of the future Greyfair water demand was found to be approximately 5.83 L/s excluding fire flow. Based GSS Water Servicing Report in Appendix A, the current site plan and subsequent loss of connection does not prohibit the future servicing of the Greyfair site.

3 Sanitary Servicing

Sanitary servicing will be designed in accordance with the MOE Design Guidelines for Sewage Works.

Sanitary design flows will be based on the following:

- Flow rate for average residential daily flow: 400 L/cap/day
- Population : 2.1 p.p.u.
- Maximum day peaking factor: 4
- Infiltration rate: 0.26 L/s

3.1 Existing Sanitary Sewer Infrastructure

From information available, there is a sanitary sewer service south of the development on the corner of 23rd St East and 16th Ave East with a diameter of 200mm and an invert height of 209.56m above sea level (MASL). (See Appendix B)

3.2 Proposed Sanitary Servicing

Peak sanitary flow from the proposed development is calculated to be 4.04L/s and consists of residential and infiltration flow.

Since the new sanitary sewer services are to be lower than any existing services in the area, a pumping station (Designed by Others) is required to discharge sanitary sewage. 200mm diameter sanitary sewers are proposed to be installed throughout the development, where they will run to a pumping station on the south side of the development. The pumping station will pump the sanitary sewage south to proposed MH02. From MH02, a 200mm diameter sanitary sewer is proposed to take the sanitary flow to the existing MH on the corner of 23rd St East and 16th Ave East, see Servicing Drawing C102 for more details.

The proposed sanitary service connections to the apartment units are 200mm in diameter.

The proposed sanitary service connections to the 3-plex and 4-plex buildings are 100mm in diameter.

The sanitary design calculations are shown in Appendix B; see Appendix C for the sanitary design sheet.

3.3 Impact to Greyfair Site

The original intent was for the 10th Ave Estates property to outlet sanitary through the Greyfair site. However, the proposed sanitary servicing does not have a connection to the Greyfair. Therefore, in our opinion the Greyfair Site can be serviced with existing infrastructure on 9th Avenue E and 26th Street East.

4 Storm servicing

The storm servicing will consist of pipe sizes ranging from 250mm diameter to 525mm diameter. The servicing will start at the high side at the west end of the site and work its way east to the proposed Stormwater Pond in the northeast corner of the site. See servicing drawing C102 for more details and Appendix D for the storm sewer design sheet.

The stormwater management design has been provided under separate cover.

5 Conclusions

The existing infrastructure and proposed servicing strategies for the new 2.53-hectare residential development in Owen Sound have been meticulously evaluated. The detailed analysis confirms the following:

Existing Infrastructure:

- The site is currently vacant, zoned for Medium Density Residential (R4), and well-positioned adjacent to existing residential, industrial, and open space areas. Existing water and sanitary sewer infrastructure are identified and evaluated for connectivity and capacity.

Water Supply and Distribution:

- The proposed water servicing plan includes a 200mm diameter watermain within the new subdivision, looping back and reconnecting at the tee in the development. The calculated water demand of 203.32 L/s will be met through this extension and a second connection to the industrial pressure zone, ensuring adequate pressure and fire flow in accordance with MOE Design Guidelines. Water service connections for the apartment units and multi-plex residences are appropriately sized to meet the anticipated demand.
- Hydrants will be placed approximately 90m intervals for fire protection within the development.
- Detailed modelling and calculations of proposed water supply has been completed by GSS Water Servicing report in Appendix A.

Sanitary Servicing:

- The sanitary servicing design incorporates the construction of a pumping station due to the elevation and gravity flow constraints. The proposed 200mm diameter sanitary sewers will collect wastewater throughout the development and direct it to the pumping station, which will then discharge the flow through a 200mm diameter pipe to the existing sanitary sewer at the corner of 23rd St East and 16th Ave East. This system is designed to handle a peak sanitary flow of 4.04 L/s, inclusive of residential and infiltration flows.

Grading and Drainage:

- The site will be graded to direct drainage internally towards a stormwater management system, minimizing adverse impacts on adjacent properties. An emergency overland flow route will ensure runoff is effectively directed towards the Kenny Drain.

The Greyfair Site

- The elimination of the through road does not impact the future development which can be serviced by existing infrastructure 9th Avenue E and 26th Street East.

This Functional Servicing Report has been designed to be in support of the ZBA approval. The findings of this report indicate that the proposed development can be constructed to the City of Owen Sound Engineering Standards with no impact on the undeveloped lands to the north.

Report Prepared By:

Keith Welsh

Clearwater Shores Inc.

Report Reviewed By:

Michelle Henry, P.Eng.

Clearwater Shores Inc.

Appendix A

Water Demand Calculations

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepaired by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	3-Sep-24

Project: 10th Ave Estates Development
Water Demand Calculations

Demestic Flow Calculations

Average Day Per Capita Flow =	400 L/c/d	
Number of Proposed Units =	85	
Residential Density =	2.1 ppu	
Population =	178.5	
Average Day Demand =	71,400 L/d	
=	0.83 L/s	
Peak Factor =	4	
Total Domestic Peak Demand =	3.32 L/s	199.2 L/m
Total Fire Peak Flow =	200 L/s	11,000 L/m
Total Peak Flow =	203.32 L/s	11,199.2 L/m

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by: Keith Welsh
Checked by: Michelle Henry
Project Number: 24003
Date: 4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Summary

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

Dwelling Notation	Number of Units	Number of Floors	Fire Flow Demand (Lpm)	Fire Flow Demand (Lps)
Townhouse A	3	1	8,000	134
Townhouse B	3	1	8,000	134
Townhouse C	4	1	10,000	170
Townhouse D	4	1	10,000	170
Townhouse E	4	1	10,000	170
Townhouse F	4	1	8,000	134
Apartment A1	34	4	12,000	200
Apartment A2	29	3.5	10,000	170

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Townhouse A

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 1.5 for wood frame construction

= 1.5

A = 470.4 m2

F = 220 * C * √A

= 7,161 Lpm

= 7,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1,050 Lmp

F = 5,950 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 5,950 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	>45m	-	0%
East Side	22m	-	10%
South Side	>45m	-	0%
West Side	13m	-	15%
			25% = 1,750 Lmp

F = 7,700 Lpm

= 8,000 Lpm (Rounded to the Nearest 1,000 Lmp)

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Townhouse B

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 1.5 for wood frame construction

= 1.5

A = 435.3 m2

F = 220 * C * √A

= 6,897 Lpm

= 7,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1050 Lmp

F = 5,950 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 5,950 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	23m	-	10%
East Side	15m	-	15%
South Side	>45m	-	0%
West Side	23m	-	10%
			35% = 2450 Lmp

F = 8,400 Lpm

= 8,000 Lpm (Rounded to the Nearest 1,000 Lmp)

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Townhouse C

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 1.5 for wood frame construction

= 1.5

A = 578.5 m2

F = 220 * C * √A

= 7,920 Lpm

= 8,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1200 Lmp

F = 6,800 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 6,800 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	21m	-	10%
East Side	15m	-	15%
South Side	>45m	-	0%
West Side	15m	-	15%
			35% = 2800 Lmp

F = 9,600 Lpm

= 10,000 Lpm (Rounded to the Nearest 1,000 Lmp)

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	20-Aug-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Townhouse D

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 1.5 for wood frame construction

= 1.5

A = 519.2 m2

F = 220 * C * √A

= 7,524 Lpm

= 8,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1,200 Lmp

F = 6,800 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 6,800 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	30m	-	10%
East Side	17m	-	15%
South Side	21m	-	10%
West Side	34m	-	5%
			40% = 3200 Lmp

F = 10,000 Lpm

= 10,000 Lpm (Rounded to the Nearest 1,000 Lmp)

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Townhouse E

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 1.5 for wood frame construction

= 1.5

A = 578.5 m2

F = 220 * C * √A

= 7,920 Lpm

= 8,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1,200 Lmp

F = 6,800 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 6,800 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	12m	-	15%		
East Side	>45m	-	0%		
South Side	15m	-	15%		
West Side	17m	-	15%		
			45%	=	3,600 Lmp

F = 10,400 Lpm

= 10,000 Lpm (Rounded to the Nearest 1,000 Lmp)

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Townhouse F

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 1.5 for wood frame construction

= 1.5

A = 519.2 m2

F = 220 * C * √A

= 7,524 Lpm

= 8,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1,200 Lmp

F = 6,800 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 6,800 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	>45m	-	0%
East Side	30m	-	10%
South Side	15m	-	15%
West Side	35m	-	5%
			30% = 2,100 Lmp

F = 9,200 Lpm

= 9,000 Lpm (Rounded to the Nearest 1,000 Lmp)

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Apartment A-1

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 0.8 for fire resistive construction

= 0.8

A = 4126.8 m2 — for building with a coefficient below 1.0 and unporotected openings consider the two largest adjoing floor areas plus 50% of all floors immediatley above them up to a max of 8

F = 220 * C * √A

= 11,299 Lpm

= 11,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1,800 Lmp

F = 9,200 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 9,200 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	>45m	-	0%		
East Side	35m	-	5%		
South Side	22m	-	10%		
West Side	28m	-	10%		
			25%	=	2750 Lmp

F = 11,950 Lpm

= 12,000 Lpm (Rounded to the Nearest 1,000 Lmp)

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepared by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	4-Sep-24

Project: 10th Ave Estates Development

Preliminary Estimate of Required Fire Flow - Apartment A-2

Fire Underwriters Survey "Water Supply for Public Fire Protection", 2020

F = **220 * C * √A** = Required Fire Flow in liters per minute

C = 0.8 for fire resistant construction

= 0.8

A = 3544.5 m2 — for building with a coefficient below 1.0 and unporotected openings consider the two largest adjoing floor areas plus 50% of all floors immediatley above them up to a max of 8

F = 220 * C * √A

= 10,477 Lpm

= 10,000 Lpm (Rounded to the Nearest 1,000 Lmp)

Apartments/Dwellings = LOW HAZROD occupancy = 15% Reduction = - 1,500 Lmp

F = 8,500 Lpm

Reduction due to automatic sprinkler suppression = 0% = 0 Lmp

F = 8,500 Lpm

Increase added due to structures exposed with in 45 meters:

North Side	>45m	-	0%
East Side	>45m	-	0%
South Side	14m	-	10%
West Side	44m	-	5%
			15% = 1,500 Lmp

F = 10,000 Lpm

= 10,000 Lpm (Rounded to the Nearest 1,000 Lmp)

DJS Water Services Inc.
209 Laurel Springs Crt.
Kitchener, Ontario N2N 3N8
Tel (519) 581-7756 Fax (519) 571 7251

August 14, 2024 Ref #Clearwater

Keith Welsh
Clearwater Shores Inc.
37 Alice Street
Allenford, ON, N0H 1A0

Dear Mr. Welsh,

Re: Hydrant flow test, 2304 10th Ave. E., Owen Sound

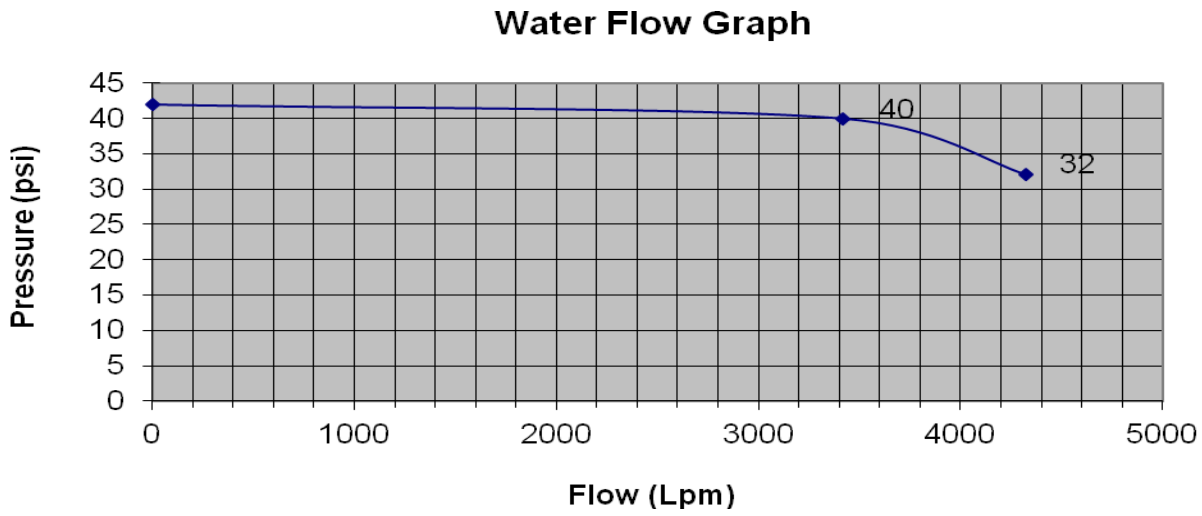
A hydrant flow test was performed at the above location. Please find below a summary of the test results.

Location: Hydrant #1A194
Date: August 14, 2024
Time: 8:00 am
Static Pressure (psi): 42

Co Efficient value: 0.90
Configuration value for two outlets: 0.88
Size of feeder watermain (in):
Size of source watermain (in):
Turns to close valve: n/a

				Graph Data	
Configuration:	one port	Configuration:	two ports	Pressure (psi)	Flow (Lpm)
Outlet Size (in):	2.5	Outlet Size (in):	2.5	42	0
Pitot Reading (psi):	28	Pitot Reading (psi):	15	40	3356
Residual Pressure (psi):	40	Residual Pressure (psi):	32	32	4323
Calculated Flow (Lpm):	3356	Calculated Flow (Lpm):	4323		

Note: Hydrant was flushed for a period of approximately 5 minutes at high flows to ensure water was clear and clean of debris.
Residual Hydrant location was 848 23rd St. E. Hydrant #1A196
Flows are calculated by established Hazen-Williams formulas.



Should you require any additional information please do not hesitate to call.

Sincerely,

Dan Smuk

Water Servicing Modelling

10th Avenue Estates

City of Owen Sound

Graham Design & Construction

Project 24-054

September, 2024

Prepared By:

GSS Engineering Consultants Ltd.

Unit 230, 945 3rd Avenue East

Owen Sound, ON N4K 2K8

TABLE OF CONTENTS

FIGURES

APPENDICES

1 INTRODUCTION

GSS Engineering Consultants Ltd. was retained by Graham Design & Construction to perform water system modelling to support development of the proposed 10th Avenue Estates.

The water modelling evaluates two options for providing water servicing to the 10th Avenue Estates development. Further, as requested by the City of Owen Sound the modelling evaluates the potential impact of the 10th Avenue Estates development on the water servicing of the future Greyfair development to the north.

This report is to accompany the Functional Servicing Report (latest version) prepared by Clearwater Shores for the 10th Avenue Estates development.

2 BACKGROUND

The 10th Avenue Estates development is located on a 2.53 ha parcel in the northeast corner of Owen Sound. The parcel is between 9th Avenue East and 18th Avenue East on the west and east and 23rd Street East and 26th Street East on the south and north. The proposed development consists of two apartment buildings, Tower A1 with 34 units and Tower A2 with 29 units, as well as 4 single storey 4-plex townhomes and 2 single storey 3-plex townhomes. 85 total units are proposed.

The Functional Servicing Report (FSR) for the site has been prepared by Clearwater Shores. As per comments provided by the City of Owen Sound on August 28th, 2024, water modelling is required to support the FSR. The City's comments are provided in **Appendix A** for reference.

The City identified two items that are to be supported by water modelling: evaluation of options to service the 10th Avenue Estates and evaluation to ensure that the development of 10th Avenue Estates does not impact the ability of the Greyfair development to provide water servicing.

The Greyfair development is proposed on a 9.77 ha parcel adjacent to the 10th Avenue Estates to the north. The City has provided the draft plan for the Greyfair development prepared by Gamsby and Mannerow Ltd. in 2006 as attached in **Appendix A**.

As per the draft plan 70 lots are proposed in the Greyfair development. Three connections to the City water system were proposed being - a connection to 9th Avenue, a connection to an anticipated watermain on 26th Street, and a connection to 10th Avenue through the 10th Avenue Estates property.

The proposed configuration of 10th Avenue Estates would eliminate the connection of the Greyfair development to 10th Avenue as shown in the Greyfair draft plan.

The Owen Sound water system is comprised of multiple pressure zones. Two pressure zones exist adjacent to the subject property: a higher pressure "Industrial Pressure Zone" and a lower pressure "Municipal Pressure Zone".

3 METHODOLOGY

For all water modelling, the Owen Sound water model provided by the City was used in EPAnet 2.2 software. All new pipes were assumed to be PVC and modelled with a friction factor (C-factor) of 130.

As per the Ministry of Environment (MOE) guidelines, to be considered adequate, the water system must provide the maximum day demand at a minimum pressure of 40 psi and must maintain 20 psi throughout the system during a fire flow (while providing maximum day demand to all locations).

3.1 Water Servicing for 10th Avenue Estates

The FSR provides an estimate of 3.32 L/s as the maximum day demand for the 10th Avenue Estates development. Tower A1 accounts for 1.33 L/s, Tower A2 for 1.13 L/s, each of the four 4-plexs for 0.16 L/s, and 0.11 L/s for each of the two 3-plexs. The estimate provided in the FSR was determined in accordance with MOE guidelines. Therefore, we are in agreement with this estimate of maximum day demand and this estimate was used for water modelling.

The FSR also provides estimates of required fire flows for the various proposed buildings. As per the FSR the maximum estimated townhome fire flow is 170 L/s, the fire flow for Tower A1 is 150 L/s, and the fire flow for Tower A2 is 133 L/s. However, the apartment fire flows were estimated with a building coefficient of C = 0.6 which is indicative of construction with a fire resistance rating of 3-hours. To provide a more conservative fire flow estimate, a C = 0.8 coefficient is recommended, which is indicative of non-combustible construction. This, therefore, increases the fire flow for Tower A2 to 170 L/s and the fire flow for Tower A1 to 200 L/s.

Two options were evaluated for water servicing to 10th Avenue Estates:

Option 1: a looped connection to the (lower pressure) Municipal Pressure Zone to the 200 mm diameter watermain at the end of the 10th Avenue East cul-de-sac as well as to the 200 mm diameter watermain on 9th Avenue East approximately 85 m northwest of the subject development. The connection to 9th Avenue East would require an easement to be obtained from one of the two landowners to the north. The proposed Option 1 layout is provided in **Figure 1**, with the connection to 9th Avenue East following the path suggested by the City of Owen Sound.

Option 2: a connection to the Municipal Pressure Zone at the end of the 10th Avenue East cul-de-sac and a second connection to the higher-pressure Industrial Zone to the 300 mm diameter watermain at 23rd Street. The watermain connection to 23rd Street would follow the path of the sanitary sewer that outlets to 23rd Street from the 10th Avenue Estates development. The connection to the Industrial Pressure Zone would contain a pressure reducing valve (PRV) set at approximately 35 psi. This would ensure that the 10th Avenue Estate's domestic water demands are serviced from the Municipal Pressure Zone and servicing from the Industrial Pressure Zone only occurs during significant drops in water pressure (likely during a fire flow). **It is assumed that a bulk water meter would not be required on the connection to the Industrial Zone as this connection would only convey fire flows.** The proposed Option 2 layout is provided on **Figure 2**.

For evaluation of the two servicing options, the 10th Avenue Estates development is represented by 3 nodes (Node-1, Node-2, Node-3) in the water model as shown on **Figures 1 and 2**. The maximum day demand was split amongst these nodes based on adjacent buildings. Node-2 represents Tower A1 which requires the maximum fire flow of 200 L/s. The elevation of all model nodes was assumed to be 2 m below ground level.

Also shown on **Figures 1 and 2** are existing model nodes 508, 720, and 710 to assess the effects of servicing 10th Avenue Estates on the existing water system.

3.2 Water Servicing for Future Greyfair Development

As previously stated, the Draft Plan for the Greyfair development is provided in **Appendix A**. However, the watermain connection to 10th Avenue East will be eliminated based on the proposed layout of the 10th Avenue Estates development. The water servicing of the Greyfair development less the connection to 10th Avenue is provided on **Figure 3** for reference.

The Greyfair development was modelled to determine if adequate water servicing could be provided without the connection to 10th Avenue.

The FSR provides an estimate of 5.83 L/s for the maximum day demand of the Greyfair development. This estimate is based on 150 units being constructed as requested by the City of Owen Sound (although only 70 lots are proposed in the draft plan). The estimate provided in the FSR was determined in accordance with MOE guidelines. Therefore, we are in agreement with this estimate of maximum day demand and this estimate was used for water modelling.

Since the development density of the future Greyfair development is unknown it was determined (through discussions with the City) that a maximum required fire flow of 170 L/s was reasonable. This is representative of a single storey 4-plex townhome.

For water modelling, the Greyfair development is represented by four nodes (Node-4, Node-5, Node-6, Node-7). These nodes are shown on **Figure 3**. Since development density is unknown the maximum day demand was split amongst these four nodes equally (1.46 L/s each). The maximum fire flow was assumed to occur at Node-4 as it is the furthest point from connections to the City water system and represents the worst-case scenario.

Nodes 8 through to 12 are required by the model to provide elevation information at watermain intersections. See **Figure 3**. These five nodes are not provided with a water demand. However, the pressures at these nodes were evaluated for reference. Existing Node 293 is also provided (as shown on **Figure 3**) to evaluate the effects of servicing Greyfair on the existing water system.

4 RESULTS AND DISCUSSION

4.1 Modelling Results for Water Servicing of 10th Avenue Estates

Option 1 – Looped Connection to Municipal Pressure Zone:

The results from modelling of Option 1 are provided in **Figure 1** and **Table 1**.

The model indicates that Option 1 is able to provide the maximum day demand to the proposed development at sufficient pressures. Pressures range from 52 psi to 57 psi. However, Option 1 is not able to provide the required maximum fire flow of 200 L/s and this results in negative pressures throughout the development and negative pressure on 9th Avenue.

This appears to be due to insufficient pressures in the Municipal Pressure Zone when providing the maximum fire flow. The two connection points (Nodes 508 and 720) to the Municipal Pressure Zone drop to -38 psi and -26 psi under a fire flow condition.

The model indicates that the maximum fire flow that can be provided to the proposed development with Option 1 is only 100 L/s (half of the required flow).

The EPAnet model results tables are provided for the evaluated nodes in **Appendix B**.

Option 2 – Connection to Municipal & Industrial Pressure Zone:

The results from modelling of Option 2 are provided in **Figure 2** and **Table 2**.

The model indicates that Option 2 is able to provide the maximum day demand to the proposed development at sufficient pressures. The maximum day demand pressures are the same as Option 1 (52-57 psi) since domestic demands are still met from the Municipal Pressure Zone. Booster pumps will likely be required within the apartment buildings to provide maximum day demand at 40 psi to the top floors. This will be further evaluated at the detailed design phase.

Option 2 is able to provide the required maximum fire flow of 200 L/s to Node-2 at 35 psi while maintaining greater than 20 psi (between 32-36) at all other locations.

The model indicates that Option 2 can provide up to 253 L/s to Node-1, 475 L/s to Node-2, and 310 L/s to Node-3 while maintain adequate pressure throughout the water system. This far exceeds required fire flows for all nodes.

The EPAnet model results tables are provided for the evaluated nodes in **Appendix B**.

4.2 Modelling Results for Water Servicing of Greyfair Development

The results from modelling of the Greyfair development are provided in **Figure 3** and **Table 3**.

The model indicates that Greyfair can provide the maximum day demand at pressures of 96-104 psi throughout the development without the connection to 10th Avenue East. These pressures exceed safe pressure guidelines (maximum of 90 psi) which indicates that PRVs will likely be required for Greyfair to connect to the Industrial Pressure Zone as proposed.

Further, when providing the maximum fire flow of 170 L/s to Node-4 pressures are maintained between 73-92 psi. The model indicates that Greyfair can provide a maximum fire flow of 290 L/s to Node-4.

The EPAnet model results tables are provided for the evaluated nodes in **Appendix B**.

5 CONCLUSIONS

- The maximum day demand for the 10th Avenue Estates development was determined to be 3.32 L/s by Clearwater Shores in the FSR. We agree with this estimate.

- The FSR for 10th Avenue Estates estimated a fire flow of 170 L/s for largest townhome, 133 L/s for apartment tower A2, and 150 L/s for apartment tower A1. However, a more conservative maximum fire flow of 200 L/s was used for modelling.

- The model indicated that Option 1 for servicing 10th Avenue Estates (looped connection to the Municipal Pressure Zone) would provide sufficient pressure for maximum day demand but insufficient fire flows (maximum of only 100 L/s).

- The model indicated that Option 2 (connection to the Municipal Pressure Zone and through a PRV to the Industrial Pressure Zone) would provide sufficient pressure for Maximum day demand and provide required maximum fire flows throughout the development.

- The maximum day demand for the Greyfair development was determined to be 5.83 L/s by Clearwater Shores in the FSR based on 150 units being constructed as requested by the City of Owen Sound. We agree with this estimate.

- Through discussions with the City it was determined that a single storey 4-plex requiring 170 L/s could be assumed as the maximum fire flow for the Greyfair development as true development density is unknown.

- The model indicated that the Greyfair development to the north can provide required water servicing (meet max day and fire flow demands) without the connection to 10th Avenue East through the 10th Avenue Estates property.

6 RECOMMENDATIONS

Based on the results of water modelling it is recommended that servicing of 10th Avenue Estates is achieved through a looped connection to the Municipal and Industrial Pressure Zones in accordance with Option 2 shown on **Figure 2**. Modelling indicates that this option provides sufficient pressure for maximum day demand and fire flows, while Option 1 (connection to the Municipal Pressure Zone) does not provide sufficient fire flows.

Further, it is recommended that the City of Owen Sound allow the proposed layout of the 10th Avenue Estates that removes the connection of the Greyfair development to the City water system at 10th Avenue as water modelling indicates that sufficient pressures for maximum day demand and fire flows can still be achieved.

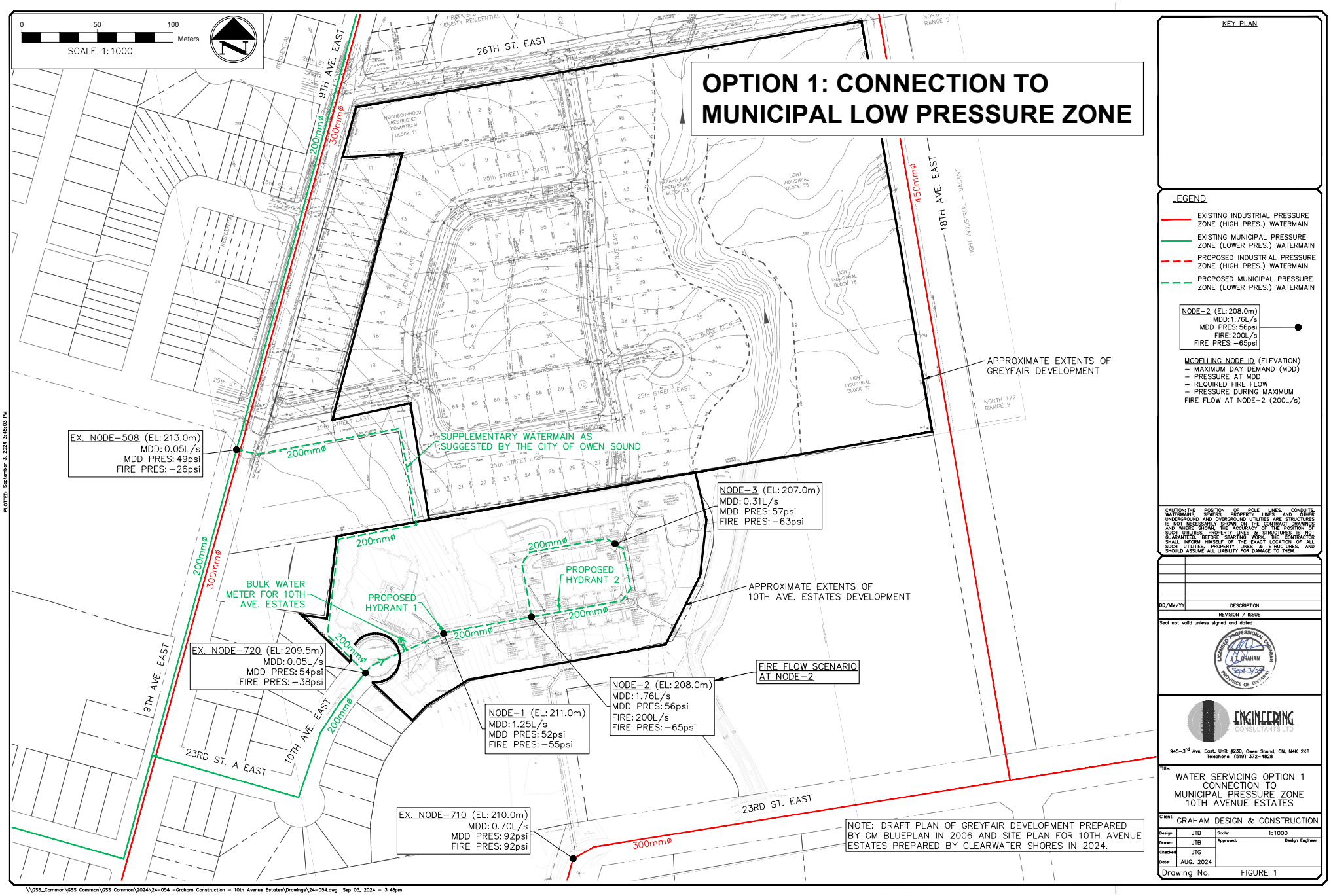
Respectfully submitted,

GSS Engineering Consultants Ltd.

Jacob Bartley, E.I.T

Jeff Graham, P. Eng., President

JB/JG



KEY PLAN

LEGEND

- EXISTING INDUSTRIAL PRESSURE ZONE (HIGH PRES.) WATERMAIN
- EXISTING MUNICIPAL PRESSURE ZONE (LOWER PRES.) WATERMAIN
- PROPOSED INDUSTRIAL PRESSURE ZONE (HIGH PRES.) WATERMAIN
- PROPOSED MUNICIPAL PRESSURE ZONE (LOWER PRES.) WATERMAIN

NODE–2 (EL: 208.0m)
MDD: 1.76L/s
MDD PRES: 56psi
FIRE: 200L/s
FIRE PRES: –65psi

MODELLING NODE ID (ELEVATION)
– MAXIMUM DAY DEMAND (MDD)
– PRESSURE AT MDD
– REQUIRED FIRE FLOW
– PRESSURE DURING MAXIMUM FIRE FLOW AT NODE–2 (200L/s)

CAUTION: THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS, PROPERTY LINES AND OTHER UNDERGROUND AND OVERGROUND UTILITIES ARE STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES, PROPERTY LINES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES, PROPERTY LINES & STRUCTURES, AND SHOULD ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

DD/MM/YY	DESCRIPTION
	REVISION / ISSUE

Seal not valid unless signed and dated

J.T. GRAHAM
Sept 3/24
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

ENGINEERING CONSULTANTS LTD
945–3rd Ave. East, Unit #230, Owen Sound, ON, N4K 2K8
Telephone: (519) 372–4828

Title: WATER SERVICING OPTION 1
CONNECTION TO
MUNICIPAL PRESSURE ZONE
10TH AVENUE ESTATES

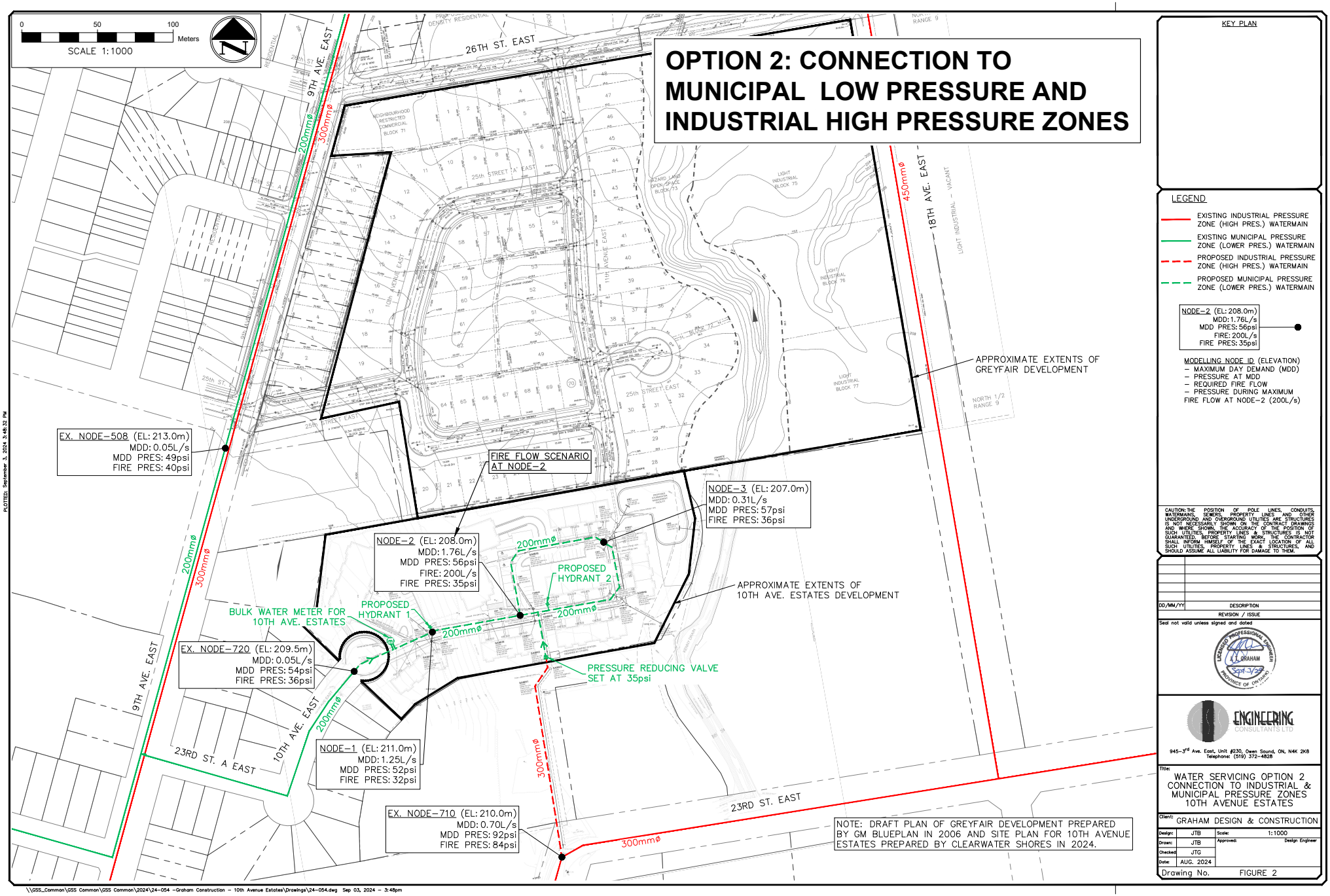
Client: GRAHAM DESIGN & CONSTRUCTION

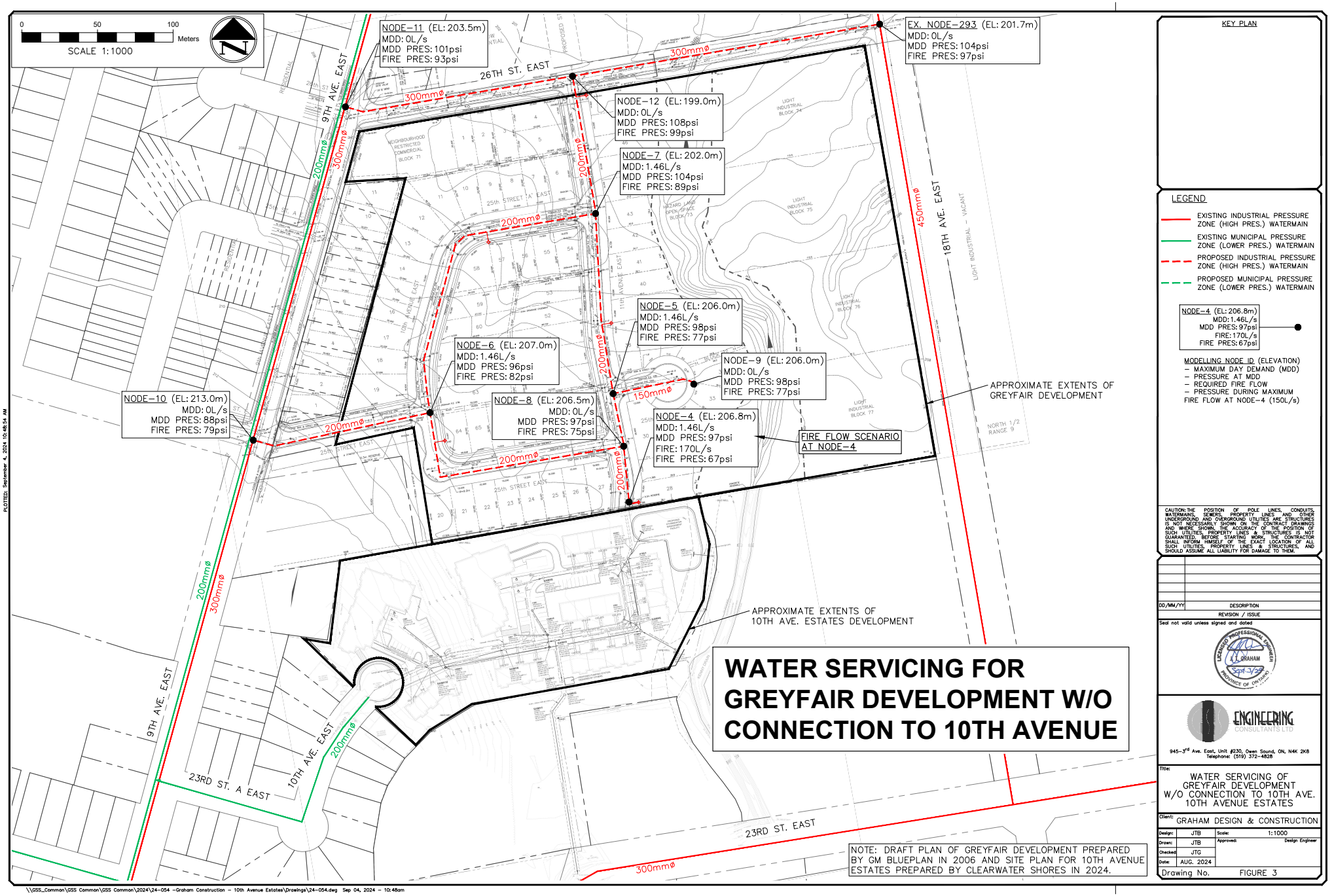
Design:	JTB	Scale:	1:1000
Drawn:	JTB	Approved:	Design Engineer
Checked:	JTG		
Date:	AUG. 2024		

Drawing No. FIGURE 1

PLOTTED: September 3, 2024 3:48:03 PM

\\GSS_Common\GSS Common\GSS Common\2024\24-054 -Graham Construction – 10th Avenue Estates\Drawings\24-054.dwg Sep 03, 2024 – 3:48pm


0
50
100
Meters
SCALE 1:1000
OPTION 2: CONNECTION TO MUNICIPAL LOW PRESSURE AND INDUSTRIAL HIGH PRESSURE ZONES
26TH ST. EAST
9TH AVE. EAST
10TH AVE. EAST
11TH AVENUE EAST
18TH AVE. EAST
25th STREET EAST
25th STREET 1A EAST
23RD ST. A EAST
23RD ST. EAST
200mmø
300mmø
450mmø
EX. NODE–508 (EL: 213.0m)
MDD: 0.05L/s
MDD PRES: 49psi
FIRE PRES: 40psi
FIRE FLOW SCENARIO AT NODE–2
NODE–2 (EL: 208.0m)
MDD: 1.76L/s
MDD PRES: 56psi
FIRE: 200L/s
FIRE PRES: 35psi
NODE–3 (EL: 207.0m)
MDD: 0.31L/s
MDD PRES: 57psi
FIRE PRES: 36psi
PROPOSED HYDRANT 2
PROPOSED HYDRANT 1
BULK WATER METER FOR 10TH AVE. ESTATES
APPROXIMATE EXTENTS OF GREYFAIR DEVELOPMENT
APPROXIMATE EXTENTS OF 10TH AVE. ESTATES DEVELOPMENT
EX. NODE–720 (EL: 209.5m)
MDD: 0.05L/s
MDD PRES: 54psi
FIRE PRES: 36psi
PRESSURE REDUCING VALVE SET AT 35psi
NODE–1 (EL: 211.0m)
MDD: 1.25L/s
MDD PRES: 52psi
FIRE PRES: 32psi
EX. NODE–710 (EL: 210.0m)
MDD: 0.70L/s
MDD PRES: 92psi
FIRE PRES: 84psi
NOTE: DRAFT PLAN OF GREYFAIR DEVELOPMENT PREPARED BY GM BLUEPLAN IN 2006 AND SITE PLAN FOR 10TH AVENUE ESTATES PREPARED BY CLEARWATER SHORES IN 2024.
KEY PLAN
LEGEND
EXISTING INDUSTRIAL PRESSURE ZONE (HIGH PRES.) WATERMAIN
EXISTING MUNICIPAL PRESSURE ZONE (LOWER PRES.) WATERMAIN
PROPOSED INDUSTRIAL PRESSURE ZONE (HIGH PRES.) WATERMAIN
PROPOSED MUNICIPAL PRESSURE ZONE (LOWER PRES.) WATERMAIN
NODE–2 (EL: 208.0m)
MDD: 1.76L/s
MDD PRES: 56psi
FIRE: 200L/s
FIRE PRES: 35psi
MODELLING NODE ID (ELEVATION)
– MAXIMUM DAY DEMAND (MDD)
– PRESSURE AT MDD
– REQUIRED FIRE FLOW
– PRESSURE DURING MAXIMUM FIRE FLOW AT NODE–2 (200L/s)
CAUTION: THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS, PROPERTY LINES AND OTHER UNDERGROUND AND OVERGROUND UTILITIES ARE STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES, PROPERTY LINES OR STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES, PROPERTY LINES & STRUCTURES, AND SHOULD ASSUME ALL LIABILITY FOR DAMAGE TO THEM.
DD/MM/YY
DESCRIPTION
REVISION / ISSUE
Seal not valid unless signed and dated
J.T. GRAHAM
Sept 3/24
945–3rd Ave. East, Unit #230, Owen Sound, ON, N4K 2K8
Telephone: (519) 372–4828
Title:
WATER SERVICING OPTION 2
CONNECTION TO INDUSTRIAL &
MUNICIPAL PRESSURE ZONES
10TH AVENUE ESTATES
Client:
GRAHAM DESIGN & CONSTRUCTION
Design: JTB
Drawn: JTB
Checked: JTG
Date: AUG. 2024
Scale: 1:1000
Approved: Design Engineer
Drawing No. FIGURE 2
PLOTTED: September 3, 2024 3:48:32 PM
\\GSS_Common\GSS Common\GSS Common\2024\24-054 -Graham Construction – 10th Avenue Estates\Drawings\24-054.dwg Sep 03, 2024 – 3:48pm



WATER SERVICING FOR GREYFAIR DEVELOPMENT W/O CONNECTION TO 10TH AVENUE

KEY PLAN

LEGEND

- EXISTING INDUSTRIAL PRESSURE ZONE (HIGH PRES.) WATERMAIN
- EXISTING MUNICIPAL PRESSURE ZONE (LOWER PRES.) WATERMAIN
- PROPOSED INDUSTRIAL PRESSURE ZONE (HIGH PRES.) WATERMAIN
- PROPOSED MUNICIPAL PRESSURE ZONE (LOWER PRES.) WATERMAIN

NODE-4 (EL: 206.8m)
MDD: 1.46L/s
MDD PRES: 97psi
FIRE: 170L/s
FIRE PRES: 67psi

MODELLING NODE ID (ELEVATION)
- MAXIMUM DAY DEMAND (MDD)
- PRESSURE AT MDD
- REQUIRED FIRE FLOW
- PRESSURE DURING MAXIMUM FIRE FLOW AT NODE-4 (150L/s)

CAUTION: THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS, PROPERTY LINES AND OTHER UNDERGROUND AND OVERGROUND UTILITIES ARE STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES, PROPERTY LINES & STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES, PROPERTY LINES & STRUCTURES, AND SHOULD ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

DD/MM/YY	DESCRIPTION
	REVISION / ISSUE

Seal not valid unless signed and dated

LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO J.L. GRAHAM Sept 3/24

ENGINEERING CONSULTANTS LTD
945-3rd Ave. East, Unit #230, Owen Sound, ON, N4K 2K8
Telephone: (519) 372-4828

Title: WATER SERVICING OF GREYFAIR DEVELOPMENT W/O CONNECTION TO 10TH AVE. 10TH AVENUE ESTATES

Client: GRAHAM DESIGN & CONSTRUCTION

Design:	JTB	Scale:	1:1000
Drawn:	JTB	Approved:	Design Engineer
Checked:	JTG		
Date:	AUG. 2024		

Drawing No. FIGURE 3

PLOTTED: September 4, 2024 10:48:54 AM

\\GSS_Common\GSS Common\GSS Common\2024\24-054 -Graham Construction - 10th Avenue Estates\Drawings\24-054.dwg Sep 04, 2024 - 10:48am

TABLE 1
OPTION 1: CONNECTION TO MUNICIPAL PRESSURE ZONE
10TH AVENUE ESTATES WATER SERVICING

Elevation (m)	Maximum Day Demand (L/s)	Residual Pressure For MDD (psi)	Fire Flow Demand (L/s)	Residual Pres. During Max. Fire Flow at Node-2 (psi)	Maximum Fire Flow Avaliable (@ 20 psi) (L/s)
Node 1					
211	1.25	52	170	-55	101
Node 2					
208	1.76	56	200	-65	101
Node 3					
207	0.31	57	170	-63	100
Ex. Node 720*					
209.5	0.05	54	N/A	-38	N/A
Ex. Node 508*					
213	0.05	49	N/A	-26	N/A
Ex. Node 710**					
210	0.70	92	N/A	92	N/A

*Node in the Municipal Pressure Zone

**Node in the Industrial Pressure Zone

TABLE 2
OPTION 2: CONNECTION TO MUNICIPAL & INDUSTRIAL PRESSURE ZONE
10TH AVENUE ESTATES WATER SERVICING

Elevation (m)	Maximum Day Demand (L/s)	Residual Pressure For MDD (psi)	Fire Flow Demand (L/s)	Residual Pres. During Max. Fire Flow at Node-2 (psi)	Maximum Fire Flow Avaliable (@ 20 psi) (L/s)
Node 1					
211	1.25	52	170	32	253
Node 2					
208	1.76	56	200	35	475
Node 3					
207	0.31	57	170	36	310
Ex. Node 720*					
209.5	0.05	54	N/A	36	N/A
Ex. Node 508*					
213	0.05	49	N/A	40	N/A
Ex. Node 710**					
210	0.70	92	N/A	84	N/A

*Node in the Municipal Pressure Zone

**Node in the Industrial Pressure Zone

TABLE 3
WATER SERVICING FOR GREYFAIR DEVELOPMENT WITHOUT CONNECTION TO MUNICIPAL PRESSURE ZONE THROUGH 10TH AVENUE

Elevation (m)	Maximum Day Demand (L/s)	Residual Pressure For MDD (psi)	Fire Flow Demand (L/s)	Residual Pres. During Fire Flow at Node-4 (psi)	Maximum Fire Flow Avaliable (@ 20 psi) (L/s)
Node 4					
206.8	1.46	97	170	67	290
Node 5					
206.0	1.46	98	N/A	77	N/A
Node 6					
207.0	1.46	96	N/A	82	N/A
Node 7					
202.0	1.46	104	N/A	89	N/A
Node 8					
206.5	0	97	N/A	75	N/A
Node 9					
206.0	0	98	N/A	77	N/A
Node 10					
213.0	0	88	N/A	79	N/A
Node 11					
203.5	0	101	N/A	93	N/A
Node 12					
199.0	0	108	N/A	99	N/A
Ex. Node 293					
201.7	0	104	N/A	97	N/A

APPENDIX A

City of Owen Sound Comments from Jacklyn Iezzi on August 28th, 2024
and Greyfair Draft Plan (prepared by Gamsby and Mannerow Ltd. in 2006)

Jacob Bartley

From: Jacob Bartley
Sent: August 30, 2024 3:21 PM
To: Jacob Bartley
Subject: Revised Functional Servicing Report - 10th Avenue Estates

Importance: High

Hi Mike,

Thank you for providing the revised plans and studies as outlined in comments provided by City Staff on July 31, 2024.

City Staff are working on finalizing a Staff Recommendation Report to City Council with respect to ZBA 53.

The submitted Transportation Report demonstrates that the extension of 10th Avenue East is not warranted from the proposed development from a traffic impact perspective. The study area intersections of 9th Avenue East at 23rd Street East and 23rd Street 'A' East continue to operate at acceptable levels of services (LOS C or better) with the proposed development and 150 residential units anticipated within the Greyfair Subdivision and without the extension of 10th Avenue. In addition, the revised Site Plan showing the mitigation measures required by Staff and the City's third-party peer reviewer to maintain active transportation and emergency services connectivity within the East Bluffs Planning Area is acceptable.

As part of the comments provided in July, the submission of a revised Servicing Feasibility Study (SFS) was identified as being required, prior to a Recommendation Report coming before City Council with respect to ZBA 53. The revised SFS was to incorporate the following, as outlined in the Development Comment Tracking Chart and comments received from the City's Engineering Services Division dated July 31, 2024 (attached hereto for ease of reference):

- Water supply and distribution:

The water system shall be designed on the basis of providing a minimum pressure of 140 kPa (20 psi) at ground level under maximum day demand plus fire flow conditions, in accordance with MECP criteria. This may involve using the status pressure at the nearest fire hydrant during analysis;

Based on MECP criteria, the applicant is to demonstrate that the minimum static pressure for domestic use in the building at the highest elevation is at least 275 kPa (40 psi), which may involve the use of a booster pump as may be determined during the mechanical design of the building, and hydraulic load calculations in accordance with the Ontario Building Code;

Fire flow calculations; and,

Update the report to indicate that the proposed watermain connection is to the Municipal Pressure Zone (MPZ).

Sanitary Servicing:

Review the minimum flow velocities in the design sheets (Appendix C), as they appear to be less than the minimum of 0.6 m/s.

City Engineering Services Staff have reviewed the revised Functional Servicing Report (FSR) by Clearwater Shores dated August 21, 2024, and the following is noted:

The water demand calculated by your engineering consultant for the development (domestic and fire flow) is 153.32 L/s (9,199.2 L/min or

2,430.2 gal/min).
A hydrant flow test was completed and indicates at 32 psi, the available flow is 4,323 L/min (72 L/s).
It is unclear what fire flow is available at 20 psi (minimum drop during fire flow demands) however, extrapolated from curve is likely ~5,000 L/min (83 L/s) or less.

Based on the results of the revised FSR,there is a deficit in water flow available in the existing 200 mm diameter watermain on 10th Avenue East entering the development to support the proposed use (83L/s or less is available, whereas 153.32 L/s is required).

The policies of the City's 2021 Official Plangenerally support housing intensification and infill development, subject to criteria as outlined in policy 3.1.8.2 including, among other matters, that existing infrastructure including sewer and water services, can support additional development. In accordance with policy 5.2.1.1, development will be permitted in areas that can be adequately serviced by municipal services, including municipal water, wastewater, stormwater management and emergency services and the City may require, as a condition of reviewing any development proposal, an analysis by a qualified professional of the capacity, availability, and appropriateness of any municipal service.

As you know, a Zoning By-law Amendment application is required to conform to the policies of the City's Official Plan.

Off-site improvements to City watermain infrastructure will be required to obtain additional water flow to support the identified water demand of the proposed development (domestic and fire flow). The revised FSR does not address how and if the fire flow demand required by the development can be met and is therefore not sufficient for demonstrating conformity with the policies of the City's 2021 Official Plan, as noted above.

Furthermore, the development is proposing the removal of the 10th Avenue East extension through the property. As discussed during the pre-consultation process, policy 4.1.3.1 of the City's Official Plan requires that lands be developed in general conformity with the schematic road system plan illustrated on Schedule 'A1' – East Bluffs Planning Area of the OP. For local roads, the road system plan may be considered illustrative only and changes to the location and configuration of such streets shall be permitted without an Official Plan Amendment,provided that the planned street does not adversely impact the development ability of adjoining lands, or the general traffic flow system provided, and the layout is in accordance with proper design principles. A Transportation Impact Assessment (TIA) was identified as being required as part of a complete ZBA application. The Terms of Reference provided for the TIA acknowledges the linear north-south underground infrastructure corridor to the east of 9th Avenue East that would be provided with the extension of 10th Avenue and requires, among other matters, an analysis of the impacts on infrastructure redundancy in the proposed absence of this road connection.

The impacts on water and sanitary servicing to the Greyfair lands is addressed in Section 2.3 and Section 3.3 of the FSR respectively. The report generally concludes that the elimination of the 10th Avenue East extension does not impact the future development, which can be serviced by existing infrastructure on 9th Avenue East and 26th Street East however, further analysis is required in this regard. Additionally, it merits note that there are no municipal services available on 26th Street East fronting the Greyfair property, as identified by the report.

As it relates to water servicing, the draft approved plan of subdivision for the Greyfair lands (attached and provided at the time of
pre-consultation) identifies the extension of the existing, 200 mm diameter PVC watermain at the termination of 10th Avenue East northerly through the subject property via 10th Avenue and looping through the internal roads of the subdivision to connect to the existing, 200 mm diameter ductile iron watermain on 9th Avenue East at 25th Street East in the Municipal Pressure Zone, to provide for a looping watermain. The removal of the 10th Avenue East extension will remove the potential for a looping watermain and rationale for the water supply for Greyfair is required in consideration of this loss (i.e., there may need to be multiple taps of the watermain to loop and provide waterflow, which may have been offset by the connection through the subject property via 10th Ave). Additionally, it merits note that a looping

watermain as it's anticipated by the draft plan, would provide for additional water flow which, based on the conclusions of the revised FSR, is required for the subject development.

In order to continue to accommodate a Staff Recommendation Report to City Council on September 9, 2024, a revised FSR will need to be provided by Wednesday, September 4, 2024, end of day. Please advise if this timeline is achievable. If a meeting with City Staff is required to discuss the required revisions to the report in greater detail, please do not hesitate to contact me.

Sincerely,

Jacklyn Iezzi,BES.
Senior Planner

City of Owen Sound
808 2nd Ave. E., Owen Sound, ON N4K 2H4
519-376-4440 ext. 1261
[mailto:jiezzi@owensound.ca]jiezzi@owensound.ca [
https://linkprotect.cudasvc.com/url?a=http%3a%2f%2fwww.owensound.ca%2f&c=E,1,bMdrQiKR_PwV6VEsjGxu-bpxVA69FNqTj7_Y_R2R6jMp-F9BHZxNrFii-0E399DMTlDCmU0frW-Bb_pDu0rxbobCMxv_g96iOTQ-3FQI4VE,&typo=1
]www.owensound.ca

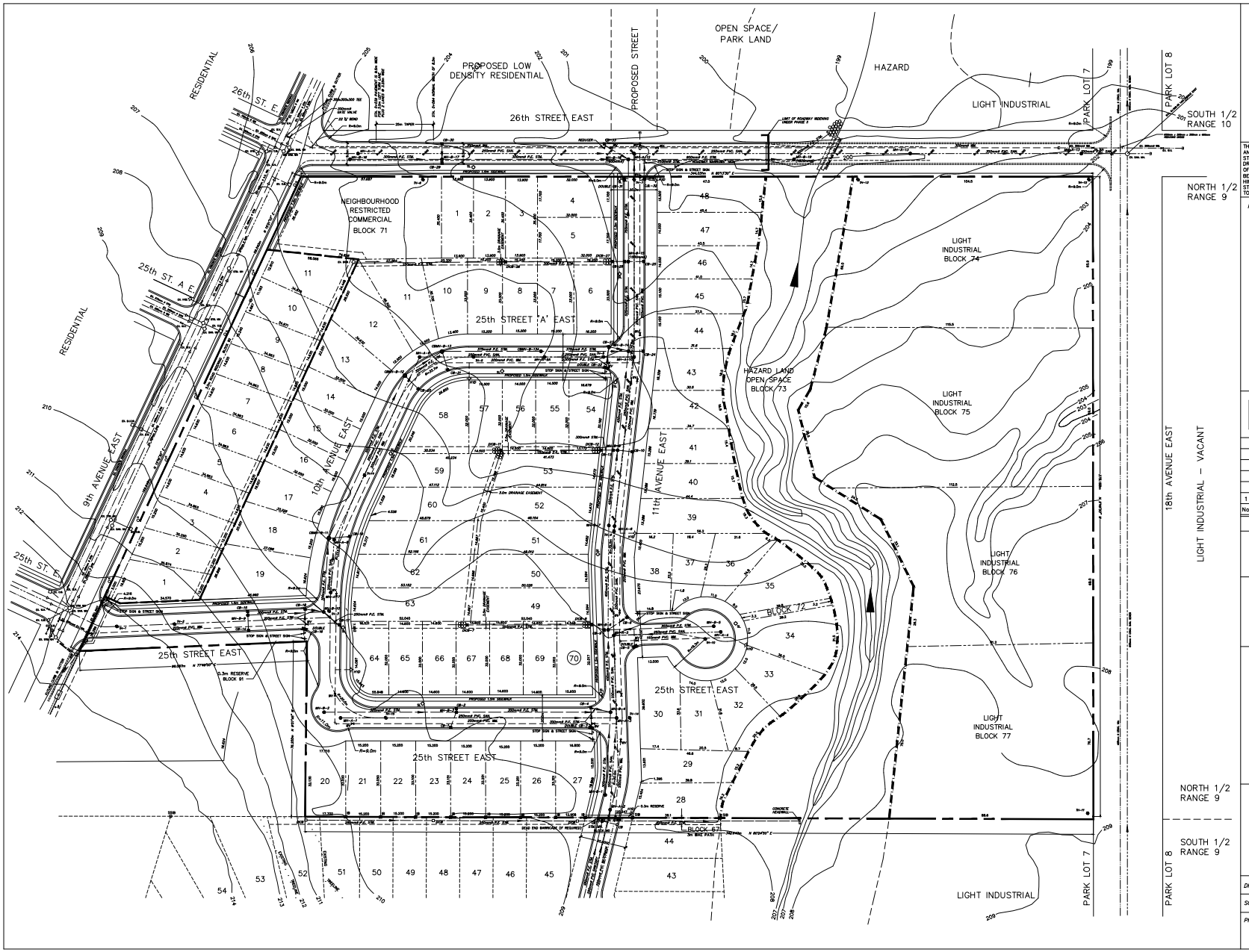
[
https://linkprotect.cudasvc.com/url?a=https%3a%2f%2fwww.owensound.ca%2fen%2findex.aspx&c=E,1,Eg4bSKIEL14O3eDBiSpx-l31zPQ2WNMHouWIw_hWKICLRBX-fSDM2mRcglf_u7O6rTwKOxLR6WkdHBH-iHM8zsFt6Aqi68o8XFYSetquuaXDOXQF80FDLyjZ&typo=1
][Image]
The City of Owen Sound respectfully acknowledges the Territoryof the Anishinabek Nation, the traditional keepers of this land.

Connect with us:
[https://www.facebook.com/CityofOwenSound/][Image] [https://twitter.com/CityOwenSound][Image] [
https://www.instagram.com/cityowensound/][Image] [
https://www.linkedin.com/authwall?trk=bf&trkInfo=AQFP3DHHanjB-gAAAYfmyktw_emLXt7iG2WWvYLPC4TLUAILuX8uai9d2h7ewy4Kvl--CLOKnCwWYoq6R0_p31l12T9-qXgE5k1lwURCsjQipEZ_0sBeXdUkBWamcA8P1SSDI_s=&original_referer=&sessionRedirect=https%3A%2F%2Fwww.linkedin.com
%2Fcompany%2Fthe-corporation-of-the-city-of-owen-sound][Image]

[Image]

My working day may not be your working day. Pleasedon't feel obligated to reply to this email outside of your working hours.

Please consider the environment before printing.



THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

NOTES:

GAMSBY AND MANNEROW LIMITED
CONSULTING PROFESSIONAL ENGINEERS
GUELPH – OWEN SOUND – LISTOWEL

No.	DESCRIPTION	BY	DATE
1	PER CITY COMMENTS	J.V.D.	SEP 25/06

REVISIONS

GENERAL PLAN PHASE II

9th AVENUE EAST AND 26th STREET EAST DEVELOPMENT

City of Owen Sound

LICENSED PROFESSIONAL ENGINEER
J. B. SLOCOMBE
PROVINCE OF ONTARIO

DRAWN BY: L.V.M.	CHECKED BY: J.V.D.
SCALE: 1:750	DATE: AUGUST 31, 2006
PROJECT No: S-1223	PLAN No. 1 of 8

SEE DRAWING: S1223-GPL-2005.dwg

APPENDIX B

EPAnet Model Results

TABLE B1 – Option 1 for Servicing 10th Avenue Estates, Maximum Day Demand Results

Network Table - Nodes at 0:00 Hrs

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc NODE-1	211	1.25	247.35	36.28
Junc NODE-2	208	1.76	247.35	39.27
Junc NODE-3	207	0.31	247.35	40.27
Junc J-720	209.5	0.05	247.36	37.78
Junc J-508	213	0.05	247.37	34.30
Junc J-710	210	0.70	275.07	64.94

TABLE B2 – Option 1 for Servicing 10th Avenue Estates, Fire Flow at Node-2 Results

Network Table - Nodes at 0:00 Hrs

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc NODE-1	211	1.25	172.43	-38.49
Junc NODE-2	208	201.76	162.20	-45.70
Junc NODE-3	207	0.31	162.20	-44.71
Junc J-720	209.5	0.05	182.43	-27.02
Junc J-508	213	0.05	194.53	-18.43
Junc J-710	210	0.70	275.07	64.94

TABLE B3 – Option 2 for Servicing 10th Avenue Estates, Maximum Day Demand Results

Network Table - Nodes at 0:00 Hrs

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc NODE-1	211	1.25	247.34	36.27
Junc NODE-2	208	1.76	247.34	39.26
Junc NODE-3	207	0.31	247.34	40.26
Junc J-720	209.5	0.05	247.35	37.77
Junc J-508	213	0.05	247.37	34.30
Junc J-710	210	0.70	275.07	64.94

TABLE B4 – Option 2 for Servicing 10th Avenue Estates, Fire Flow at Node-2 Results

Network Table - Nodes at 0:00 Hrs

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc NODE-1	211	1.25	233.61	22.57
Junc NODE-2	208	201.76	232.35	24.30
Junc NODE-3	207	0.31	232.35	25.30
Junc J-720	209.5	0.05	234.88	25.33
Junc J-508	213	0.05	241.08	28.03
Junc J-710	210	0.70	269.27	59.16

TABLE B5 – Water Servicing Greyfair Development, Maximum Day Demand Results

Network Table - Nodes at 0:00 Hrs

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc node-4	206.8	1.46	275.03	68.09
Junc node-5	206	1.46	275.03	68.89
Junc node-6	207	1.46	275.03	67.90
Junc node-7	202	1.46	275.03	72.89
Junc node-8	206.5	0.00	275.03	68.39
Junc node-9	206	0.00	275.03	68.89
Junc node-10	213	0.00	275.04	61.91
Junc node-11	203.5	0.00	275.05	71.40
Junc node-12	199	0.00	275.05	75.89
Junc J-293	201.7	0.00	275.05	73.20

TABLE B6 – Water Servicing Greyfair Development, Fire Flow at Node-4 Results

Network Table - Nodes at 0:00 Hrs

Node ID	Elevation m	Demand LPS	Head m	Pressure m
Junc node-4	206.8	171.46	254.43	47.53
Junc node-5	206	1.46	260.65	54.54
Junc node-6	207	1.46	265.06	57.94
Junc node-7	202	1.46	265.10	62.97
Junc node-8	206.5	0.00	259.33	52.72
Junc node-9	206	0.00	260.65	54.54
Junc node-10	213	0.00	268.71	55.60
Junc node-11	203.5	0.00	269.08	65.45
Junc node-12	199	0.00	269.07	69.93
Junc J-293	201.7	0.00	270.04	68.20

CLEARWATER SHORES
CIVIL ENGINEERING

10th Ave Estates Hydraulic Load Calculation

Building Fixture Units (FU) Per Single Townhouse Unit

Fixture type	Hydraulic Load (FU)	Quantity	Hydraulic Load (FU)
Bathroom Group with 6 litres per flush (LPF) flush tank	3.6	1	3.6
Bathroom Group with greater than 6 LPF flush tank	6	0	0
Water Closet (Toilet) 6 LPF	2.2	1	2.2
Water Closet greater than 6 LPF flush tank	3	0	0
Lavatory (Bathroom Sink)	0.7	1	0.7
Bathtub with or without Shower	1.4		0
Shower (per head)	1.4		0
Kitchen Sink	1.4	1	1.4
Dish Washer	1.4	1	1.4
Clothes Washer (res)	1.4	1	1.4
Clothes Washer (com)	4		0
Laundry Tub	1.4		0
Hose Bibb (Outdoor Taps)	2.5	1	2.5
Total Hydraulic Load (FU)	13.2		

Water Service Size

Water service size – Copper or PEX (From Chart Below)	3/4”

Water Service Pipe Sizing Chart

	Maximum Hydraulic Loads (FU)		
Water Service size	3/4"	1"	1 1/2"
Copper or PEX	16	31	57

Notes:

- If Hydraulic Loads exceed 57 fixture units, a Mechanical Engineer is required to provide a design.
- Fixture Loads are taken from Part 7, Table 7.6.3.2.A of the Ontario Building Code

CLEARWATER SHORES
CIVIL ENGINEERING

10th Ave Estates Hydraulic Load Calculation

F Units Building Fixture Units (FU) Per Apartment Building

Fixture type	Hydraulic Load(FU)	Quantity	Hydraulic Load(FU)
Bathroom Group with 6 litres per flush (LPF) flush tank	3.6	2	7.2
Bathroom Group with greater than 6 LPF flush tank	6	0	0
Water Closet (Toilet) 6 LPF	2.2	0	0
Water Closet greater than 6 LPF flush tank	3	0	0
Lavatory (Bathroom Sink)	0.7	0	0
Bathtub with or without Shower	1.4	0	0
Shower (per head)	1.4	0	0
Kitchen Sink	1.4	1	1.4
Dish Washer	1.4	1	1.4
Clothes Washer (res)	1.4	1	1.4
Clothes Washer (com)	4	0	0
Laundry Tub	1.4	0	0
Hose Bibb (Outdoor Taps)	2.5	0	0
Number of Units	34		
Total Hydraulic Load (FU)	387.6		

Hydraulic Load Conversion on next page.

Notes:

- If Hydraulic Loads exceed 57 fixture units, a Mechanical Engineer is required to provide a detailed design.
- Fixture Loads are taken from Part 7, Table 7.6.3.2.A of the Ontario Building Code

Hydraulic Load Calculation

Total Hydraulic Load

$$Load\ per\ Unit = 11.4FU$$

$$Number\ of\ Units = 34$$

$$Total\ Load = 11.4FU\ \times 34 = 387.6FU$$

$$1\ FU = 0.47\ \frac{L}{s}$$

$$Conversion\ to\ \frac{L}{s} = \ 387.6FU \times 0.47 = 182.172$$

$$Conversion\ to\ \frac{m^3}{s} = 1\frac{L}{s} \times \frac{1\frac{m^3}{s}}{1000\frac{L}{s}} = \frac{182.172}{1000} = 0.182\frac{m^3}{s}$$

$$Q = 0.182\frac{m^3}{s}$$

Bernoulli's Equation

$$P_1 + \frac{1}{2}pv_1{}^2 + pgh_1 = P_2 + \frac{1}{2}pv_2{}^2 + pgh_2$$

Where P_1 = -289579.81Pa (42psi), $h_1 = h_2, v_2 = -1.22\frac{m}{s},\ v_1 = \frac{Q}{A}, p = 1000\frac{kg}{m^3}\ \ Q = 0.182\frac{m^3}{s}\ \ and\ P_2 = 101325\ (atmospheric\ pressure)$

$$reduced\ equation: P_1 + \frac{1}{2}pv_1{}^2 = P_2 + \frac{1}{2}pv_2{}^2$$

$$-289579.81Pa + \frac{1}{2} \times 1000\frac{kg}{m^3} \times \left(\frac{Q_1}{A_1}\right)^2 = 101325Pa + \frac{1}{2} \times 1000\frac{kg}{m^3} \times (-1.22\frac{m}{s})^2$$

$$500 \times (\frac{Q_1}{A_1})^2 = 289579.81\ Pa + 101325\ Pa - 610Pa$$

$$(\frac{Q_1}{A_1})^2 = \frac{390294.81}{500}$$

$$\left(\frac{Q_1}{A_1}\right)^2 = 780.58$$

$$\frac{Q_1}{A_1} = \sqrt{780.59}$$

$$A_1 = \frac{0.182}{\sqrt{780.59}}$$

$$A_1 = 6.51 \times 10^{-3}$$

Finding Diameter

$$A = \pi r^2$$

$$r = \sqrt{\frac{A}{\pi}}$$

$$where\ A = 6.51 \times 10^{-3}$$

$$r = \sqrt{\frac{6.51 \times 10^{-3}}{\pi}}$$

$$r = 0.0455m$$

D = 2r

D = 2 x 0.0455m

D = 0.091m

So, the final calculated diameter of the pipe is 0.091m or 91mm. Therefore our estimate is that a 100mm or greater diameter pipe would be sufficient.

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepaired by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	19-Aug-24

Project: 10th Ave Estates Development
Water Demand Calculations
Future Greyfair Site

Demestic Flow Calculations

Average Day Per Capita Flow =	400 L/c/d
Number of Proposed Units =	150
Residential Density =	2.1 ppu
Population =	315
Average Day Demand =	126,000 L/d
=	1.46 L/s
Peak Factor =	4
Total Domestic Peak Demand =	5.83 L/s

Appendix B

Sanitary Flow Calculations

CLEARWATER SHORES
CIVIL ENGINEERING

CALCULATION SHEET

Prepaired by:	Keith Welsh
Checked by:	Michelle Henry
Project Number:	24003
Date:	04-Jun-24

Project: 10th Ave Estates Development
Sanitary Flow Calculations

Residential Sanitary Contribution

Average Day Per Capita Flow =	400 L/c/d
Number of Proposed Units =	85
Residential Density =	2.1 ppu
Population =	178.5
Average Day Demand =	71,400 L/d
=	0.83 L/s
Peak Factor =	4
Peak Flow =	**3.32 L/s**
Infiltration Allowance =	0.26 L/s/ha
Total Site Area =	2.53 ha
Infiltration =	**0.66L/s**
Total Peak Flow =	**4.04 L/s**

Appendix C

Sanitary Sewer Design Sheet

SANITARY SEWER DESIGN SHEET

10th Ave Estates Development, The City of Owen Sound

Project #: 24003.0
Date: 06/04/2024
Designed: KJW
Checked: MH

Min Diameter = 200 mm
Mannings 'n'= 0.013
Min. Velocity = 0.60 m/s
Max. Velocity = 3.65 m/s

Avg. Domestic Flow = 400.0 l/c/d
Infiltration = 0.260 l/s/ha
Max. Peaking Factor = 4.00
Min. Peaking Factor= 1.50

Factor of Safety = 10 %

CLEARWATER SHORES
CIVIL ENGINEERING

NOMINAL PIPE SIZE USED

			RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA					
DESCRIPTION	FROM MH	TO MH	AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	POP. FLOW (l/s)	CONSTANT COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)	PERCENT FULL (%)
	SAMH10	SAMH9	1.00	1.00	33		2.1	70	70							0.3	70	4.00	1.3			1.6	4.00	200	65.6	2.09	0.87	2%
	SAMH9	SAMH5	0.11	1.11	2		2.1	5	75							0.3	75	4.00	1.4			1.7	4.00	200	65.6	2.09	0.89	3%
	SAMH8	SAMH7	0.71	0.71	38		2.1	80	80							0.2	80	4.00	1.5			1.7	1.50	200	40.2	1.28	0.63	4%
	SAMH7	SAMH6	0.44	1.15	4		2.1	9	89							0.3	89	4.00	1.6			1.9	1.20	200	35.9	1.14	0.61	5%
	SAMH6	SAMH5	0.32	1.47	8		2.1	17	106							0.4	106	4.00	2.0			2.3	1.00	200	32.8	1.04	0.60	7%
	SAMH5	SAMH3	0.04	2.61			2.1		181							0.7	181	4.00	3.4			4.0	0.70	200	27.4	0.87	0.62	15%
	SAMH3	SAMH2	0.01	2.63			2.1		181							0.7	181	4.00	3.4			4.0	1.00	200	32.8	1.04	0.71	12%
	SAMH2	SAMH1	0.02	2.64			2.1		181							0.7	181	4.00	3.4			4.0	0.63	200	26.0	0.83	0.60	16%
	SAMH1	EXSAMH	0.13	2.77			2.1		181							0.7	181	4.00	3.4			4.1	0.63	200	26.0	0.83	0.60	16%

Appendix D

Storm Sewer Design Sheet

Storm Sewer Design Sheet

5-Year Design Storm

Project #: 24003.0
Date: 4-Jun-24
Designed: KJW
Checked: MH

Min. Diameter = 300 mm
Mannings 'n'= 0.013
Starting Tc = 10 min

Rainfall Intensity = $\frac{A}{(T_c+B)^c}$ ***where Tc is in hours***

A = 29.1
B = -0.724
C =

5-Yr

NOMINAL PIPE SIZE USED

DESCRIPTION	FROM MH	TO MH	AREA (ha)	RUNOFF COEFFICIENT "R"	'AR'	ACCUM. 'AR'	RAINFALL INTENSITY (mm/hr)	FLOW (m3/s)	CONSTANT FLOW (m3/s)	ACCUM. CONSTANT FLOW (m3/s)	TOTAL FLOW (m3/s)	LENGTH (m)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (m3/s)	FULL FLOW VELOCITY (m/s)	INITIAL Tc (min)	TIME OF CONCENTRATION (min)	ACC. TIME OF CONCENTRATION (min)	PERCENT FULL (%)
	CB9	CB8	0.17	0.90	0.16	0.16	106.5	0.047			0.047	30.6	0.50	300	0.068	0.97	10.00	0.53	10.53	68%
	CB8	CBMH2	0.06	0.65	0.04	0.19	102.6	0.055			0.055	8.1	1.00	300	0.097	1.37	10.53	0.10	10.63	57%
	CBMH2	CBMH1	0.08	0.70	0.06	0.25	101.9	0.071			0.071	69.3	3.93	300	0.192	2.71	10.63	0.43	11.05	37%
	CB7	CBMH5	0.15	0.50	0.08	0.08	106.5	0.022			0.022	21.4	1.00	250	0.059	1.21	10.00	0.29	10.29	37%
	CB6	CBMH5	0.19	0.80	0.15	0.15	106.5	0.044			0.044	19.0	0.50	300	0.068	0.97	10.00	0.33	10.33	64%
	CBMH5	CBMH1	0.04	0.90	0.04	0.26	104.0	0.075			0.075	8.1	0.50	375	0.124	1.12	10.33	0.12	10.45	60%
	CBMH1	STMH2	0.13	0.70	0.09	0.60	99.0	0.165			0.165	61.0	0.50	525	0.304	1.40	11.05	0.72	11.78	54%
	CB4	CB3	0.07	0.80	0.06	0.06	106.5	0.017			0.017	8.5	1.00	250	0.059	1.21	10.00	0.12	10.12	28%
	CB3	STMH2	0.10	0.70	0.07	0.13	105.6	0.037			0.037	5.3	1.00	250	0.059	1.21	10.12	0.07	10.19	62%
	DICB1	STMH2	0.35	0.50	0.18	0.18	105.0	0.051			0.051	25.5	1.00	300	0.097	1.37	10.19	0.31	10.50	53%
	STMH2	STMH1				0.73	94.6	0.191			0.191	41.8	0.50	525	0.304	1.40	11.78	0.50	12.27	63%
	CB2	CB1	0.13	0.80	0.10	0.10	106.5	0.031			0.031	8.7	1.00	250	0.059	1.21	10.00	0.12	10.12	52%
	CB1	STMH1	0.23	0.70	0.16	0.27	105.6	0.078			0.078	4.4	1.00	375	0.175	1.59	10.12	0.05	10.17	44%
	STMH1	OGS1				0.99	91.8	0.253			0.253	5.9	0.75	525	0.372	1.72	12.27	0.06	12.33	68%
	OGS1	HW1				0.99	91.5	0.252			0.252	13.7	0.75	525	0.372	1.72	12.33	0.13	12.46	68%
							90.8									#DIV/0!	12.46	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
							#DIV/0!	#DIV/0!			#DIV/0!					#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	