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Van Gaal Lands 1039 Terry Fox Drive and 5331 Fernbank Road

Site Servicing & Stormwater Management Report

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VAN GAAL LANDS – CLARIDGE DEVELOPMENT

1039 TERRY FOX DRIVE & 5331 FERNBANK ROAD

SITE SERVICEABILITY AND STORMWATER MANAGEMENT REPORT

Prepared for:

Claridge Homes

Prepared By:

NOVATECH
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario
K2M 1P6

Issued: October 10, 2018
Revised: March 29, 2019

Novatech File: 117198
Report Ref: R-2018-116

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Engineers, Planners & Landscape Architects

March 29, 2019

City of Ottawa
Planning, Infrastructure and Economic Development Department
Planning Services Branch
110 Laurier Ave. West, 4th Floor
Ottawa, Ontario
K1P 1J1

Attention: Mr. Don Herweyer, Manager of Development Review South

Reference: **Van Gaal Lands – 1039 Terry Fox Drive and 5331 Fernbank Road**
Site Serviceability and Stormwater Management Report
Novatech File No.: 117198

Novatech has prepared this revised Site Serviceability and Stormwater Management Report on behalf of Claridge Homes to support a Draft Plan of Subdivision application for 1039 Terry Fox Drive and 5331 Fernbank Road.

Claridge intends to develop a residential subdivision consisting of single-detached and street-oriented townhouses. All proposed uses conform to the current zoning.

It will address how the subject development will be serviced with sanitary sewer, watermain, storm sewers, and stormwater management.

Should you have any questions or comments, please do not hesitate to contact us.

Sincerely,

NOVATECH

Marc St. Pierre
Senior Project Manager

Encl.

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- PCSWMM Packaged Model Files
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  - 100-year 24-hour SCS Storm (JFSA)

1.0 INTRODUCTION

Novatech has been retained by Claridge Homes to prepare a Site Serviceability and Stormwater Management Report for 1039 Terry Fox Drive and 5331 Fernbank Road in South Kanata, Ottawa.

The Plan of Subdivision applies to a portion of the larger property; specifically, the area south of the Monahan Drain, and north of Cope Drive (the 'Subject Site' or 'Van Gaal Lands'). An amendment to the Zoning By-law was approved by the City in July 2017 (City File No.: D02-02-15-0066) to permit residential uses on the Subject Site. The proposed development conforms to the current zoning.

This report outlines the servicing and proposed storm drainage and stormwater management strategy for the site.

1.1 Background

The Draft Plan of Subdivision applies only to a portion of 1039 Terry Fox Drive and 5331 Fernbank Road; specifically, the area south of the Monahan Drain and north of Cope Drive (the 'Subject Site Boundary'), as shown in Figure 1.

Figure 1 – Site Location: 1039 Terry Fox and 5331 Fernbank Rd (Image Source: Google Maps, 2018)

The Subject Site is approximately 8.15 hectares in area, and is bounded by Terry Fox Drive to the west, Cope Drive to the south, the Monahan Drain (a tributary to the Jock River) to the north, and an existing residential development known as Trailwest (formerly SOHO West) to the east. Refer to **Figure 1** – Site Location and **Figure 2** – Key Plan.

The Subject Site has approximately 146 metres of frontage along Cope Drive and approximately 325 metres of frontage along Terry Fox Drive. The topography is generally flat with a gentle slope from the south to the north, towards Cell 1 of the existing Monahan Drain.

1.2 Existing / Planned Adjacent Land Uses

The following describes the existing and planned land uses adjacent to the subject site:

North: The Van Gaal Lands currently extend north of the Monahan Drain to the Trans Canada Trail and are used for cattle grazing but are intended for future employment uses. A hydro corridor cuts through this northern portion in the east-west direction.

East: The lands east of the proposed subdivision are existing detached dwellings with frontage on Northgraves Crescent in the adjacent Trailwest Community.

South: Cope Drive, a two-lane collector road, bounds the Subject Site to the south. The Van Gaal Lands extend south of Cope Drive to Fernbank Road. An application for a shopping plaza is contemplated for this southern portion of the Van Gaal Lands by Smart Centres.

West: Terry Fox Drive, a two-lane arterial road, bounds the Subject Site to the west. The Blackstone residential community is located on the west side of Terry Fox and is within the Fernbank Community Design Plan area. Additional future uses will include residential, local commercial, and a secondary school.

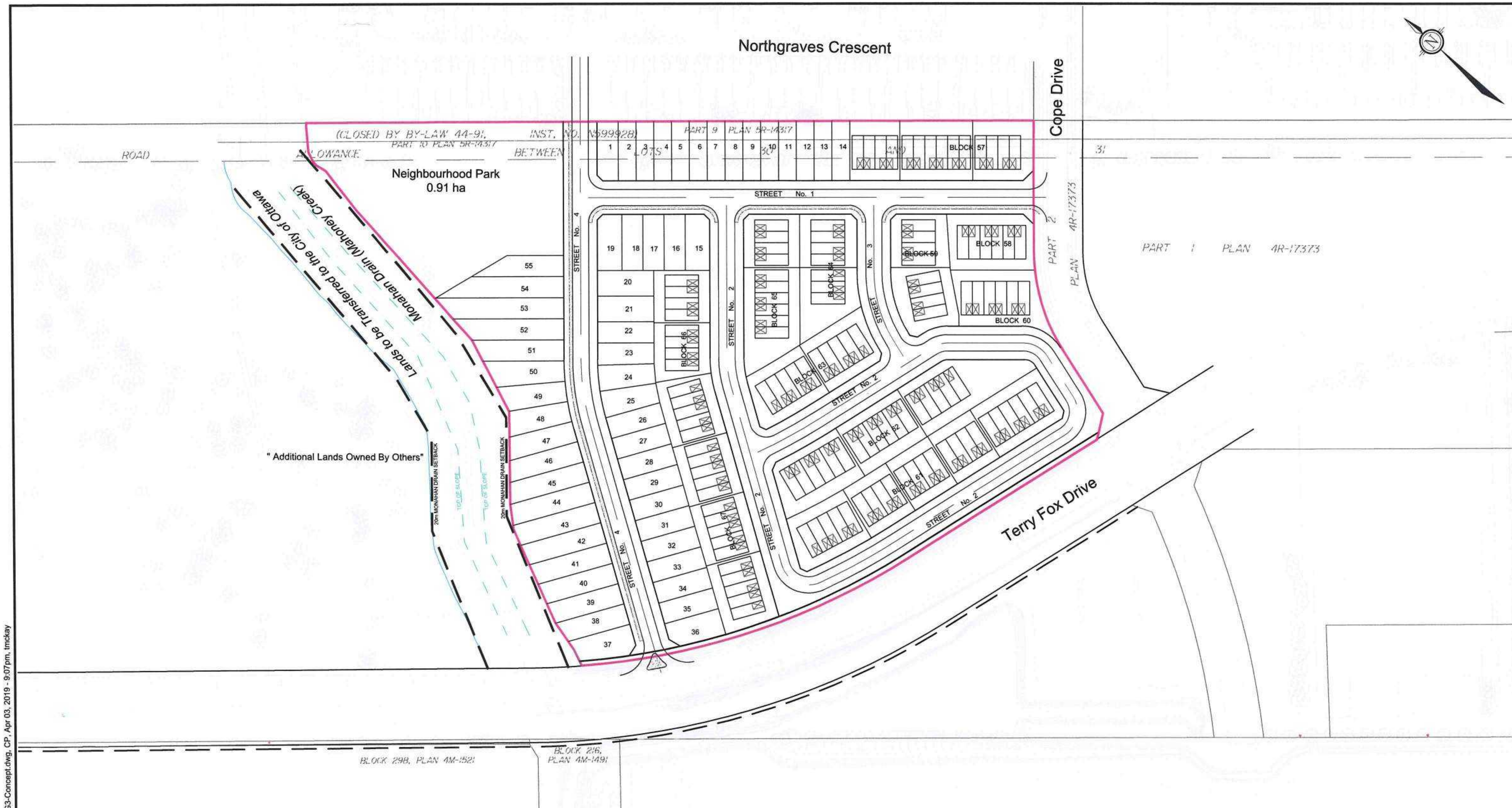
Southwest: A planned (by others) Smart Centres plaza (5357 Fernbank Road) is located at the southwest corner of Terry Fox Drive and Cope Drive.

The proposed development of the Subject Site is as a residential subdivision, as shown on **Figure 3** – Concept Plan. The proposed subdivision will consist of 129 townhouse units and 55 single units for a total of 184 units.

1.3 Additional Reports

This report provides information on the considerations and approach by which Novatech has designed and evaluated the proposed servicing for the Van Gaal Lands. This report should be read in conjunction with the following:

- *Van Gaal Lands: 1039 Terry Fox Drive and 5331 Fernbank Road, Ottawa, ON, Planning Rationale and Integrated Environmental Review Statement, completed by Novatech, Ref. No.: R-2018-106, dated October 10, 2018;*
- *Van Gaal Lands: 1039 Terry Fox Drive and 5331 Fernbank Road, Noise Impact Feasibility Study, completed by Novatech, Ref. No.: R-2018-118, dated March 29, 2019;*
- *5331 Fernbank Road and 1039 Terry Fox Drive, Traffic Impact Assessment, completed by Novatech, Ref. No.: R-2018-028, dated March 29, 2019;*
- *SOHO West - Rev. 3, Serviceability Report, Prepared by Stantec, dated October 31st, 2007;*
- *SOHO West (Phases 1 &2), Stormwater Management Report, Prepared by Stantec, dated October 31st, 2007;*
- *Van Gaal Lands: 5331 Fernbank Road and 1039 Terry Fox Drive, Ottawa, ON, Servicing & Stormwater Management Brief, completed by Novatech, Ref. No.: R-2015-123, dated September 1, 2015;*



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LEGEND

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VAN GAAL LANDS - CLARIDGE
1039 TERRY FOX DRIVE AND
5331 FERNBANK ROAD

CONCEPT PLAN

SCALE			
1 : 2000			
DATE MAR 2019	JOB 117198	FIGURE FIG3-CP	

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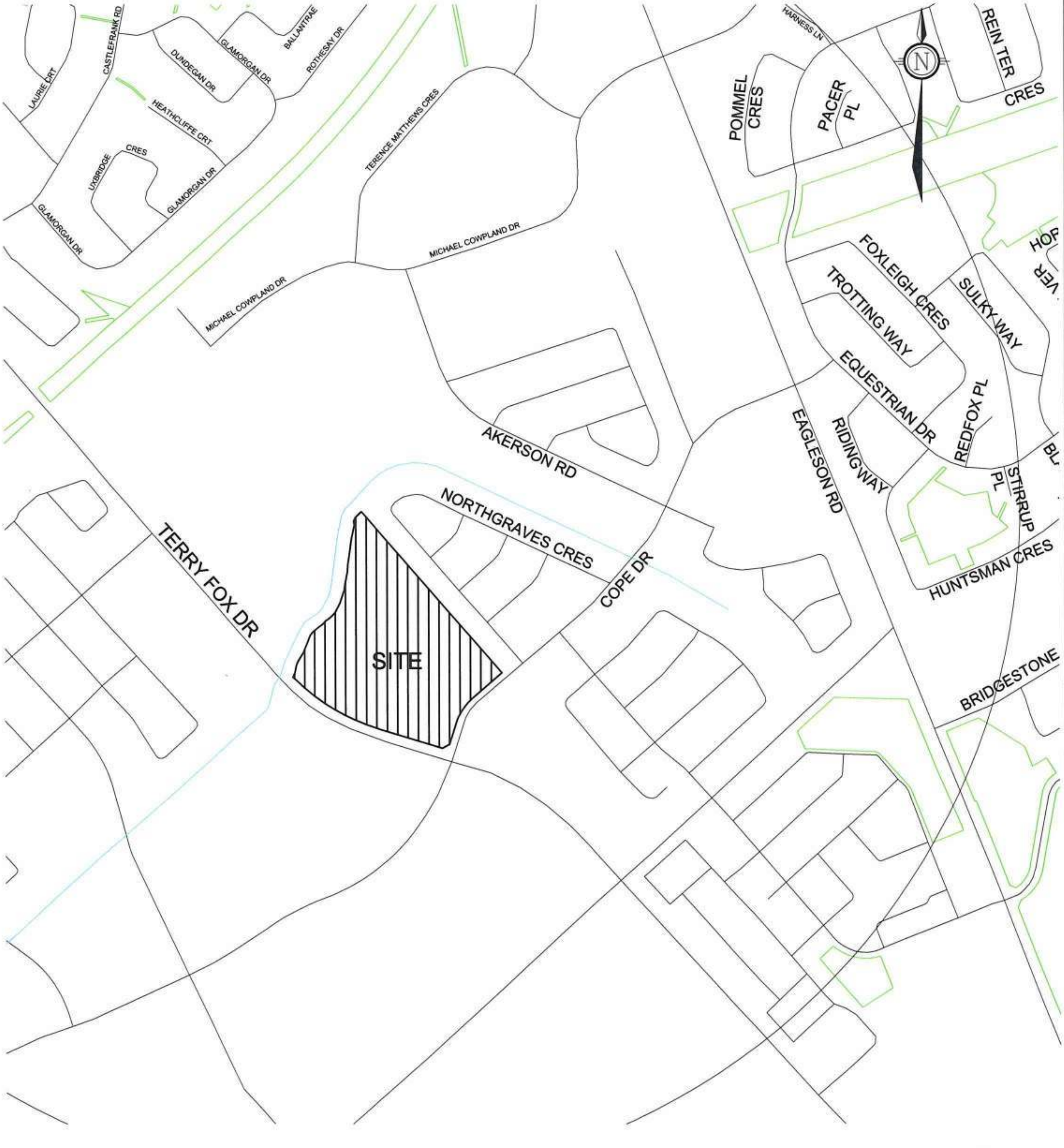

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VAN GAAL LANDS - CLARIDGE
1039 TERRY FOX DRIVE AND
5331 FERNBANK ROAD

KEY PLAN

SCALE	DATE	JOB	FIGURE
1 : 10000 (0 100 200 300 400)	MAR 2019	117198	FIG2-KP

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- *Geotechnical Investigation, Proposed Residential Development, Terry Fox Drive at Cope Drive – Ottawa, dated April 2, 2019 (Report No. PG4466-1 Revision 1).*

2.0 EXISTING CONDITIONS

2.1 Topography & Drainage

The proposed site is currently undeveloped and consists of agricultural lands. Access to the site is currently provided off Terry Fox Drive via a private gravel entrance. Refer to **Figure 4** – Existing Conditions Plan.

The site has a gentle slope from south to north, with most overland flow being directed to Cell 1 of the existing Monahan Drain along the north side of the site. Cell 1 of the Monahan Drain was constructed as part of the Phase 1 & 2 SOHO Lands (Stantec, 2007). A small amount of drainage is directed to the Terry Fox ditch which is conveyed north to the Monahan Drain.

2.2 Subsurface Conditions

Paterson Group Inc. completed two (2) geotechnical investigations in support of the proposed development. The first geotechnical investigation was as follows:

- *Preliminary Geotechnical Investigation, 20 Acre Property, Terry Fox Drive at Fernbank Road, Ottawa Ontario, dated July 25, 2006 (Report No. PG0809-1).* The fieldwork for this investigation was carried out between April 26th and 27th, 2006.

A second geotechnical investigation was conducted and incorporated the results from the first geotechnical investigation. Therefore, the second report supersedes the first report, and is as follows:

- *Geotechnical Investigation, Proposed Residential Development, Terry Fox at Cope Drive – Ottawa, dated July 12, 2018 (Report No. PG4466-1).* The fieldwork for this investigation was carried out on April 20th, 2018.

The principal findings of the geotechnical investigations are as follows:

- The work consisted of advancing six (6) boreholes to depths ranging from 6.4m to 35.8 m below ground surface.
- The existing soil profile consists of having a layer of topsoil ranging from 0.25m to 0.36m thick underlain by a thin layer of silty sand and stratified sand. Below this is a layer of silty clay layer that extends to more than 24m below the existing grade.
- Bedrock is expected to range from 25m-50m below grade.
- Groundwater is expected to range from 1.5m to 2.5m based on observations.
- There is an estimated permissible grade raise restriction of 1.8m for lot grading at the residential buildings and 2.2m for the proposed roadways.

The report provides engineering guidelines based on Paterson Group's interpretation of the borehole information and project requirements. Refer to the above-noted report for complete details.

LEGEND

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VAN GAAL LANDS - CLARIDGE
1039 TERRY FOX DRIVE AND
5331 FERNBANK ROAD

EXISTING
CONDITIONS PLAN

SCALE 1 : 2000 (0 20 40 60 80)

DATE	JOB	FIGURE
MAR 2019	117198	FIG4-EX

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M:\2017\117198\CAD\Design\Figures\Design Brief\FIG4-Existing Cond.dwg, EX, Mar 14, 2019 - 10:24am, tmckay

3.0 SANITARY SERVICING

3.1 Previous Studies

The Subject Site is located upstream of Phase 1 of the Trailwest (formerly SOHO West) Subdivision. The SOHO West Serviceability Report, *SOHO West- Rev. 3, Serviceability Report, Prepared by Stantec, dated October 31st, 2007,* calculated sanitary flows to outlet to Cope Drive from the lands that make up 1039 Terry Fox Drive and 5331 Fernbank Road, which includes the subject lands and lands north of the Monahan Drain and well as lands south of Cope Drive. Sanitary flows in this report were calculated to be 45.95L/s to outlet to the sanitary sewers on Cope Drive, which ultimately outlet to the Hazeldean Pump Station. Refer to **Appendix B** for excerpts.

In 2015, a rezoning application was submitted for the lands located at 5331 Fernbank Road & 1039 Terry Fox Drive. The land north of the Monahan Drain was rezoned from IP4 to IP to allow for the development of office buildings. The subject lands was rezoned from IP4 to R3X [2410]-h to allow for residential development. And lastly, the land south of Cope Drive to Fernbank Road was rezoned from IP4 to IP with exceptions to all for commercial development. The exceptions would allow for retail store and retail food store to be permitted as secondary uses. As part of the submission a servicing and stormwater report was included titled, *Van Gaal Lands: 5331 Fernbank Road and 1039 Terry Fox Drive, Ottawa, ON, Servicing & Stormwater Management Brief, completed by Novatech, Ref. No.: R-2015-123, dated September 1, 2015.* The 2015 report comprised of two separate outlets for the sanitary flow from 1039 Terry Fox Drive and 5331 Fernbank Road.

The subject lands and the lands south of Cope Drive outlet to the sanitary sewers on Cope Drive. A sanitary flow of 16.23L/s was calculated for the Cope Drive sanitary sewers.

The business park outlets to the existing 900mm sanitary sewer along Hazeldean Side Road due to its close proximity to the Hazeldean Pump Station. A sanitary flow of 25.81L/s was calculated to outlet to the Hazeldean Side Road sewer.

The total sanitary flows to the Hazeldean Pump Station was calculated to be 42.04L/s.

3.2 Existing Sanitary Sewer System for the Subject Lands

Currently, there is an existing 525mm sanitary trunk sewer along Cope Drive to the south and a 200mm sanitary sewer along Northgraves Crescent to the northeast. The sanitary trunk sewer along Cope Drive currently services the existing commercial plaza located at 5357 Fernbank Road and the existing Trailwest community. The Cope Drive trunk sewer ultimately outlets to the Hazeldean Pump Station via the sanitary pipe system in the Trailwest subdivision. Through pre-consultation with the City of Ottawa, underside of footing elevations (USFs) shall be a minimum of 95.30m, which is the emergency overflow elevation at the Pump Station. Please see **Appendix A** for correspondence.

3.3 Proposed Sanitary Sewer Outlet

It is proposed that the Subject Site will outlet directly to the 525mm sanitary trunk sewer along Cope Drive. The proposed outlet is consistent with the approved SOHO West Serviceability Report (Stantec) and the approved Servicing & Stormwater Management Report (Novatech) as part of the rezoning application for the Van Gaal Lands. Refer to Section 1.3 for report details.

The proposed development can be serviced with a 200mm sanitary sewer system. The proposed sanitary layout can be seen on **Figure 5** – Sanitary Sewer Layout.

3.4 Design Criteria

Sanitary sewers, for the proposed development, are designed based on criteria established by the City of Ottawa in the following documents:

- Section 4.0 of the City of Ottawa Sewer Design Guidelines (October 2012).
- Technical Bulletin ISTB-2018-01 from the City of Ottawa regarding new sanitary design parameters. Design parameters from this technical bulletin will supersede values within the Sewer Design Guidelines (2012).

The resulting design parameters are summarized as follows:

Commercial/Institutional flows = 28,000 L/ha/day
Industrial flows = 35,000 L/ha/day
Population Flow = 280 L/capita/day
Infiltration = 0.33 L/s/ha
Single Family Home = 3.4 persons per unit
Townhouse = 2.7 persons per unit
Apartment = 1.8 persons per unit
Maximum Residential Peak Factor = 4.0
Harmon Correction Factor = 0.8
Industrial/Commercial/Institutional Peak Factor
= 1.0, if area is <20% of total contributing area
= 1.5, if area is >20% of total contributing area
Industrial Peaking Factor: As per Appendix 4-B of the City of Ottawa Sewer Design Guidelines
Minimum velocity = 0.6m/s
Manning's n = 0.013

3.5 Proposed Sanitary Sewer System

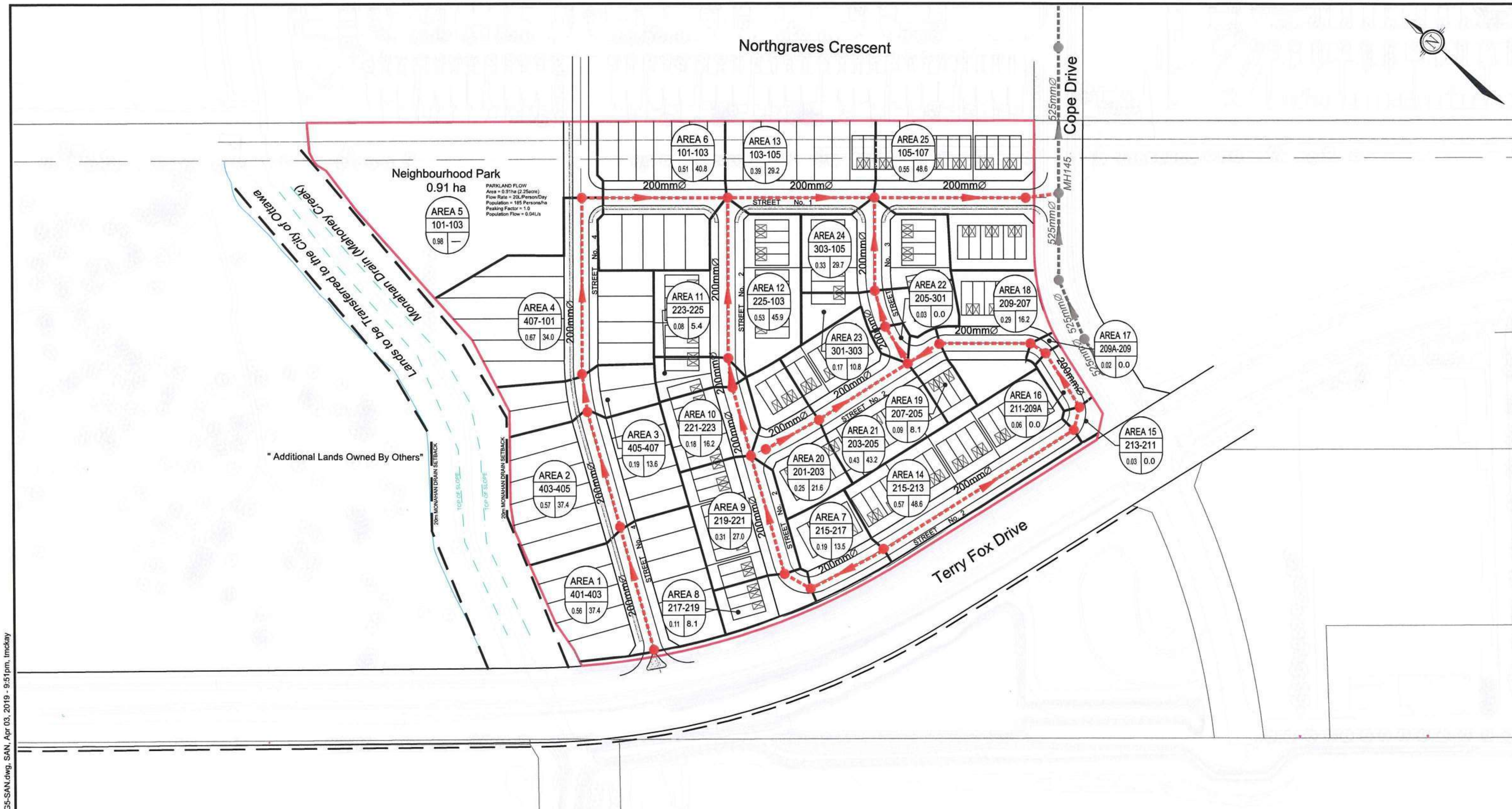
The calculated peak sanitary design flow for the development is 8.54 L/s. For detailed calculations refer to the Sanitary Sewer Design Sheet located in **Appendix B** and **Figure 5** – Sanitary Sewer Layout for sanitary drainage areas.

Sanitary flows from the subject lands were previously calculated in Stantec's Serviceability Report and the approved 2015 Servicing & Stormwater Management Report (Novatech) as part of the rezoning application for the Van Gaal Lands. As previously noted, sanitary flows from the lands north of the Monahan Drain will be directed to an existing 900mm diameter sanitary sewer on Hazeldean Side Road with the remaining two parcels outletting to the Cope Drive trunk sewer.

As a result, the proposed sanitary flows directed to the Cope Drive trunk sewer will be significantly less than previously calculated.

Outlet to Cope Drive Sewers

Proposed sanitary flows outletting to the Cope Drive trunk sewer versus the previously calculated sanitary flows from previous serviceability reports are listed in **Table 3.1**.



LEGEND

PROPOSED DEVELOPMENT BOUNDARY

SANITARY DRAINAGE AREA BOUNDARY

PROPOSED SANITARY SEWER C/W FLOW DIRECTION

EXISTING SANITARY SEWER C/W FLOW DIRECTION

AREA 1 — AREA ID
815-813 — MANHOLE TO MANHOLE
0.81 | 89.1 — POPULATION EQUIVALENT / AREA IN HECTARES

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VAN GAAL LANDS - CLARIDGE
1039 TERRY FOX DRIVE AND
5331 FERNBANK ROAD

SANITARY SEWER LAYOUT

SCALE		
1 : 2000 (0 20 40 60 80)		
DATE MAR 2019	JOB 117198	FIGURE FIG5-SAN

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Table 3.1: Sanitary Flow Summary to Cope Drive

Development Condition	Population	Area (ha)	Peak Flow (L/s)	Peak Ext. Flow (L/s)	Peak Design Flow (L/s)
Claridge Residential Development (Subject Site)	535	8.14	5.88	2.66	8.54
Commercial Area***		3.68	0.4	1.2	1.60
Total Flow* (Proposed)**					**10.14**
Stantec Serviceability Report	2811	23.14	39.47*	6.48	**45.95**
Novatech Approved Serviceability Report (rezoning)**		11.87	12.91	3.32	**16.23**

**Based on a peaking factor of 3.5, as per the Harmon Equation used in Stantec's Report.*
***Based on Table 4.1 of the rezoning report, Van Gaal Lands: 5331 Fernbank Road and 1039 Terry Fox Drive, Ottawa, ON, Servicing & Stormwater Management Brief, completed by Novatech, Ref. No.: R-2015-123,dated September 1, 2015.*
****Based on Site Servicing and Stormwater Management Report – Terry Fox Drive and Cope Drive Commercial Shopping Development, completed by Stantec, dated July 26, 2018.*

The total proposed sanitary flow from the subject lands and commercial area is 10.14 L/s, which represents a 77.9% decrease in sanitary flows compared to the calculated flows in the Stantec Serviceability Report (45.95 L/s) and a 37.5% decrease in sanitary flows compared to the calculated flows from Novatech's approved rezoning Servicing and Stormwater Management report (16.23L/s). This indicates there will be adequate capacity in the Cope Drive sewers to accommodate the proposed development.

For design sheet, drainage plans and design parameters from the Stantec Serviceability Report, refer to excerpts in **Appendix B**.

For excerpt from Novatech's approved rezoning Servicing and Stormwater Management Report, refer to **Appendix B**.

For excerpt from the commercial lands Servicing and Stormwater Management Report, refer to **Appendix B**.

As per the pre-consultation with the City of Ottawa, an HGL analysis of the sanitary system is required to confirm that the underside of footing elevations are acceptable as per the Ottawa Sewer Design Guidelines. An analysis of the sanitary HGL will be completed at the detailed design stage. The underside of footing elevations are governed by an emergency overflow elevation at the Hazeldean pump station of 95.30m. All USF elevations will have a minimum elevation of 95.30m. Correspondence can be found in **Appendix A**.

4.0 WATERMAIN

4.1 Proposed Watermain System

A preliminary hydraulic analysis was performed for the Van Gaal Lands. It is proposed to service the Van Gaal Lands site with a combination of 50mm pipe and 200mm pipe with two connections to the existing watermain. The first connection will be made to the 300mm watermain on Cope Drive at the southern entrance. The second connection will be made to the 200mm watermain on Northgraves Crescent via a road connection near the northwest corner of the site. **Figure 6** – Watermain Layout highlights the proposed works and connection points. All existing watermain boundary conditions were provided by the City of Ottawa and are included in **Appendix C**.

4.2 Design Criteria

Fire flow demands have been calculated as per the Fire Underwriter's Survey (FUS) and are included in **Appendix C**. However as per the City of Ottawa's technical bulletin ISTB-2014-02 (Revisions to Ottawa Design Guidelines – Water), the majority of the single and townhouse fireflows have been capped at 10,000 L/min (167 L/s). Watermain analysis was completed based on the following criteria:

<u>Demands:</u>

- Single Unit Density — 3.4 persons/unit
- Townhouse Density — 2.7 persons/unit
- Condo/Apartment Density — 1.8 persons/unit
- Average Daily Demand — 280 L/capita/day (Revised as per City Comment A5)
- Max. Daily Demand — 2.5 x Average Daily Demand
- Peak Hour Demand — 2.2 x Maximum Daily Demand
- Fire Flow Demand — Fire Underwriters Survey

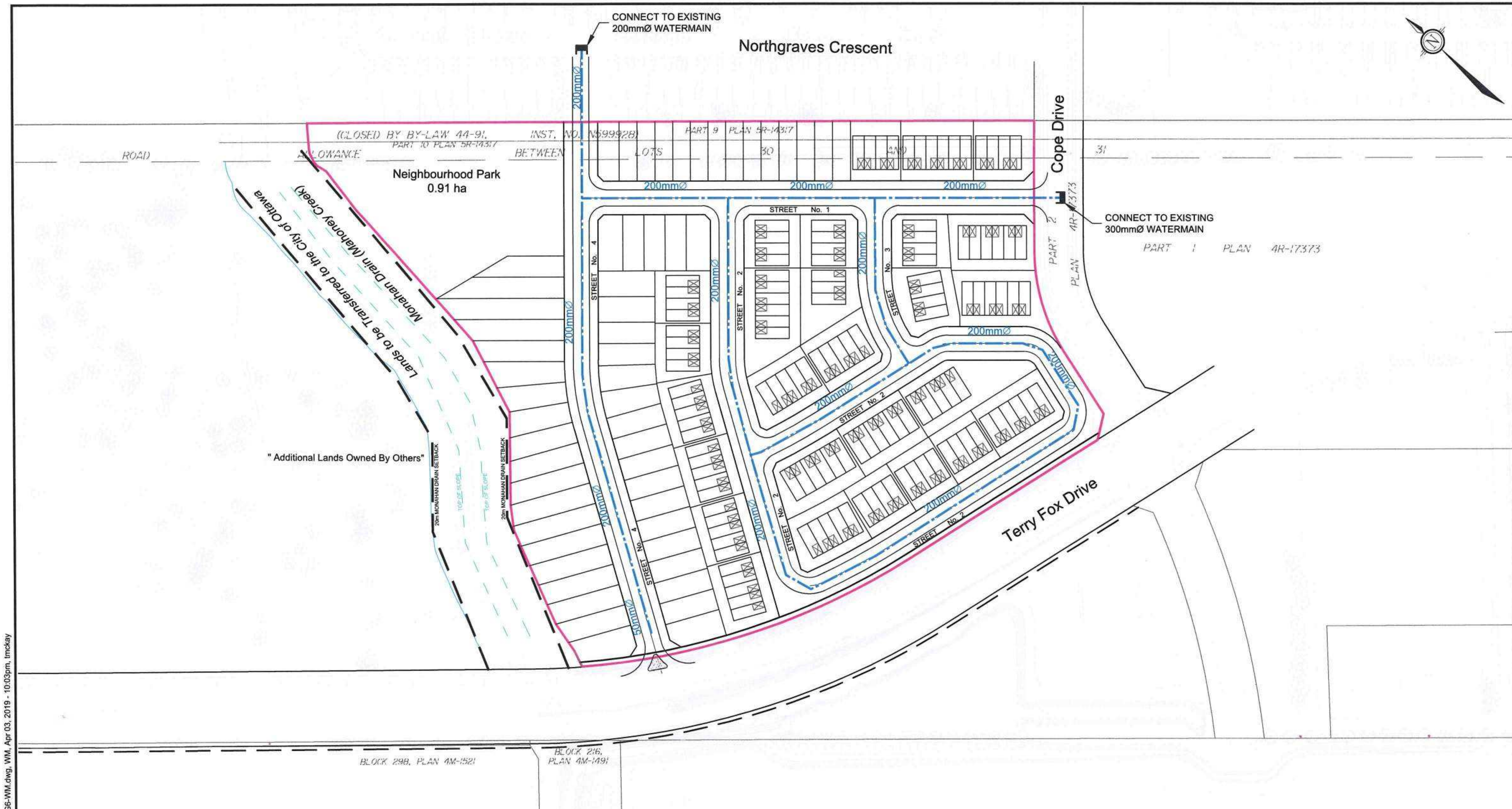
<u>System Requirements:</u>

- Max. Pressure (Unoccupied Areas) — 690 kPa (100 psi)
- Max. Pressure (Occupied Areas) — 552 kPa (80 psi)
- Min. Pressure — 276 kPa (40 psi) excluding fire flows
- Min. Pressure (Fire) — 138 kPa (20 psi) including fire flows
- Max. Age (Quality) — 192 hours (onsite)

<u>Friction Factors:</u>

- Watermain Size — C-Factor
- 50mm — 100
- 200 — 110

Hydraulic modelling of the Subject Site was completed using EPANET 2.0. EPANET is public domain software capable of modeling municipal water distribution systems by performing simulations of the water movement within a pressurized system. EPANET utilized the Hazen-Williams equation to predict the performance of the proposed watermain and considered the



LEGEND

PROPOSED DEVELOPMENT BOUNDARY

PROPOSED WATERMAIN

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VAN GAAL LANDS - CLARIDGE
1039 TERRY FOX DRIVE AND
5331 FERNBANK ROAD

WATERMAIN LAYOUT

SCALE 1 : 2000 (0 20 40 60 80)

DATE MAR 2019 | JOB 117198 | FIGURE FIG6-WM

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M:\2017\117198\CAD\Design\Figures\Design Brief\FIG6-WM.dwg, WM, Apr 03, 2019 - 10:03pm, tmckay following input parameters: water demand, pipe length, pipe diameter, pipe roughness, and pipe elevation.

4.3 Hydraulic Analysis

Table 4.1 summarizes the watermain operating conditions during the high pressure, maximum daily demand and fire flow, and peak hour demands. Results of the hydraulic analysis are included in **Appendix C**. Refer to **Figure WM** – Proposed Watermain Node Network, provided in **Appendix C**, for details about the node and pipe network.

Table 4.1: Water Demand Summary

Condition	Demand (L/s)	Fire Flow (L/s)	Allowable Max/Min Pressure (kPa/psi)	Max/Min Pressure (kPa/psi)	Time (hours)
High Pressure	1.73	N/A	690/80 (Max)	638.4/92.6	23.1
Maximum Daily Demand + Fire Flow	4.34	167	138/20 (Min)	155.5/22.6	N/A
Maximum Daily Demand + Fire Flow	4.34	233.3	138/20 (Min)	211.5/30.7	N/A
Peak Hour	9.54	N/A	276/40 (Min)	575.8/83.5	N/A

The analysis of the maximum daily demand plus fire flow condition was completed in accordance with City of Ottawa's technical bulletin ISTB-2018-02 (Revisions to Ottawa Design Guidelines – Water) and Appendix I: Guideline on Coordination of Hydrant Placement with Required Fire Flow.

The analysis confirms the proposed watermain can service the Subject Site under all operating conditions. It is noted that pressure in the main is greater than 552 kPa/80psi during the high pressure and peak hour condition for all the lots and blocks, therefore the use of pressure reducing values will be considered during detailed design.

A copy of the boundary conditions provided by the City of Ottawa, fire flow calculations, detailed hydraulic analysis results, and watermain layout figure are included in **Appendix C**.

There are no deviations from the City of Ottawa Design Guidelines – Water Distribution (2010).

5.0 STORM SEWER SYSTEM AND STORMWATER MANAGEMENT

The post-development storm sewer and stormwater management system has been designed in accordance with the Ottawa Sewer Design Guidelines and will adhere to previously established release rates for this area.

5.1 Previous Studies (Trailwest Subdivision / Monahan Drain Cell 1)

The Claridge Van Gaal Lands (subject site) are tributary to the existing storm sewer on Cope Drive, which was designed by Stantec (2007) as part of Phase 1 of the Trailwest (formerly SOHO West) Subdivision. The Claridge Van Gaal Lands were included in the overall storm drainage design and are represented as subcatchment FUT-13A. Refer to *Drawing OSD – Overall Storm Drainage Area Plan, SOHO – Kanata South (Rev. 7), Stantec* (February 25, 2009), provided in **Appendix D**.

5.2 Allowable Release Rate

SOHO (Trailwest) Subdivision (Stantec, 2007)

As part of the overall storm drainage design for the SOHO Subdivision, storm runoff from the Claridge Van Gaal Lands (catchment FUT13-A) was allocated to MH1013 on Cope Drive based on the following parameters:

Drainage Area Parameters: Claridge Van Gaal Lands

- Area ID = FUT-13A
- Drainage Area = 8.26 ha
- Runoff Coefficient = 0.65

The stormwater management model for the SOHO subdivision assigned the following stormwater management criteria to catchment FUT-13A:

- Minor system inlet rate = 85 L/s/ha (sewer connection at MH1013 on Cope Dr.)
- Major system storage = 60 m^3/ha
- After the two above criteria are met, major system overland flow is permitted.

The 85 L/s/ha allowable release rate for the 8.26 ha area corresponds to a minor system peak flow of 702 L/s. The 100-year major system peak flow was estimated as 1,537 L/s. The total 100-year peak flow to the Monahan Drain was 2,239 L/s.

Van Gaal Lands (Novatech, 2019)

The City has retained J.F. Sabourin and Associates (JFSA) to complete an updated hydrologic and hydraulic assessment of the Monahan Drain SWM Facility. Pending finalization of this study, The City has indicated that Novatech is to use the SWM criteria identified in the SOHO SWM Report (Stantec, 2007) for the purposes of Draft Approval:

- Minor system inlet rate = 702 L/s
- Major system storage = 60 m^3/ha
- 100-year Major system peak flow = 1,537 L/s

At the detailed design stage, Novatech may re-evaluate the allowable release rates to ensure that the SWM design is consistent with the current Sewer Design Guidelines.

5.3 Existing Drainage Conditions

Under existing conditions, storm runoff from the site generally flows overland to Cell 1 of the Monahan Drain Constructed Wetlands SWM Facility along the north side of the site. A small amount of drainage is directed to the Terry Fox Drive roadside ditch which also outlets to Cell 1.

5.4 Existing and Proposed Storm Infrastructure

The proposed development will be serviced by approximately 1,165m of storm sewers ranging from 250mm to 1050mm in diameter. The minor system outlet is an existing 1200mm x 1800mm concrete box storm sewer at MH1013 on Cope Drive, which runs through the Trailwest Subdivision and conveys runoff to a Vortechnics hydrodymanic separator for water quality treatment before discharging to Cell 1 of the Monahan Drain.

Runoff from the rearyards and park block will flow overland directly into Cell 1 of the Monahan Drain upstream of Cope Drive. Refer to **Figure 7** – Storm Sewer Layout.

5.4.1 Minor System (Storm Sewers)

Storm servicing for the proposed subdivision will be provided using a dual-drainage system. Runoff from frequent events will be conveyed by the proposed storm sewers (minor system), while flows from large storm events that exceed the capacity of the minor system will be stored on the surface in road sags and/or conveyed overland along defined overland flow routes (major system).

Storm Sewer Design Criteria

The following is the storm sewer design criteria [Ottawa Sewer Design Guidelines (Oct. 2012)]:

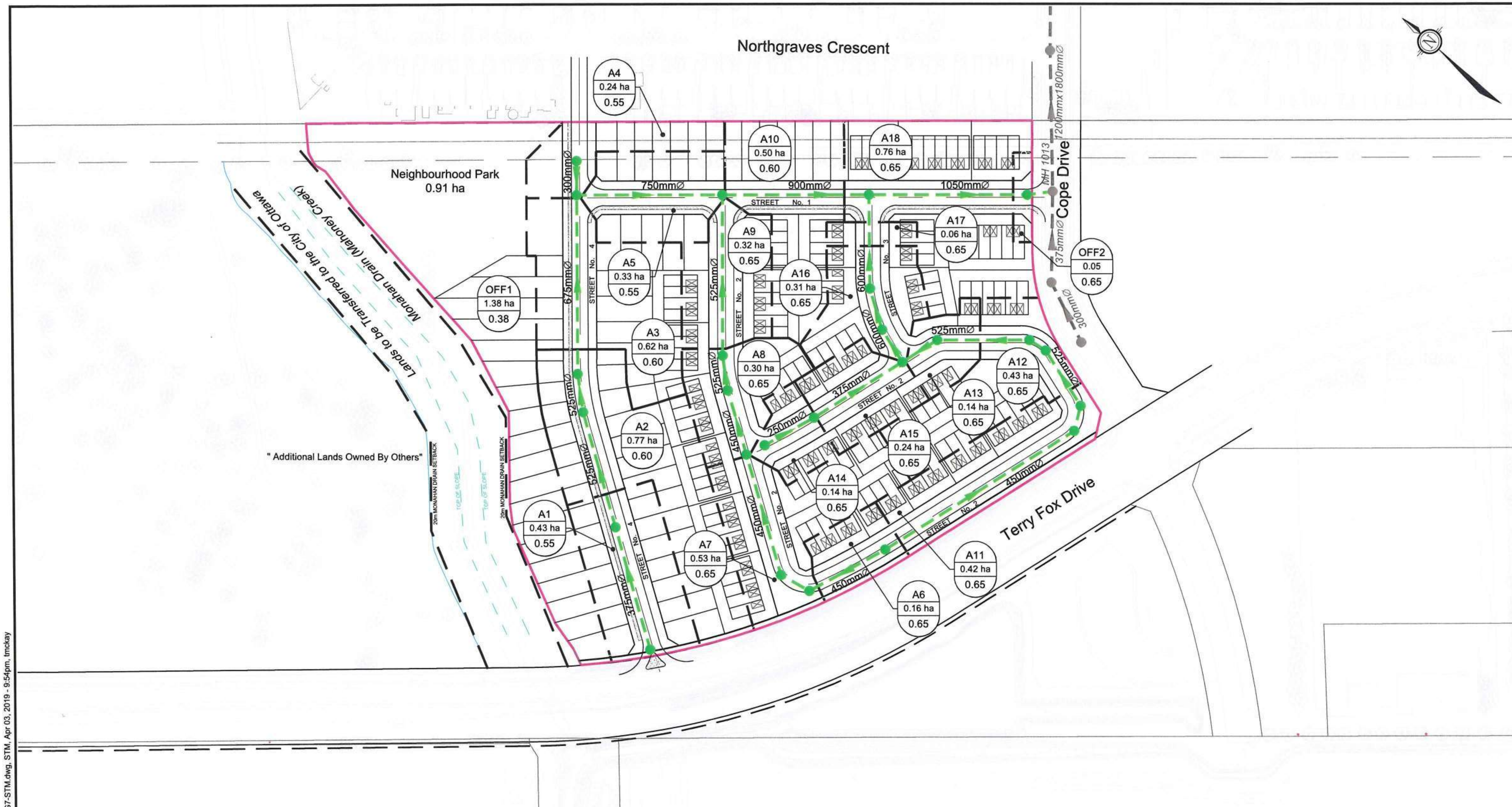
- Rational Method (Q) = 2.78CIA, where
    - Q = peak flow (L/s)
    - C = runoff coefficient
        - C = (0.70 * %Imp.) + 0.20
    - I = rainfall intensity for a 2-year return period (mm/hr)
        - $I_{2yr} = 732.951 / [(Tc(min) + 6.199)]^{0.810}$
    - A = site area (ha)
- Minimum Pipe Size = 250 mm; Minimum / Maximum Full Flow Velocity = 0.8 m/s / 3.0 m/s

The on-site storm sewers will be sized to convey the peak flows corresponding to a 2-year return period storm event. Refer to the storm sewer design sheets provided in **Appendix D**.

Inlet Control Devices

Inlet control devices (ICDs) will be used to restrict inflows to the minor system. Rear yard catch basins will be connected in series with an ICD installed at the outlet of the most downstream structure. ICDs will be sized to control minor system peak flows to the Cope Drive storm sewer to the allowable release rate of 702 L/s.

The rear yards and park block areas that drain directly to Cell 1 of the Monahan Drain will be uncontrolled. The uncontrolled flows from these areas have been accounted for as part of the major system design.



LEGEND

PROPOSED DEVELOPMENT BOUNDARY

STORM DRAINAGE AREA BOUNDARY

PROPOSED STORM SEWER C/W FLOW DIRECTION

EXISTING STORM SEWER C/W FLOW DIRECTION

NW-1 — AREA IDENTIFICATION

0.16 ha — DRAINAGE AREA (hectares)

0.65 — RUN-OFF COEFFICIENT

NOVATECH

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VAN GAAL LANDS - CLARIDGE
1039 TERRY FOX DRIVE AND
5331 FERNBANK ROAD

STORM SEWER LAYOUT

SCALE 1 : 2000

DATE MAR 2019 | JOB 117198 | FIGURE FIG7-STM

SHT11X17.DWG - 279mmX432mm

M:\2017\117198\CAD\Design\Figures\Design Brief\FIG7-STM.dwg, STM, Apr 03, 2019 - 9:54pm, tmckay

Hydraulic Grade Line

The storm sewers will be designed to ensure the hydraulic grade line (HGL) elevation for a 100-year storm event will provide a minimum 0.30 m clearance from the underside of footing (USF) elevation.

5.4.2 Major System (Overland Flow)

Under post-development conditions, the site will be graded to provide an overland flow path to convey major system runoff towards Cope Drive, with the exception of the rear yards and park block that will outlet directly to Cell 1 of the Monahan Drain. Refer to the Grading Plan (Drawing 117198-GR).

Major System (Overland Flow) Criteria

Runoff from storms that exceed the minor system capacity are to be stored or conveyed overland within the right-of-way and/or defined drainage easements. The following overland flow criteria from the OSDG will be applied to the design:

- Provide a minimum of 60 m^3/ha of major system storage.
- Ensure that major system flows have a maximum dynamic depth of 0.35 m (static ponding + dynamic flow) during the 100-year event.
- Ensure the product of velocity x depth does not exceed 0.60 during the 100-year event.

During detailed design, the major system will be evaluated using a hydraulic model to ensure that the maximum total flow depth (static + dynamic) will be restricted to 0.35 m during the 100-year storm event; and water levels will not touch the building envelope / lowest opening during the Stress Test event (100-year +20%).

5.5 Proposed Stormwater Management Strategy

Stormwater Quality Control

The existing Vortechs unit immediately upstream the outlet to Cell 1 of the Monahan Drain Constructed Wetlands has been designed to provide an Enhanced level of water quality control for the contributing drainage area, including Claridge Van Gaal Lands. The proposed site layout has a smaller drainage area and runoff coefficient than was used to size the Vortechs unit, and as such will provide the required level of water quality treatment – refer to **Table 5.1**. This will be confirmed at the detailed design stage.

Table 5.1: Vortechs Sizing Criteria (Van Gaal Lands)

Design	Catchment ID	Parameters	Description
Stantec (2007)	FUT-13A	8.26 ha, C = 0.65	Area to Cope Drive / Vortechs Unit
Novatech (2019)	A1-A18	6.70 ha, C = 0.62	Area to Cope Drive / Vortechs Unit
	OFF1, OFF2	1.43 ha, C = 0.38	Park & rear yard areas to Monahan Cell 1
	TOTAL	8.13 ha, C = 0.58	Total Drainage Area (Controlled + Uncontrolled)

Stormwater Quantity Control

Surface storage will be provided within the road sags, based on the minimum major system storage requirement of 60 m^3/ha.

The Cope Drive storm sewer and Cell 1 of the Monahan Drain Constructed Wetlands have been designed to accommodate post-development runoff from the site based on a contributing drainage area of 8.26 ha and a runoff coefficient of C = 0.65. The proposed development has a total drainage area of 8.13 ha and a runoff coefficient of C = 0.58. Therefore, there will be no increase in runoff volume to the Monahan Drain from the 2007 design.

Best Management Practices and Low Impact Development

The proposed development will explore the use of best management practices (BMPs) and low impact development (LID) techniques to reduce the impacts of development on the hydrologic cycle and mitigate the reduction in groundwater infiltration / recharge resulting from the proposed development. The use and implementation of BMPs and LIDs will be reviewed during the detailed design process and may include measures such as the use of bioretention / infiltration systems within the rights-of-way.

5.6 Monahan Drain SWM Model Coordination

The impact on the Monahan Drain due to the proposed development of the Claridge Van Gaal Lands and neighbouring developments is being evaluated by JFSA.

A conceptual stormwater management model (PCSWMM) for the Claridge Van Gaal Lands was prepared to coordinate with the overall SWM model of the Monahan Drain being prepared by JFSA. The PCSWMM model for the Claridge Van Gaal Lands was provided to Stantec, who combined the model with their PCSWMM model for the remaining PH1-SOHO Lands and provided the resulting hydrographs to JFSA.

5.6.1 PCSWMM Model Parameters

Design Storms

The model includes the following design storms based on the City of Ottawa IDF data presented in the City of Ottawa Sewer Design Guidelines (October 2012). The 24-hour SCS storm distribution was provided by JFSA and was used for the analysis of the Monahan Drain.

- 3-hour Chicago Storm Distribution (10-minute time step)
- 24-hour SCS Storm Distribution from JFSA (12-minute time step)

Each storm distribution includes the 2-year, 5-year, 100-year, and 100-year (+20%) return periods.

PCSWMM Model Schematics, Output Data and Modeling Files

PCSWMM model schematics and output data for the 100-year 3-hour Chicago and 100-year 24-hour SCS (JFSA) storm distributions are provided in **Appendix D**. The PCSWMM modeling files are provided on the enclosed CD.

Subcatchment Areas / Runoff Coefficients

- The conceptual PCSWMM model uses a semi-lumped approach, with catchment areas representing the total area to each storm sewer run (i.e. front and rear yard areas are combined) based on the preliminary grading plan (Drawing 117198-GR). Refer to **Figure 7** – Storm Sewer Layout for drainage areas.

- The following runoff coefficients have been applied based on the proposed land use:

  C = 0.25 – Park Lands
  C = 0.55 – Single Family Homes
  C = 0.65 – Townhomes

  The weighted runoff coefficients and percent impervious values are provided in **Appendix D**. As per the City of Ottawa Sewer Design Guidelines (October 2012), the percent impervious values are based on the following equation:

  % Imp. = (C – 0.20) / 0.7

<u>Depression Storage</u>

- The default values for depression storage (1.57mm impervious / 4.67 mm pervious) have been applied to all catchments.
- The 'zero impervious' parameter (areas with no depression storage) for all catchments draining to Cope Drive is set to 60%. This represents the percent of roof top areas to total impervious area.
- The 'zero impervious' parameter for rear yard areas draining directly to Cell 1 of the Monahan Drain (subcatchment 'OFF01') is set to 90%. This represents the imperviousness of rear yard areas being 90% rooftop areas and 10% other impervious areas (i.e. patios).

<u>Subarea Routing</u>

- Subarea routing for all catchments draining to Cope Drive is 'pervious to impervious'.
- Subarea routing for catchment 'OFF1', is 'impervious to pervious'.

<u>Equivalent Width</u>

- The equivalent width parameter for all subcatchments is based on 225 m/ha.

<u>Inlets / Orifices / Outlet Rating Curves</u>

Each inlet to the minor system has been sized to provide the equivalent 104.8 L/s/ha flow rate (based on the subcatchment area):

- Inlets for catchbasins at low points are represented as orifices assuming a head of 1.6m plus the static ponding depth.
- Inlets for catchbasins on-grade are represented as outlets, with rating curves based on capture / bypass characteristics of standard CB grates and capped at 104.8 L/s/ha.

<u>Minor System Conduits (Bend / Exit Losses)</u>

- The minor system network was created in Civil3D and imported into PCSWMM.

- The following exit losses have been inputted into the model. They represent the loss coefficient based on the bend angle, as per the Appendix 6-B in the City of Ottawa Sewer Design Guidelines (October 2012).

Bend Angle	Loss Coefficient
0	0.00
15	0.09
30	0.21
45	0.39
60	0.64
75	0.96
90	1.32

Major System Conduits

- Major system conduits (road network) have been defined using an irregular transect representing an 18.5m right-of-way with a 3% crossfall from the centerline of the road to the bottom of curb.
- Junctions at high points have an invert elevation that represents either the bottom of curb or the road centerline, depending on the path of the overland flow route.

Downstream Boundary Condition (Minor System)

- The storm sewer outlet for the Claridge Val Gaal Lands (OUT-Minor) is the existing maintenance hole (MH1013) on Cope Drive.
- The boundary condition for the Claridge Van Gaal storm outlet was set at the 100-year HGL elevation of the outgoing sewer (94.97m). This is based on the Sensitivity Analysis currently being completed by JFSA on behalf of the City of Ottawa. It represents an ultimate buildout condition of the vacant lands within the watershed.

5.6.2 Hydraulic Grade Line (PCSWMM)

The Hydraulic Grade Line (HGL) within the storm sewer system was evaluated using the a fixed HGL of 94.97 at MH 1013 on Cope Drive. This HGL elevation surcharges the storm sewer on Cope Drive by 0.16m (obvert elevation = 97.81m).

During the 100-year storm event the on-site storm sewer will surcharge at most 0.27m (MH224). During stress test (i.e. 100-year +20%) the surcharge depth at MH224 will increase to 0.30m (+0.03m). The minimum USF elevations have been set 0.30m higher than the 100-year HGL elevations. The actual USF elevations. shown on the preliminary grading plans (Drawing 117198-GR), are higher than the required minimum USF elevations.

Refer to the 100-year HGL Table provided in **Appendix D**.

5.6.3 Summary of Peak Flows (PCSWMM)

Table 5.2 provides a summary of the minor and major system flows from the Claridge Van Gaal Lands to Cope Drive, and the direct flows to Cell 1 of the Monahan Drain. Outflow hydrographs for the 100-year 3-hour Chicago and 100-year 24-hour SCS storm distributions are provided in **Appendix D**.

Table 5.2: Summary of Peak Flows (PCSWMM)

Outfall	Allowable Release Rate (Stantec, 2007)	100-year Peak Flow(2) (L/s)		Description
		3-hour Chicago	24-hour SCS	
Minor System	702 L/s (1)	693	688	To Cope Drive MH1013
Major System	1,537 L/s	249	184	Overland flow to Cope Drive
		214	233	Overland Flow to Cell 1
TOTAL	**2,239 L/s**	**1,156**	**1,105**	

(1) Based on 8.26 ha drainage area x 85 L/s/ha
(2) PCSWMM model results; fixed outfall at 94.97m (100-year HGL elevation at MH 1013 on Cope Drive).

The 100-year minor system peak flow to Cope Drive is controlled to just under the allowable release rate of 702 L/s for both the 3-hour Chicago and 24-hour SCS distributions.

The major system peak flows are significantly less than the allowable rate of 1,537 L/s. The PCSWMM model is based on the conceptual grading design, which provides significantly more than the required 60 m^3/ha of major system storage. At detailed design, the grading design will be refined to ensure that all major system criteria are met.

6.0 TRAFFIC IMPACT BRIEF

An analysis of the effect from the proposed Van Gaal Lands development on the existing traffic patterns has been performed and detailed in the report, *5331 Fernbank Road and 1039 Terry Fox Drive, Traffic Impact Assessment, completed by Novatech, Ref. No.: R-2018-028, dated October 10, 2018;* and is submitted under a separate cover. Please refer to this report for more details.

7.0 ROADWAYS

7.1 Proposed Road Infrastructure

The proposed development will consist of local roadways with 16.5m right of ways (ROW) for single loaded roadways (window streets) and 18.0m right of ways for dual loaded streets. The proposed cross sections will conform to City of Ottawa Standards.

8.0 NOISE CONTROL

The analysis of the roadway traffic along Terry Fox Drive and Cope Drive indicates that the City of Ottawa's criteria for residential noise will be exceeded, primarily for units in close proximity to the noise sources. Attenuation measures are required and they may include the installation of a noise barrier, central air conditioning, forced air ventilation and/or a notice may be placed on title with regards to the noise levels to be expected. The detailed results are included in the Noise Impact Feasibility Study and is submitted under a separate cover. Refer to *Van Gaal Lands, 1039 Terry Fox Drive and 5331 Fernbank Road, Noise Impact Feasibility Study, dated March 29, 2019 by Novatech, Report No.: R-2018-118* for more details.

9.0 UTILITIES

The development will be serviced by hydro, phone, gas and cable, which will be constructed in a three-party trench, as per the City and utility standard right-of-way cross-sections. All local roads will follow the City of Ottawa standard cross-section. During detailed design, the works will be coordinated with local utility companies. Canada Post will service the site with community mailboxes. Site lighting will be provided along roadways, sidewalks and walkways as per City standards.

10.0 EROSION AND SEDIMENT CONTROL

Erosion and sediment control measures will be implemented during construction in accordance with the "Guidelines on Erosion and Sediment Control for Urban Construction Sites" (Government of Ontario, May 1987). An Erosion and Sediment Control Plan will be prepared as part of the detailed design.

Typical erosion and sediment control measures recommended include, but are not limited to, the use of silt fences around perimeter of site (OPSD 219.110), catch basin inserts under catch basin/maintenance hole lids, heavy duty silt fence barrier (OPSD 219.130), straw bale check dams (OPSD 219.180), rock check dams (219.210 or OPSD 219.211), riprap (OPSS 511), mud mats, silt bags for dewatering operations, topsoil and sod to disturbed areas and natural grassed waterways. Dewatering and sediment control techniques will be developed for the individual situations based on the above guidelines and utilizing typical measures to ensure erosion and sediment control is controlled in an acceptable manner and there is no negative impact to adjacent Lands, water bodies or water treatment/conveyance facilities.

It will be the responsibility of the Contractor to submit a detailed construction schedule and appropriate staging, dewatering and erosion and sediment control plans to the Contract

Administrator for review and approval prior to the commencement of work. A copy of the City of Ottawa Special Provision F-1005 is included in **Appendix E** which will become part of any contract and which outlines the contractual requirements which includes preparation of a detailed erosion and sediment control plan.

General Erosion and Sediment Control Measures

- All erosion and sediment control measures are to be installed to the satisfaction of the engineer, the municipality and the conservation authority prior to undertaking any site alterations (filling, grading, removal of vegetation, etc.) and remain present during all phases of site preparation and construction.
- A qualified inspector, provided by the owner, should conduct daily visits during construction to ensure that the contractor is working in accordance with the design drawings and that mitigation measures are being implemented as specified.
  - A light duty silt fence barrier is to be installed in the locations shown on the Erosion and Sediment Control Plan.
  - Rock check dams and/or straw bales are to be installed in drainage ditches.
  - Catch basin inserts are to be placed under the grates of all proposed and existing catchbasins and structures.
  - After complete build-out, all sewers are to be inspected and cleaned and all sediment and construction fencing is to be removed.
- The contractor shall ensure that proper dust control is provided with the application of water (and if required, calcium chloride) during dry periods.
- The contractor shall immediately report to the engineer or inspector any accidental discharges of sediment material into any ditch or sewer system. Appropriate response measures shall be carried out by the contractor without delay.

The contractor acknowledges that failure to implement erosion and sediment control measures may result in penalties imposed by any applicable regulatory agency.

11.0 CONCLUSIONS AND RECOMMENDATIONS

Sanitary Servicing

The analysis of the proposed sanitary servicing confirms the following:

- It is proposed that the proposed development will outlet directly to the 525mm sanitary trunk sewer along Cope Drive. The proposed outlet is consistent with the approved SOHO West Serviceability Report (Stantec) and the approved Servicing & Stormwater Management Report (Novatech) as part of the rezoning application for the Van Gaal Lands.
- The proposed development can be serviced with a 200mm sanitary sewer system.
- The total proposed sanitary flow from the subject lands and commercial area is 10.14 L/s, which represents a 77.9% decrease in sanitary flows compared to the calculated flows in the Stantec Serviceability Report (45.95 L/s) and a 37.5% decrease in sanitary flows compared to the calculated flows from Novatech's approved rezoning Servicing and Stormwater Management Report (16.23L/s).
- The proposed sanitary sewers have adequate capacity to accommodate the peak sanitary flow.
- Through pre-consultation with the City of Ottawa, underside of footing elevations (USFs) shall be a minimum of 95.30m, which is the emergency overflow elevation at the Hazeldean Pump Station.

Watermain

The analysis of the proposed watermain network confirms the following:

- It is proposed to service the Van Gaal Lands site with 50mm and 200mm pipe with two connections to the existing watermain. The first connection will be made to the 300mm watermain on Cope Drive at the southern entrance. The second connection will be made to the 200mm watermain on Northgraves Crescent via a road connection near the northwest corner of the site.
- The analysis confirms the proposed watermain can service the Claridge Van Gaal Lands under all operating conditions.
- It is noted that pressure in the main is greater than 552 kPa/80psi during the high pressure and peak hour condition for all the lots and blocks, therefore the use of pressure reducing valves will be considered during detailed design.

Stormwater Management

The following provides a summary of the storm sewer and stormwater management system:

- Proposed storm sewer system will convey stormwater to existing MH 1013 on Cope Drive.
    - Storm sewers (minor system) have been designed to convey the uncontrolled 2-year peak flow using the Rational Method.
    - Inflows to the minor system will be controlled using inlet control devices (ICDs) to an overall allowable release rate of 702 L/s.
    - A minimum clearance of 0.30m will be provided between the 100-year hydraulic grade line (HGL) and the designed underside of footing elevations.

- Roads graded in a saw-toothed pattern to provide surface stormwater storage during storm events that exceed the allowable minor system inlet rate.
    - The major overland flow outlet for the site is Cope Drive / Monahan Drain.
    - Ponding depths will not exceed 0.35m for all storms up to and including the 100-year event.
- Direct uncontrolled flows from rear yards and park block to Cell 1 of the Monahan Drain.
- PCSWMM model developed for coordination with JFSA's Sensitivity Analysis for the Monahan Drain.

Erosion and Sediment control

- Erosion and sediment control measures (i.e. filter fabric, silt fences, etc.) will be implemented prior to construction and are to remain in place until vegetation is established.
- An Erosion and Sediment Control Plan will be prepared during detailed design to ensure erosion and sediment control is controlled in an acceptable manner and there is no negative impact to adjacent lands, water bodies or water treatment/conveyance facilities.

12.0 CLOSURE

The preceding report is respectfully submitted for review and approval. Please contact the undersigned should you have questions or require additional information.

NOVATECH

Prepared by:

LICENSED PROFESSIONAL ENGINEER
S. A. M. ZORGEL
100[illegible]
March 29/19
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
C. M. STANG
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Steve Zorgel, P.Eng.
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Project Manager, Water Resources

Reviewed by:

Marc St. Pierre
Senior Project Manager, Engineering

Michael Petepiece, P.Eng.
Senior Project Manager, Water Resources

Appendix A
Correspondence

patersongroup
consulting engineers

memorandum

re:	**Geotechnical Response to City of Ottawa Review Comments** **Proposed Residential Development** **Terry Fox Drive at Cope Drive - Ottawa**
to:	Claridge Homes - **Mr. Vincent Denomme** - vincent.denomme@claridgehomes.com
cc:	Novatech Engineering - **Mr. Greg Winters** - g.winters@novatech-eng.com Novatech Engineering - **Ms. Ellen Potts** - e.potts@novatech-eng.com
date:	March 1, 2019
file:	PG4466-MEMO.01

Further to your request, Paterson Group (Paterson) prepared a response to the City of Ottawa review comment issued December 21, 2018 for the development application prepared for the aforementioned development.

Geotechnical Investigation - Comment A1

Comment: *Although the groundwater levels summary is prefaced with "groundwater readings at piezometers can be influenced by surface water perched within the borehole backfill material", the readings provided are significantly shallower than the estimated 1.5-2.5mbgs range. Only one reading is within the estimated range, with the rest of the readings being significantly shallower. Please explain how the groundwater level estimate was set if not based on the readings.*

Response: The current response should be read in conjunction with the updated Paterson Report PG4466-1 Revision 1 dated April 2, 2019. As noted in the updated geotechnical report: "*Groundwater conditions can also be estimated based on the observed colour and consistency of the recovered soil samples*".

Based on these observations, the long-term groundwater table can be determined based on the colour of the obtained soil samples and the undrained shear strength (consistency) values within the silty clay deposit. Based on our experience, undrained shear strength values decrease as the moisture levels increase in the silty clay. Typically, a shear strength value of 50 kPa or less is an indicator of the location of the long-term groundwater table. Also, the colouring of the silty clay is an indicator of the long-term groundwater table location. The brown silty clay crust transitions into a grey silty clay as the moisture level increases. The abovenoted shear strength value is typically noted to consist of a grey silty clay. For this particular site, our observations indicated that the long-term groundwater levels fluctuate between 1.5 m and 2.5m below ground surface.

We trust that this information satisfies your requirements.

Paterson Group Inc.

Drew Petahtegoose, EIT

LICENSED PROFESSIONAL ENGINEER
April 2, 2019
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

patersongroup
consulting engineers

memorandum

re: **Preliminary Grading Plan Review**
Proposed Van Gaal Lands Residential Development
Terry Fox Drive at Cope Drive - Ottawa

to: Claridge Homes - **Mr. Vincent Denomme** - vincent.denomme@claridgehomes.com

to: Novatech Engineering - **Mr. Marc St. Pierre** - m.stpierre@novatech-eng.com

date: April 2, 2019

file: PG4466-MEMO.02

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to summarize our grading plan review for the proposed Van Gaal Lands residential development. The following memorandum should be read in conjunction with Paterson Report PG4466-1 Revision 1 dated April 2, 2019.

Grading Plan Review

Paterson reviewed the following preliminary grading plan prepared by Novatech for aforementioned residential development:

- ❑ Grading Plan - Project No. 117198-00 - Revision 2 dated March 7, 2019

Based on the preliminary grading plan provided, the proposed grade raises for the lots are within our permissible grade raise restriction of 1.8 m and are considered acceptable from a geotechnical perspective.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Apr. 2-2019
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Kevin A. Pickard, E.I.T.

David J. Gilbert, P.Eng.

Trevor McKay

From: Cripps, Brad <brad.cripps@ottawa.ca>
Sent: Wednesday, March 20, 2019 11:52 AM
To: Trevor McKay
Cc: Surprenant, Eric
Subject: RE: Comment Clarification - D07-16-190001 & D07-16-18-0027

Hello Trevor,

The comment that was provided related to the Bridlewood 3 application was provided by the water resources group. I have reached out to them to confirm what was meant by that comment and the implications. My understanding now is that there is a spill relief protection for the Fernbank and Stittsville trunk lines near the Hazeldean PS at 95.3m, however there is no such spill point in the South Glencairn trunk line. The operation of the pump station has been set up so that during large events the Fernbank and Stittsville trunk lines will be isolated and allowed to spill if there is a need while the pump station capacity will be reserved for the South Glencairn trunk line.

In speaking with infrastructure planning their recommendation is to use 95.3m as an approximate design value for selecting appropriate USF elevations to provide some level of protection during a large event. In your email below a reference to 99.3m as a minimum USF, can you confirm where this value was determined?

If you would like to discuss further please feel free to contact me.

Brad Cripps, P.Eng.
Project Manager, Infrastructure Approvals
Development Review West
City of Ottawa
110 Laurier Avenue West, Ottawa ON, K1P 1J1
613-580-2424, Ext. 28699
Brad.Cripps@ottawa.ca

From: Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Sent: March 18, 2019 3:21 PM
To: Cripps, Brad <brad.cripps@ottawa.ca>
Subject: FW: Comment Clarification - D07-16-190001 & D07-16-18-0027

Hi Brad,

Could you review the below. I was sure that you had spoken to me about this. Any information you can provide them on this?

Thanks
Eric S.

From: Trevor McKay <t.mcKay@novatech-eng.com>
Sent: March 18, 2019 1:55 PM
To: Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Cc: Drew Blair <D.Blair@novatech-eng.com>; Marc St.Pierre <m.stpierre@novatech-eng.com>
Subject: Comment Clarification - D07-16-190001 & D07-16-18-0027

Eric,

Further to my voicemail early last week, we are requesting clarification on the intent/meaning of comments that we have received in response to the submissions for draft plan approval on the Van Gaal Lands (1039 Terry Fox Drive & 5331 Fernbank Road, D07-16-18-0027) and Bridlewood 3 (866 & 898 Eagleson Road and 1355 & 1365 Terry Fox Drive, D07-16-190001).

We have been informed that you will be the Engineering lead on both files, taking over from Gabrielle Schaeffer.

We have received different information regarding the sanitary sewer outlet conditions on both projects.

1. On the Van Gaal lands project we were informed during the pre-consultation that the sanitary sewer had an overflow at the Hazeldean Pump Station and that an elevation of 99.30 should be used for the minimum USF on site.
2. On the Bridlewood 3 project, we have received a comment (#46) which states that the Hazledean PS does not have an overflow for this branch of the sanitary sewer.

Based on our understanding of the sanitary sewer system, both proposed outlets flow to the trunk sewer on Akerson Road. They share a common outlet from the corner of Cope Drive and Akerson Road to the Hazledean Pump Station.

We would also like clarification on what the requirements relating to the submission of an HGL analysis for the sanitary sewer are for draft approval. We understand the request for an HGL analysis, however it is our suggestion that based on the proposed USF elevations being higher than downstream developments, that this should be a requirement at the detail design phase.

Your clarification is appreciated. We are available should you wish to call and discuss.

Trevor McKay, B.Eng., E.I.T., Project Coordinator | Engineering/Contract Administration
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 291 | Cell: 613.263.9113 | Fax: 613.254.5867

Steve Zorgel

From:	McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Sent:	Tuesday, February 13, 2018 4:02 PM
To:	Greg Winters
Cc:	Eric Bays; Marc St.Pierre; jim.burghout@claridgehomes.com; John Riddell
Subject:	Pre-Consultation Follow-Up: 1039 Terry Fox & 5331 Fernbank
Attachments:	Plan & Study List.pdf
Follow Up Flag:	Follow up
Flag Status:	Completed

Hi Greg,

Please refer to the below regarding our Pre-Consultation Meeting on Tuesday February 6th, 2018 on 1039 Terry Fox Drive and 5331 Fernbank Road. I have also attached the Plans & Study List.

General

- Subdivision development for 72 walk-up apartment units with a height of 3-storeys, consisting of 4 units on each storey and 182 townhouses
- Right-in / Right-out onto Terry Fox, as per the Councillor's request
- Idea of conveying Monahan Drain corridor as a block to the City, thereby creating a natural severance
  - Create an R-Plan to convey block to the City
- Zoning already in place for subdivision
- Holding can be lifted after draft approval
- Addressing and Signs has confirmed that 1039 Terry Fox and 5331 Fernbank will be used with the application

Planning/Urban Design

- The Official Plan designation is now General Urban
  - An increased product diversity can be attained with the designation change as singles and semi detached units are now permitted
- Please consider increasing the amount of park land with the land allocated to large deep lots in the Northwest corner abutting the Monahan Drain

Engineering

- Please establish the residential underside of footings to carry out a hydraulic grade line analysis of the sanitary sewer system. Please use the emergency overflow elevation for the Hazeldean Pumping Station of 95.30m to establish USF elevations in accordance with the Ottawa Sewer Design Guidelines. Please account for grade raise restrictions when completing the analysis.
- The geotechnical report is to look at grade raise restrictions and all current trees in sensitive clay soils. Geotechnical guideline requirements must be implemented. Refer to the Tree Planting in Sensitive Marine Clay Soils 2017 Guidelines.
- The applicant will be required to assess the hydraulic impact on the Monahan Drain against the controlling 100 year elevation of 95.30 metres at the Hazeldean Pump Station overflow outlet location into the Didsbury ditch. Please include all post-development Van Gaal Lands in the hydraulic assessment.
- The applicant is responsible to provide any required stormwater mitigation measures for this specific development. Mitigation measures will need to be handled via on-site stormwater management, which may affect the proposed layout.

- The Stormwater Management solution for all lands south of the Monahan Drain should be addressed with one common approach.
- The applicant is required to address quality and quantity requirements as set through the RCVA and the Monahan Stormwater facility.
- Please show the 100 year high water level elevations along the Monahan Drain on plans. No development within the 100 year HWLs nor within the 40 metre Monahan Drain Corridor.
- No structures nor controls are to be located within the Park block.
- The MOECC are in the final stages of updating their Stormwater Management guidelines. Please follow these new guidelines in anticipation of the expected 2018 change found below:

  Runoff Volume Control Targets for Ontario

  The proposed RVCt and recommended approach to implementation can be summarized as:
  i) Control of 90% of the annual average rainfall, commonly determined through the use of the 90th percentile storm. For the City of Ottawa, this has been identified as 26-28mm (depending on location).
  ii) the RCVt is to be applied to new development, redevelopment, re-urbanization and residential intensification, as well as "linear projects" that include all right-of-way (ROW) project (new roads, widenings , reconstruction and resurfacing) as well as trails, sidewalks, rail lines and transit infrastructure.
  iii) A mandatory control hierarchy, which requires that the RVCt be met:
  - First via **retention:** runoff volume is to be reduced via infiltration, evapotranspiration, and/or re-use, with this volume being define by the existing condition water balance on this site;
  - Second via **detention and release:** runoff volume not eliminated is to be treated via filtration approaches, e.g., filtering through bio retention (LID) features with slowed release to the storm sewer system
  - third via "**other detention and release:**" remaining proportion of the RVCt volume to be detained and treated, e.g., storage of runoff for sedimentation in end-of-pipe facilities.
- For questions related to engineering, please contact Gabrielle Schaeffer

Transportation

- Please follow the new Transportation Impact Assessment (TIA) guidelines for this development
- Right of way protection is required on Terry Fox (44.5m) and on Cope (24m)
- Discussion regarding a pork chop approach to allow for a right in/ right out connection to Terry Fox
  - Is this the best solution?
  - How can the access be controlled?
- It is advised that the applicant contacts OC Transpo about their future plans for the proposed development
  - Bus stops on Cope
- A Noise Feasibility Study will be required
  - Noise walls required in several locations
- Discussion around placement of sidewalks and their associated connections
  - Intersection near park
    - Pedestrian destination
    - "T" with no pedestrian control, suggested PXO
    - Look at internal design
  - Look at connections into the existing neighbourhood
- For questions related to engineering, please contact Rosanna Baggs

Environmental

- Tree Conservation Report
  - What is possible to retain along the drain, back property line and near the park block
- Be vigilant for Butternut Trees on the property as they are a protected endangered species under the *Endangered Species Act*

- Please submit the IER with the Planning Rationale
- It is the owner's responsibility for maintenance to the Monahan Drain if the land is not owned by the City

Parks

- Please take care of vegetation observed on stockpile
- Maintain culvert for park connection crossing purposes
- Facility Fit Plan will be required for registration

Rideau Valley Conservation Authority

- The RCVA requires 80% TSS removal
- No building encroachment is permitted within the 30 metre setback from the Monahan Drain
- Rear yard fencing is required along properties that back onto the Monahan Drain to maintain protection of the Drain
- Any overland flows are not to exceed 0.3 metres during major events

Please do not hesitate to contact me if you have any questions.

Regards,
Laurel

Laurel McCreight MCIP, RPP
Planner
Development Review West
Urbaniste
Examen des demandes d'aménagement ouest

City of Ottawa | Ville d'Ottawa
613.580.2424 ext./poste 16587
ottawa.ca/planning / ottawa.ca/urbanisme

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Appendix B

Sanitary Design Sheets &
Excerpts from Relevant Reports

SANITARY SEWER DESIGN SHEET

Van Gaal Lands - Claridge Development - 1039 Terry Fox Drive & 5331 Fernbank Road

Developer: Claridge Homes

LICENSED PROFESSIONAL ENGINEER
D. D. BLAIR
100122737
Mar. 29 2019
PROVINCE OF ONTARIO

NOVATECH
Engineers, Planners & Landscape Architects

PROJECT # : 117198
DESIGNED BY : SAZ
CHECKED BY : DDB
DATE PREPARED : 7-Sep-18
DATE REVISED : 5-Mar-19

LOCATION				RESIDENTIAL								PARK			INFILTRATION			FLOW	PROPOSED SEWER							
				INDIVIDUAL				CUMULATIVE				PARK														
STREET	FROM MH	TO MH	Area ID	Single Units	Town Units	Population (in 1000's)	AREA (ha.)	Population (in 1000's)	AREA (ha.)	PEAK FACTOR M	POPULATION FLOW Qr(p) (L/s)	AREA (ha.)	Accu. AREA (ha.)	PARK FLOW Qc(p) (L/s)	Total Area (ha.)	Accu. Total AREA (ha.)	PEAK EXTRAN. FLOW Q(i) (L/s)	PEAK DESIGN FLOW Q(d) (L/s)	LENGTH (m)	PIPE SIZE (mm)	PIPE ID (mm)	TYPE OF PIPE	GRADE %	CAPACITY (L/s)	FULL FLOW VELOCITY (m/s)	Qpeak/ Qcap
Street 4	401	403	1	11		0.037	0.56	0.037	0.56	3.7	0.44		0.00	0.00	0.56	0.56	0.18	0.63	63.9	200	203.20	DR 35	0.36	20.5	0.63	3.1%
Street 4	403	405	2	11		0.037	0.57	0.075	1.13	3.6	0.88		0.00	0.00	0.57	1.13	0.37	1.25	67.2	200	203.20	DR 35	0.36	20.5	0.63	6.1%
Street 4	405	407	3	4		0.014	0.19	0.088	1.32	3.6	1.03		0.00	0.00	0.19	1.32	0.44	1.47	17.7	200	203.20	DR 35	0.45	23.0	0.71	6.4%
Street 4	407	101	4	10		0.034	0.67	0.122	1.99	3.6	1.42		0.00	0.00	0.67	1.99	0.66	2.07	95.7	200	203.20	DR 35	0.36	20.5	0.63	10.1%
Parkland	101	103	5			0.000	0.07	0.122	2.06	3.6	1.42	0.91	0.91	0.04	0.98	2.97	0.98	2.44	78.0	200	203.20	DR 35	0.36	20.5	0.63	14.9%
Street 1			6	12		0.041	0.51	0.163	2.57	3.5	1.87		0.91	0.04	0.51	3.48	1.15	3.06								
Street 2	215	217	7		5	0.014	0.19	0.014	0.19	3.7	0.16		0.00	0.00	0.19	0.19	0.06	0.23	44.6	200	203.20	DR 35	0.65	27.6	0.85	0.8%
Street 2	217	219	8		3	0.008	0.11	0.022	0.30	3.7	0.26		0.00	0.00	0.11	0.30	0.10	0.36	16.0	200	203.20	DR 35	0.50	24.2	0.75	1.5%
Street 2	219	221	9		10	0.027	0.31	0.049	0.61	3.7	0.58		0.00	0.00	0.31	0.61	0.20	0.78	65.7	200	203.20	DR 35	0.36	20.5	0.63	3.8%
Street 2	221	223	10		6	0.016	0.18	0.065	0.79	3.6	0.76		0.00	0.00	0.18	0.79	0.26	1.02	38.2	200	203.20	DR 35	0.36	20.5	0.63	5.0%
Street 2	223	225	11		2	0.005	0.08	0.070	0.87	3.6	0.82		0.00	0.00	0.08	0.87	0.29	1.11	15.8	200	203.20	DR 35	0.51	24.4	0.75	4.6%
Street 2	225	103	12		17	0.046	0.53	0.116	1.40	3.6	1.35		0.00	0.00	0.53	1.40	0.46	1.81	85.9	200	203.20	DR 35	0.36	20.5	0.63	8.8%
Street 1	103	105	13	7	2	0.029	0.39	0.309	4.36	3.5	3.46		0.91	0.04	0.39	5.27	1.74	5.24	78.5	200	203.20	DR 35	0.36	20.5	0.63	25.5%
Street 2	215	213	14		18	0.049	0.57	0.049	0.57	3.7	0.58		0.00	0.00	0.57	0.57	0.19	0.76	119.9	200	203.20	DR 35	0.36	20.5	0.63	3.7%
Street 2	213	211	15			0.000	0.03	0.049	0.60	3.7	0.58		0.00	0.00	0.03	0.60	0.20	0.77	12.6	200	203.20	DR 35	0.50	24.2	0.75	3.2%
Street 2	211	209A	16			0.000	0.06	0.049	0.66	3.7	0.58		0.00	0.00	0.06	0.66	0.22	0.79	34.1	200	203.20	DR 35	0.36	20.5	0.63	3.9%
Street 2	209A	209	17			0.000	0.02	0.049	0.68	3.7	0.58		0.00	0.00	0.02	0.68	0.22	0.80	9.6	200	203.20	DR 35	0.50	24.2	0.75	3.3%
Street 2	209	207	18		6	0.016	0.29	0.065	0.95	3.6	0.76		0.00	0.00	0.29	0.95	0.31	1.08	48.3	200	203.20	DR 35	0.36	20.5	0.63	5.2%
Street 2	207	205	19		3	0.008	0.09	0.073	1.04	3.6	0.86		0.00	0.00	0.09	1.04	0.34	1.20	20.3	200	203.20	DR 35	0.36	20.5	0.63	5.8%
Street 2	201	203	20		8	0.022	0.25	0.022	0.25	3.7	0.26		0.00	0.00	0.25	0.25	0.08	0.34	32.3	200	203.20	DR 35	0.65	27.6	0.85	1.2%
Street 2	203	205	21		16	0.043	0.43	0.065	0.68	3.6	0.76		0.00	0.00	0.43	0.68	0.22	0.99	56.5	200	203.20	DR 35	0.36	20.5	0.63	4.8%
Street 3	205	301	22			0.000	0.03	0.138	1.75	3.6	1.59		0.00	0.00	0.03	1.75	0.58	2.17	23.0	200	203.20	DR 35	0.37	20.8	0.64	10.4%
Street 3	301	303	23		4	0.011	0.17	0.149	1.92	3.6	1.71		0.00	0.00	0.17	1.92	0.63	2.34	20.0	200	203.20	DR 35	0.45	23.0	0.71	10.2%
Street 3	303	105	24		11	0.030	0.33	0.178	2.25	3.5	2.04		0.00	0.00	0.33	2.25	0.74	2.78	49.9	200	203.20	DR 35	0.36	20.5	0.63	13.6%
Street 1	105	107	25		18	0.049	0.55	0.535	7.16	3.4	5.84		0.91	0.04	0.55	8.07	2.66	8.54	81.0	200	203.20	DR 35	0.36	20.5	0.63	41.6%
Street 1	107	EX145				0.000		0.535	7.16	3.4	5.84		0.91	0.04	0.00	8.07	2.66	8.54	17.9	200	203.20	DR 35	0.45	23.0	0.71	37.2%
Total Flows											**5.84**			**0.04**			**2.66**	**8.54**								

Notes:
1. Q(d) = Qr(p) + Q(i) + Qc(p)
2. Q(i) = 0.33 L/sec/ha
3. Qr(p) = (PxqxM/86,400)
3. Qc(p) = (A*q*Pf)/86,400

Definitions:
Q(d) = Design Flow (L/sec)
Qr(p) = Population Flow (L/sec), Residential
Q(i) = Extraneous Flow (L/sec)
Qc(p) = Population Flow (L/sec), Commercial/Institutional/Park

P = Population (3.4 persons per single unit, 2.7 persons per townhouse unit)
q = Average per capita flow = 280 L/cap/day - Residential
q = Average per gross ha. flow = 35000 L/gross ha/day - Light industrial
q = Average per gross ha. flow = 28000 L/gross ha/day - Commercial/Institutional
q = Average per gross ha. flow = 3700 L/gross ha/day - Park (20L/day/person, 185 persons/ha - as per Appendix 4-A of the City of Ottawa Sewer Design Guidelines)
M = Harmon Formula (maximum of 4.0), K = Correction Factor = 0.8
Min pipe size 200mm @ min. slope 0.32%
Mannings n = 0.013
Pf = Peak factor (Commercial/Institional/Park) = 1.0 (less than 20% of total contributing areas), 1.5 (if area is 20% or greater of total contributing area)

Serviceability Report

Cavanagh Construction Ltd. / Karam

SOHO West – Rev 3

Project #604-00502

Urban Land
1505 Laperriere Avenue
Ottawa, Ontario
K1Z 7T1
(613) 722-4420

October 31, 2007

Stantec

Stantec

Cavanagh Construction

SOHO Development Phase 1 and 2

DATE: April 2007
REVISION: October 2007
DESIGNED BY: MJS
CHECKED BY: KK

SANITARY SEWER DESIGN SHEET

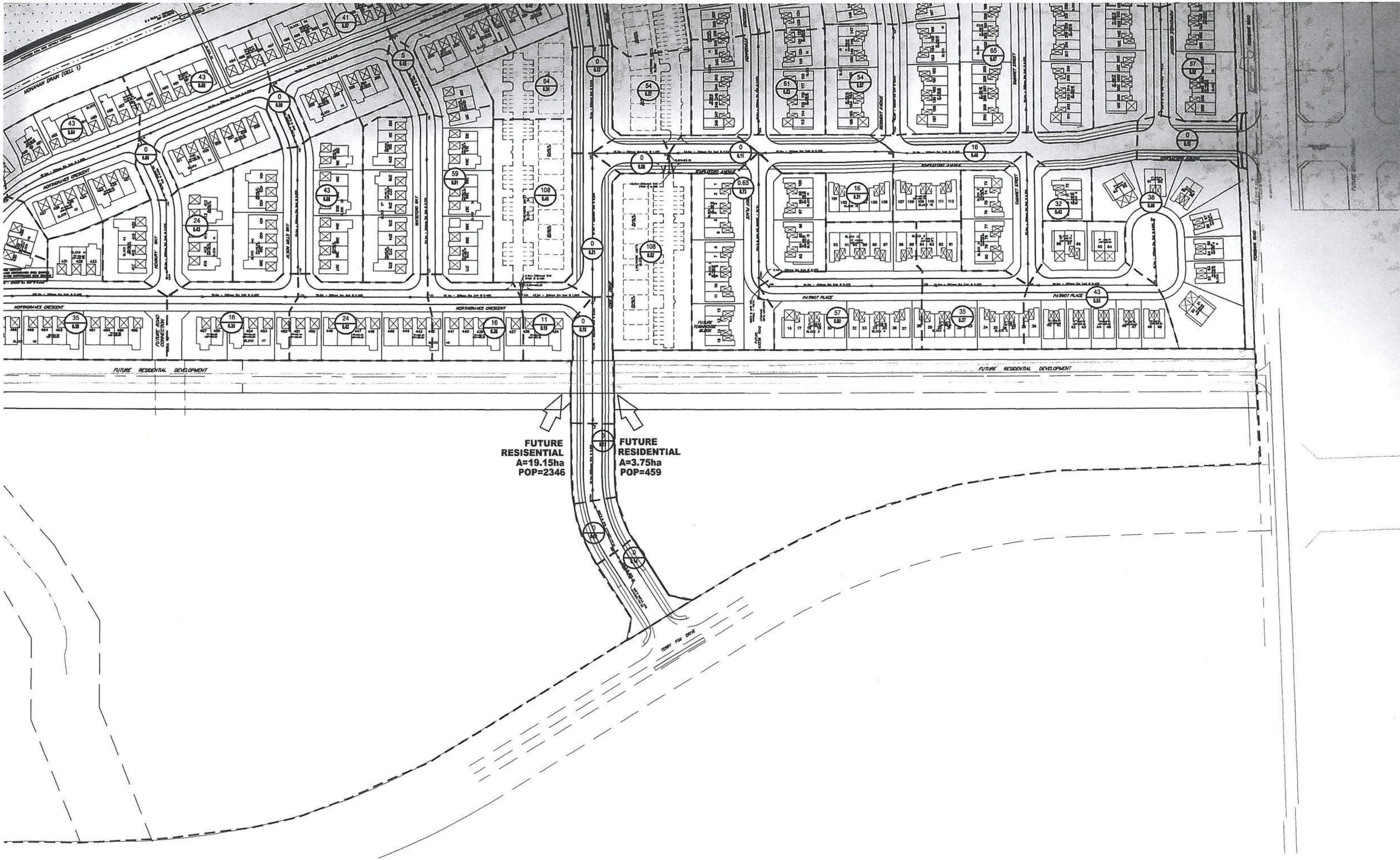
(City of Ottawa)

FILE NUMBER: 1604-00502

DESIGN PARAMETERS

AVG. DAILY FLOW / PERSON =	350	l/p/day	COMMERCIAL	50,000.00	l/Ha/day
MINIMUM VELOCITY =	0.60	m/s	LIGHT INDUSTRIAL	35,000.00	l/Ha/day
n =	0.013		INSTITUTIONAL	0.60	l/s/Ha
MAX PEAK FACTOR =	4.0		INFILTRATION	0.28	l/s/Ha
MIN PEAK FACTOR =	2.4		RESIDENTIAL HARMON PEAKING FACTOR PERSONS/UNIT =	4.0	
			KANATA WEST REPORT PERSONS/UNIT =	3.0	
Peaking Factor Industrial:	1.5		POPULATION DENSITY PER UNIT = Single Family =	3.4	
Peaking Factor Comm. / Inst.:	1.5		Townhouse =	2.7	

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INDUST		INSTIT		C+I+I	INFILTRATION				PIPE					
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS Singles	UNITS Towns	UNITS (KWR)	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT	PEAK FLOW (l/s)	AREA (ha)	ACCU AREA (ha)	AREA (ha)	ACCU AREA (ha)	AREA (ha)	ACCU AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU AREA (ha)	INFILT FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	VEL (FULL) (m/s)	VEL (ACT.) (m/s)
Phase 1																												
PATRIOT PLACE	101	102	0.80		14	0	38	0.80	38	4.00	0.62							0.00	0.80	0.80	0.224	0.84	40.5	200	0.65	26.88	0.84	0.34
PATRIOT PLACE	102	104	0.55		16	0	43	1.35	81	4.00	1.31							0.00	0.55	1.35	0.378	1.69	76.9	200	0.45	22.40	0.70	0.36
PATRIOT PLACE	104	105	0.37		13	0	35	1.72	116	4.00	1.88							0.00	0.37	1.72	0.482	2.36	64.0	200	0.45	22.40	0.70	0.43
PATRIOT PLACE	105	106	0.60		21	0	57	2.32	173	4.00	2.80							0.00	0.60	2.32	0.650	3.45	98.0	200	0.45	22.40	0.70	0.48
PATRIOT PLACE	106	109	0.73		24	0	65	3.05	238	4.00	3.86							0.00	0.73	3.05	0.854	4.71	81.0	200	0.45	22.40	0.70	0.53
TABARET STREET	104	107	0.43		12	0	32	0.43	32	4.00	0.52							0.00	0.43	0.43	0.120	0.64	83.8	200	0.70	27.84	0.87	0.35
TEMPLEFORD AVENUE	107	108	0.48		6	0	16	0.91	48	4.00	0.78							0.00	0.48	0.91	0.265	1.04	81.0	200	0.45	22.40	0.70	0.33
TEMPLEFORD AVENUE	108	109	0.31		6	0	16	1.22	64	4.00	1.04							0.00	0.31	1.22	0.342	1.38	81.0	200	0.45	22.40	0.70	0.36
TEMPLEFORD AVENUE	109	110	0.11		0	0	0	4.38	302	4.00	4.89							0.00	0.11	4.38	1.226	6.12	53.6	200	0.84	30.72	0.96	0.71
BLOCK 1	110B	110	0.52		40	0	108	0.52	108	4.00	1.75							0.00	0.52	0.52	0.146	1.90	111.5	200	0.75	29.12	0.91	0.47
TEMPLEFORD AVENUE	110	147	0.08		0	0	0	4.98	410	4.00	6.64							0.00	0.08	4.98	1.394	8.03	46.5	200	1.18	36.48	1.14	0.89
NORTHGRAVES	129	130	0.20		3	0	8	0.20	8	4.00	0.13							0.00	0.20	0.20	0.056	0.19	13.0	200	0.65	26.88	0.84	0.00
NORTHGRAVES	130	131	0.59		13	0	35	0.79	43	4.00	0.70							0.00	0.59	0.79	0.221	0.92	105.2	200	0.45	22.40	0.70	0.33
NORTHGRAVES	131	132	0.35		6	0	16	1.14	59	4.00	0.96							0.00	0.35	1.14	0.319	1.28	78.0	200	0.45	22.40	0.70	0.33
NORTHGRAVES	132	133	0.42		9	0	24	1.56	83	4.00	1.34							0.00	0.42	1.56	0.437	1.78	78.0	200	0.45	22.40	0.70	0.36
NORTHGRAVES	133	133A	0.26		6	0	16	1.82	99	4.00	1.60							0.00	0.26	1.82	0.510	2.11	55.4	200	0.45	22.40	0.70	0.41
BLOCK 34 ****	133C	133B	0.24		20	0	54	0.24	54	4.00	0.88							0.00	0.24	0.24	0.067	0.95	42.5	200	0.65	26.88	0.84	0.34
BLOCK 34 ****	133B	133A	0.48		40	0	108	0.72	162	4.00	2.63							0.00	0.48	0.72	0.202	2.83	113.0	200	0.40	21.12	0.66	0.44
NORTHGRAVES	133A	146	0.16		4	0	11	2.70	272	4.00	4.41							0.00	0.16	2.70	0.756	5.17	43.2	200	1.09	34.88	1.09	0.75
COPE DR ***	STUB	145B	125.14		0	0	8075	125.14	8075	3.05	99.77			28.72	28.72			17.45	153.86	153.86	43.081	160.30	20.4	525	0.25	223.00	1.00	1.09
COPE DR	145B	145A	0.09		0	0	0	125.23	8075	3.05	99.77				28.72			17.45	0.09	153.95	43.106	160.33	34.4	525	0.25	223.00	1.00	1.09
COPE DR	145A	145	0.12		0	0	0	125.35	8075	3.05	99.77				28.72			17.45	0.12	154.07	43.140	160.36	46.4	525	0.25	223.00	1.00	1.09
COPE DR	145	146	23.14		0	0	2811	148.49	10886	2.92	128.77				28.72			17.45	23.14	177.21	49.619	195.84	78.0	525	0.25	223.00	1.00	1.14
HENBURY WAY	134A	134	0.43		9	0	24	0.43	24	4.00	0.39							0.00	0.43	0.43	0.120	0.51	58.3	200	0.65	26.88	0.84	0.00
HENBURY WAY	134	141	0.06		0	0	0	0.49	24	4.00	0.39							0.00	0.06	0.49	0.137	0.53	42.6	200	0.65	26.88	0.84	0.00
ALSON MILLS WAY	135	136	0.68		16	0	43	0.68	43	4.00	0.70							0.00	0.68	0.68	0.190	0.89	79.9	200	0.65	26.88	0.84	0.34
ALSON MILLS WAY	136	142	0.06		0	0	0	0.74	43	4.00	0.70							0.00	0.06	0.74	0.207	0.91	41.6	200	0.82	30.40	0.95	0.38
WHITEFORD WAY	137	138	0.81		22	0	59	0.81	59	4.00	0.96							0.00	0.81	0.81	0.227	1.19	101.1	200	0.78	29.44	0.92	0.43
WHITEFORD WAY	138	143	0.18		2	0	5	0.99	64	4.00	1.04							0.00	0.18	0.99	0.277	1.32	54.4	200	0.78	29.44	0.92	0.43
NORTHGRAVES	129	139	0.22		4	0	11	0.22	11	4.00	0.18							0.00	0.22	0.22	0.062	0.24	26.7	200	0.65	26.88	0.84	0.00
NORTHGRAVES	139	140	0.29		7	0	19	0.51	30	4.00	0.49							0.00	0.29	0.51	0.143	0.63	31.2	200	0.45	22.40	0.70	0.28
NORTHGRAVES	140	141	0.64		16	0	43	1.15	73	4.00	1.18							0.00	0.64	8.00	2.240	3.42	87.6	200	0.65	26.88	0.84	0.55
NORTHGRAVES	141	142	0.60		16	0	43	2.24	140	4.00	2.27							0.00	0.60	9.09	2.545	4.82	85.7	200	0.35	19.84	0.62	0.50
NORTHGRAVES	142	143	0.57		15	0	41	3.55	224	4.00	3.63							0.00	0.57	10.40	2.912	6.54	79.8	200	0.55	24.96	0.78	0.64
NORTHGRAVES	143	144	0.44		11	0	30	4.98	318	4.00	5.16							0.00	0.44	11.83	3.312	8.46	60.0	200	0.69	27.84	0.87	0.76
NORTHGRAVES	144	149	0.42		10	0	27	5.40	345	4.00	5.59							0.00	0.42	12.25	3.430	9.02	64.5	200	0.69	27.84	0.87	0.77


FUTURE RESISENTIAL
A=19.15ha
POP=2346
FUTURE RESIDENTIAL
A=3.75ha
POP=459
FUTURE RESIDENTIAL DEVELOPMENT
FUTURE RESIDENTIAL DEVELOPMENT
NORTHGRAVES CRESCENT
PATRIOT PLACE
PATRIOT PLACE
TERRY FOX DRIVE
FUTURE ROAD CONNECTION

day and maximum day demands. At a residual pressure of 20 psi, the available fire flow in the adjacent distribution systems was greater than 10,000 L/min.

4.0 SANITARY SEWER

4.1 Design Flows

The design criteria used to determine the sanitary flows produced by the proposed development is as follows;

Design Residential Domestic Flow per capita	350 L/cap/day
Capita per dwelling	2.7 persons per townhouse
Residential Peak Factor	Where P is population in 1000s;

$$P.F. = 1 + \frac{14}{\sqrt{4 + P^{0.5}}}$$

Commercial Flow	50,000 L/ha/day
Commercial Peak Factor	1.5
Light Industrial Flow	35,000 L/ha/day
Light Industrial (Business Park) Peak Factor	4 (Appendix 4-B Ottawa Sewer Design Guidelines)
Infiltration	0.28 L/ha/day
Minimum Velocity	0.60 m/s
Minimum Pipe Size	250 mm dia. (0.432 % slope)

Table 4.1 - Sanitary Design Flows under Proposed Land Use and Zoning

	Proposed Zoning	Area (ha)	Pop. (1000's)	Peak Popul. Flow Q(p) (L/s)	Peak Busi. Flow Q(i) (L/s)	Peak Comm. Flow Q(c) (L/s)	Peak Extran. Flow Q(e) (L/s)	Peak Design Flow Q(d) (L/s)
Business Park (Light Industrial)	IP	13.58			22.00		3.80	25.81
Residential	R4	8.14	0.608	9.67			2.28	11.95
Commercial	IP	3.73				3.24	1.04	4.28
Total		25.45	0.608	9.67	22.00	3.24	7.13	42.04

Stantec	SUBDIVISION: **Terry Fox Drive and Cope Drive Commercial Shopping Development**	**SANITARY SEWER DESIGN SHEET** (City of Ottawa)
	DATE: 7/23/2018 REVISION: 1 DESIGNED BY: TKR CHECKED BY: -	FILE NUMBER: 160401397

DESIGN PARAMETERS

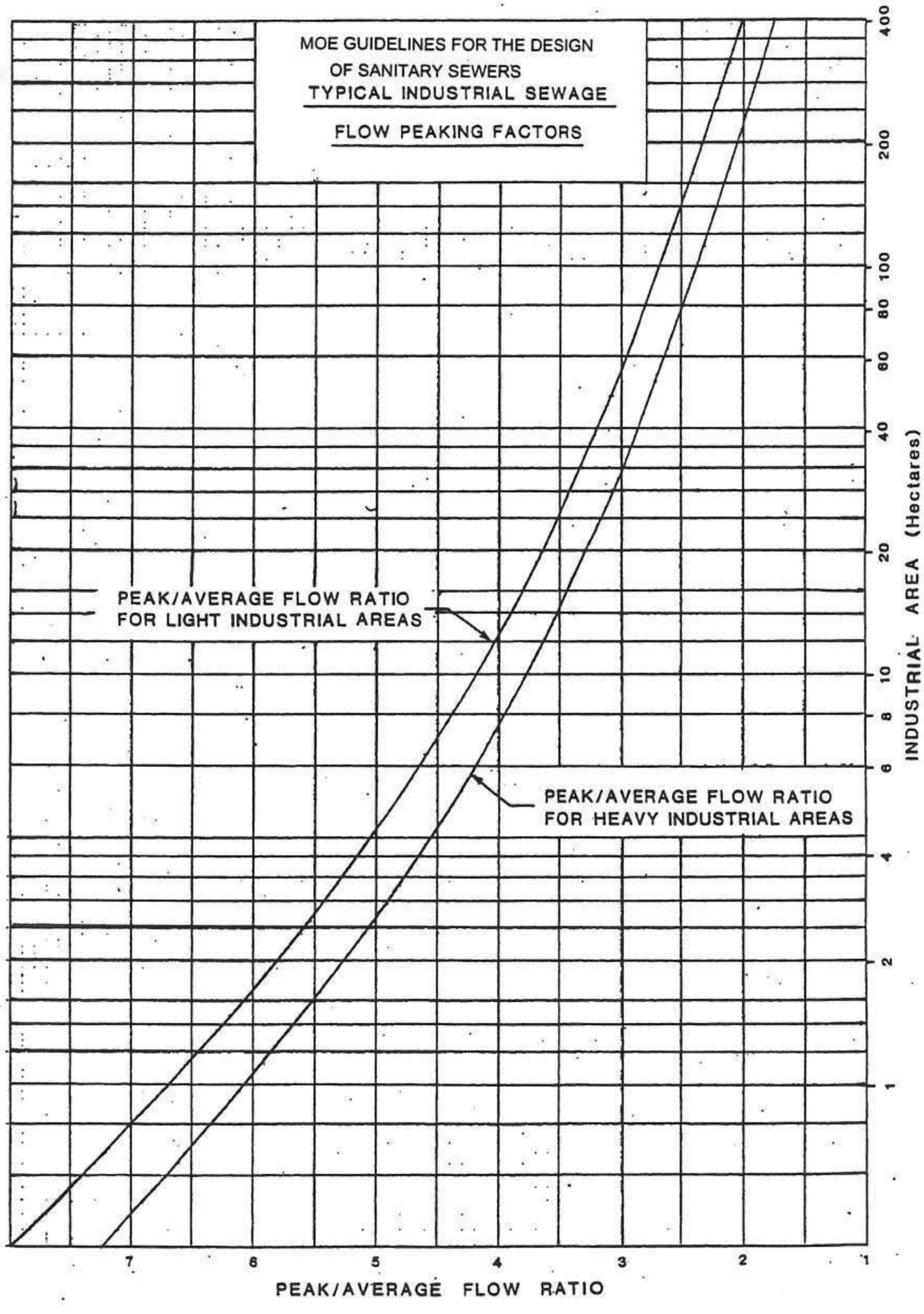
MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	280 l/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	28,000 l/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 l/ha/day	MANNINGS n	0.013
PEAKING FACTOR (ICI >20%):	1.5	INDUSTRIAL (LIGHT)	35,000 l/ha/day	BEDDING CLASS	B
PERSONS / SINGLE	3.4	INSTITUTIONAL	28,000 l/ha/day	MINIMUM COVER	2.50 m
PERSONS / TOWNHOME	2.7	INFILTRATION	0.33 l/s/Ha	HARMON CORRECTION FACTOR	0.8
PERSONS / APARTMENT	1.8				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	SINGLE	UNITS TOWN	APT	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	FLOW (l/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
C106B	38	106	0.00	0	0	0	0	0.00	0	4.00	0.0	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.03	0.03	0.0	0.0	14.6	100	PVC	DR 28	1.00	5.3	0.43%	0.67	0.14
C106A	39	106	0.00	0	0	0	0	0.00	0	4.00	0.0	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.01	0.01	0.0	0.0	6.2	150	PVC	DR 28	1.00	15.3	0.05%	0.86	0.07
G106A, G106B	106	105	0.00	0	0	0	0	0.00	0	4.00	0.0	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.65	0.0	0.65	0.69	0.2	0.2	23.4	250	PVC	SDR 35	0.50	42.9	0.57%	0.86	0.19
C105B	41	105	0.00	0	0	0	0	0.00	0	4.00	0.0	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.06	0.06	0.0	0.0	5.8	150	PVC	DR 28	1.00	15.3	0.31%	0.86	0.16
G105A	105	104	0.00	0	0	0	0	0.00	0	4.00	0.0	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.56	1.21	0.0	0.56	1.31	0.4	0.5	94.8	250	PVC	SDR 35	0.50	42.9	1.11%	0.86	0.25
C105A	42	104	0.00	0	0	0	0	0.00	0	4.00	0.0	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.14	0.14	0.0	0.1	5.8	150	PVC	DR 28	1.00	15.3	0.75%	0.86	0.21
G104A	104	103	0.00	0	0	0	0	0.00	0	4.00	0.0	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.27	1.48	0.1	0.27	1.71	0.6	0.7	40.6	250	PVC	SDR 35	0.50	42.9	1.59%	0.86	0.27
C103A	43	103	0.00	0	0	0	0	0.00	0	4.00	0.0	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.11	0.11	0.0	0.1	19.0	150	PVC	DR 28	1.00	15.3	0.60%	0.86	0.21
C103B	44	103	0.00	0	0	0	0	0.00	0	4.00	0.0	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.04	0.04	0.0	0.0	25.0	150	PVC	DR 28	1.00	15.3	0.20%	0.86	0.14
G103A	103	100	0.00	0	0	0	0	0.00	0	4.00	0.0	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.98	2.46	0.2	0.98	2.84	0.9	1.1	105.3	250	PVC	SDR 35	0.50	42.9	2.62%	0.86	0.31
	46	102	0.00	0	0	0	0	0.00	0	4.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.0	0.0	7.2	150	PVC	DR 28	1.00	15.3	0.00%	0.86	0.00
C102A	102	100	0.00	0	0	0	0	0.00	0	4.00	0.0	0.32	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.2	0.32	0.32	0.1	0.3	23.8	250	PVC	SDR 35	7.45	165.5	0.16%	3.33	0.53
C101A	48	101	0.00	0	0	0	0	0.00	0	4.00	0.0	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.06	0.06	0.0	0.0	20.6	150	PVC	DR 28	1.00	15.3	0.30%	0.86	0.16
C101B	49	101	0.00	0	0	0	0	0.00	0	4.00	0.0	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.08	0.08	0.0	0.1	28.1	150	PVC	DR 28	1.00	15.3	0.44%	0.86	0.19
	101	100	0.00	0	0	0	0	0.00	0	4.00	0.0	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.14	0.0	0.0	13.5	250	PVC	SDR 35	0.50	42.9	0.11%	0.86	0.11
G100A	100	33	0.00	0	0	0	0	0.00	0	4.00	0.0	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.38	2.83	0.4	0.38	3.68	1.2	1.6	58.3	250	PVC	SDR 35	0.50	42.9	3.80%	0.86	0.34
																												250							

APPENDIX 4-B

PEAKING FACTOR FOR INDUSTRIAL AREAS

APPENDIX 4-B PEAKING FACTOR FOR INDUSTRIAL AREAS



Appendix C

Watermain Boundary Conditions,
FUS Calculations, &
Modelling Results

Trevor McKay

From:	Candow, Julie <julie.candow@ottawa.ca>
Sent:	Thursday, March 07, 2019 8:58 AM
To:	Trevor McKay; Surprenant, Eric
Cc:	Marc St.Pierre
Subject:	RE: Boundary Condition Request - Van Gaal
Attachments:	Van Gaal Boundary Conditions.docx

Hi Trevor,

See attached and below from IP:

I have updated the FF. The existing HGL and Pressures provided in the previous document holds true to fire flow of 234 L/s corresponding to 14,000 L/min as requested in the BC request. The 15,000 L/min was an error on the sheet.

Julie Candow, P.Eng.
Project Manager - Infrastructure Approvals

City of Ottawa
Development Review - West Branch
Planning, Infrastructure and Economic Development Department
110 Laurier Ave., 4th Floor East;
Ottawa ON K1P 1J1
Tel: 613-580-2424 x 13850

From: Trevor McKay <t.mcKay@novatech-eng.com>
Sent: March 07, 2019 7:43 AM
To: Candow, Julie <julie.candow@ottawa.ca>; Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Cc: Marc St.Pierre <m.stpierre@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Julie/Eric,

Could you please confirm which fire flow was used to calculate the boundary conditions for fire flow demand #2. The calculation sheet references both 15000L/min (250L/s) and 234L/s (14,000L/min). See attached markup.

Thanks,

Trevor McKay, B.Eng., E.I.T., Project Coordinator | Engineering/Contract Administration
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 291 | Cell: 613.263.9113 | Fax: 613.254.5867

From: Candow, Julie <julie.candow@ottawa.ca>
Sent: Wednesday, March 06, 2019 3:06 PM
To: Marc St.Pierre <m.stpierre@novatech-eng.com>

Cc: Trevor McKay <t.mcKay@novatech-eng.com>; Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Subject: RE: Boundary Condition Request - Van Gaal

Hi Marc,

Please see attached boundary condition results for Van Gaal lands. Please note the following provided by Infrastructure Planning:

The third fire of 300 l/s or 18,000 L/min will not pass the minimum pressure and HGL requirements of fire flow for the first connection on NorthGraves Cres.
I provided HGL and pressures for the 167 l/s fire as well as the 234 L/s fires.

For future reference, Eric Suprenant will be taking over this file in Gabrielle's absense.

Regards,

Julie Candow, P.Eng.
Project Manager - Infrastructure Approvals

City of Ottawa
Development Review - West Branch
Planning, Infrastructure and Economic Development Department
110 Laurier Ave., 4th Floor East;
Ottawa ON K1P 1J1
Tel: 613-580-2424 x 13850

From: Candow, Julie
Sent: March 06, 2019 11:41 AM
To: 'Marc St.Pierre' <m.stpierre@novatech-eng.com>
Cc: Trevor McKay <t.mcKay@novatech-eng.com>
Subject: FW: Boundary Condition Request - Van Gaal

Hi Marc,

I just received your voicemail. Your boundary condition calculations were approved and passed along to the Infrastructure Planning department. I have been advised that they are currently working on the request and it should be available shortly.

Thanks,

Julie Candow, P.Eng.
Project Manager - Infrastructure Approvals

City of Ottawa
Development Review - West Branch
Planning, Infrastructure and Economic Development Department
110 Laurier Ave., 4th Floor East;
Ottawa ON K1P 1J1
Tel: 613-580-2424 x 13850

From: Trevor McKay <t.mcKay@novatech-eng.com>
Sent: February 22, 2019 3:17 PM
To: Candow, Julie <julie.candow@ottawa.ca>; Marc St.Pierre <m.stpierre@novatech-eng.com>; McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Cc: Steve Zorgel <s.zorgel@novatech-eng.com>; Greg Winters <G.Winters@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Julie,

See attached package with the unit numbers added for townhomes 151 to 154.

Thank you

Trevor McKay, B.Eng., E.I.T., Project Coordinator | Engineering/Contract Administration
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 291 | Cell: 613.263.9113 | Fax: 613.254.5867

From: Candow, Julie <julie.candow@ottawa.ca>
Sent: Friday, February 22, 2019 11:43 AM
To: Marc St.Pierre <m.stpierre@novatech-eng.com>; McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Cc: Steve Zorgel <s.zorgel@novatech-eng.com>; Greg Winters <G.Winters@novatech-eng.com>; Trevor McKay <t.mcKay@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Hi Marc,

Can you please provide a plan which shows the location of townhouse units 151-154 (which the fire flow calculations are based off of)?

Thanks,

Julie Candow, P.Eng.
Project Manager - Infrastructure Approvals

City of Ottawa
Development Review - West Branch
Planning, Infrastructure and Economic Development Department
110 Laurier Ave., 4th Floor East;
Ottawa ON K1P 1J1
Tel: 613-580-2424 x 13850

From: Marc St.Pierre <m.stpierre@novatech-eng.com>
Sent: Thursday, February 21, 2019 9:33 AM
To: McCreight, Laurel <Laurel.McCreight@ottawa.ca>; Candow, Julie <julie.candow@ottawa.ca>
Cc: Steve Zorgel <s.zorgel@novatech-eng.com>; Greg Winters <G.Winters@novatech-eng.com>; Trevor McKay <t.mcKay@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Then can someone at least be assigned to review Trevor's boundary conditions request. The City's delay is holding us up from proceeding with addressing the City's engineering comments and re-submitting the draft approval design package.

Regards,

Marc St. Pierre, Senior Project Manager | Land Development Engineering
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 247 | Cell: 613.229.9714 | Fax: 613.254.5867

From: McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Sent: Thursday, February 21, 2019 9:13 AM
To: Marc St.Pierre <m.stpierre@novatech-eng.com>; Candow, Julie <julie.candow@ottawa.ca>
Cc: Steve Zorgel <s.zorgel@novatech-eng.com>; Greg Winters <G.Winters@novatech-eng.com>; Trevor McKay <t.mcKay@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Hi Marc,

The file has yet to be reassigned. Derrick is currently working on reassigning all of Gabrielle's files and we hope to have an answer soon.

Thanks,
Laurel

Laurel McCreight MCIP, RPP
Planner
Development Review West
Urbaniste
Examen des demandes d'aménagement ouest

City of Ottawa | Ville d'Ottawa
613.580.2424 ext./poste 16587
ottawa.ca/planning / ottawa.ca/urbanisme

From: Marc St.Pierre <m.stpierre@novatech-eng.com>
Sent: Thursday, February 21, 2019 9:09 AM
To: McCreight, Laurel <Laurel.McCreight@ottawa.ca>; Candow, Julie <julie.candow@ottawa.ca>
Cc: Steve Zorgel <s.zorgel@novatech-eng.com>; Greg Winters <G.Winters@novatech-eng.com>; Trevor McKay <t.mcKay@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Laurel / Julie

Who in DRS is this file being reviewed by?

Regards,

Marc St. Pierre, Senior Project Manager | Land Development Engineering

NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 247 | Cell: 613.229.9714 | Fax: 613.254.5867
The information contained in this email message is confidential and is for exclusive use of the addressee.

From: Bougadis, John <John.Bougadis@ottawa.ca>
Sent: Wednesday, February 20, 2019 5:16 PM
To: Trevor McKay <t.mcKay@novatech-eng.com>
Cc: Marc St.Pierre <m.stpierre@novatech-eng.com>; Steve Zorgel <s.zorgel@novatech-eng.com>; McCreight, Laurel <Laurel.McCreight@ottawa.ca>; Candow, Julie <julie.candow@ottawa.ca>
Subject: RE: Boundary Condition Request - Van Gaal

Hi Trevor,

I forwarded this email to Development Review Services (DRS). Boundary conditions will be provided once the DRS file lead completes an initial review (i.e. review of design flows, FUS calculation sheets, etc).

Thanks

John
X14990

From: Trevor McKay <t.mcKay@novatech-eng.com>
Sent: Wednesday, February 20, 2019 12:11 PM
To: Bougadis, John <John.Bougadis@ottawa.ca>
Cc: Marc St.Pierre <m.stpierre@novatech-eng.com>; Steve Zorgel <s.zorgel@novatech-eng.com>; McCreight, Laurel <Laurel.McCreight@ottawa.ca>
Subject: FW: Boundary Condition Request - Van Gaal

John,

Please find attached a revised boundary condition request package for 1039 Terry Fox Drive and 5331 Fernbank Road.

We appreciate you assistance as we have been unable to confirm if Gabrielle had passed this request along before beginning her leave and have not yet been advised who the new engineering lead is on this file.

If you have any questions, please contact us.

Trevor McKay, B.Eng., E.I.T., Project Coordinator | Engineering/Contract Administration
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 291 | Cell: 613.263.9113 | Fax: 613.254.5867
The information contained in this email message is confidential and is for exclusive use of the addressee.

From: Trevor McKay
Sent: Thursday, February 07, 2019 2:28 PM
To: Schaeffer, Gabrielle <gabrielle.schaeffer@Ottawa.ca>
Cc: Marc St.Pierre <m.stpierre@novatech-eng.com>; Steve Zorgel <s.zorgel@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Gabrielle,

Based on clarifications in the recent technical bulletins issued by the City of Ottawa relating to the application of the 167L/s fireflow cap (ISDTB 2018-02), we are requesting revised hydraulic boundary conditions for the proposed development at 1039 Terry Fox Drive and 5331 Fernbank Road.

The proposed development will consist of 55 single units and 129 townhouse units.

There will be two connection points to the existing watermain. The first connection will be to the existing 300mm watermain located at Cope Drive, approximately 150m north of the Cope Drive/Terry Fox intersection. The second connection will be to the existing 200mm watermain on Northgraves Crescent at the Northgraves Crescent/Henbury Way intersection, refer to attached Figure-BC for details.

The watermain demand, figure and calculated fireflows are attached. Please note there are 3 governing fire flows for the site. The fireflow value of 167L/s represents the maximum fireflow as per Technical Bulletin ISDTB-2014-02. Fireflows of 233.0L/s and 300.0L/s represent the maximum fireflows based on FUS calculations for the two areas of the site where the fireflows can not be capped as per Technical Bulletin ISDTB-2014-02.

If you have any questions, please contact us.

Trevor McKay, B.Eng., E.I.T., Project Coordinator | Engineering/Contract Administration
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 Ext: 291 | Cell: 613.263.9113 | Fax: 613.254.5867

From: Schaeffer, Gabrielle <gabrielle.schaeffer@Ottawa.ca>
Sent: Thursday, April 26, 2018 11:22 AM
To: Steve Zorgel <s.zorgel@novatech-eng.com>
Cc: Marc St.Pierre <m.stpierre@novatech-eng.com>
Subject: RE: Boundary Condition Request - Van Gaal

Hi Steve,

Attached are the revised drinking water boundary conditions. There was an error in the model that has now been rectified.

Please note there is a new Technical Bulletin ISDTB 2018-02 dated March 21, 2018 that has information about hydrants and FUS calculations.

Regards,
Gabrielle

From: Steve Zorgel <s.zorgel@novatech-eng.com>
Sent: Wednesday, April 11, 2018 3:13 PM
To: Schaeffer, Gabrielle <gabrielle.schaeffer@Ottawa.ca>
Cc: Marc St.Pierre <m.stpierre@novatech-eng.com>
Subject: Boundary Condition Request - Van Gaal

Hi Gabrielle,

We would like to request boundary conditions for the Van Gaal lands, located at 1039 Terry Fox Drive. This is subsequent to the pre-consultation held on February 6, 2018. As part of draft plan approval, we are required to complete a hydraulic assessment and will require boundary conditions for the analysis of the watermain network. The proposed development will consist of 54 single units and 129 townhouse units.

There will be two connection points to the existing watermain. The first connection will be to the existing 300mm watermain located at Cope Drive, approximately 150m north of the Cope Drive/Terry Fox intersection. The second connection will be to the existing 200mm watermain on Northgraves Crescent at the Northgraves Crescent/Henbury Way intersection, refer to attached Figure-BC for details.

The watermain demand, figure and calculated fireflows are attached. Please note the governing fireflow for the site is **167L/s**, which is less than the calculated values for the townhouse blocks as per the FUS. The fireflow value of 167L/s represents the maximum fireflow as per Technical Bulletin ISDTB-2014-02.

If you have any questions or concerns please don't hesitate to ask, thank you.

Regards,

Steve Zorgel, **P.Eng.**, Project Coordinator | Engineering
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x298 | Fax: 613.254.5867

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BOUNDARY CONDITIONS

Boundary Conditions For: Van Gaal – 1039 Terry Fox and 5331 Fernbank rd

Date of Boundary Conditions: 2019-Mar-06

Provided Information:

Scenario	Demand	
	L/min	L/s
Average Daily Demand	104.4	1.7
Maximum Daily Demand	260.4	4.3
Peak Hour	573	9.6
Fire Flow #1 Demand	10,000	167
Fire Flow #2 Demand	14,000	233.3

Number Of Connections: 2

Location:

BOUNDARY CONDITIONS

Results:

Connection #: 1

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	162.1	92.8
Peak Hour	156.7	85.0
Max Day Plus Fire (10,000) L/min	141.4	62.9
Max Day Plus Fire (14,000) L/min	126.6	41.8

[1]Elevation: **97.170 m**

Connection #: 2

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	162.1	92.8
Peak Hour	156.7	85.0
Max Day Plus Fire (10,000) L/min	153.3	80.2
Max Day Plus Fire (14,000) L/min	148.5	73.4

[1]Elevation: **96.860 m**

Notes:

1) As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:

a) If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
b) Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

2) Third requested fire for 300 L/s will not meet minimum pressure and HGL fire requirements off connection 1.

Disclaimer

FUS - Fire Flow Calculations

As per 1999 Fire Underwriter's Survey Guidelines

NOVATECH
Engineers, Planners & Landscape Architects

Novatech Project #: 117198
Project Name: Van Gaal Lands - 1039 Terry Fox Drive & 5331 Fernbank Road
Date: 2/7/2019
Input By: Trevor McKay
Reviewed By: Steve Zorgel

Legend: Input by User; No Information or Input Required

Building Description: Townhouses - 4 Units, <10m rear seperation (Units 151-154)
Wood frame

Step			Input	Multiplier Options	Value Used	Total Fire Flow (L/min)
	Base Fire Flow					
1	**Construction Material**					
	Coefficient related to type of construction C	Wood frame	Yes	1.5	1.5	
		Ordinary construction		1		
		Non-combustible construction		0.8		
		Fire resistive construction (< 3 hrs)		0.7		
		Fire resistive construction (> 3 hrs)		0.6		
2	**Floor Area**					
	A	Building Footprint (m^2)	439.2			
		Number of Floors/Storeys	2			
		Area of structure considered (m^2)			878	
	F	**Base fire flow without reductions** $F = 220\ C\ (A)^{0.5}$				10,000
	Reductions or Surcharges					
3	**Occupancy hazard reduction or surcharge**					
	(1)	Non-combustible		-25%	-15%	8,500
		Limited combustible	Yes	-15%		
		Combustible		0%		
		Free burning		15%		
		Rapid burning		25%		
4	**Sprinkler Reduction**					
	(2)	Adequately Designed System (NFPA 13)		-30%		0
		Standard Water Supply		-10%		
		Fully Supervised System		-10%		
				Cumulative Total	**0%**	
5	**Exposure Surcharge (cumulative %)**					
	(3)	North Side	20.1 - 30 m		10%	5,100
		East Side	3.1 - 10 m		20%	
		South Side	3.1 - 10 m		20%	
		West Side	20.1 - 30 m		10%	
				Cumulative Total	**60%**	
	Results					
6	(1) + (2) + (3)	**Total Required Fire Flow, rounded to nearest 1000L/min**			L/min	**14,000**
		(2,000 L/min < Fire Flow < 45,000 L/min)		or	L/s	**233**
				or	USGPM	3,699
7	**Storage Volume**	Required Duration of Fire Flow (hours)			Hours	3
		Required Volume of Fire Flow (m^3)			m^3	2520

Population and Consumption Rate Calculations

Node	Number of Single Units	Number of Townhouse Units	Residential Population	Consumption Rates (L/s) Average Daily	Maximum Daily	Maximum Hourly
R1						
R2						
1	3		10	0.03	0.08	0.18
2	8		27	0.09	0.22	0.48
3	10		34	0.11	0.28	0.61
4	14		48	0.15	0.39	0.85
5			0	0.00	0.00	0.00
6	8		27	0.09	0.22	0.48
7			0	0.00	0.00	0.00
8	12	4	52	0.17	0.42	0.92
9		21	57	0.18	0.46	1.01
10			0	0.00	0.00	0.00
11		13	35	0.11	0.28	0.63
12		11	30	0.10	0.24	0.53
13		12	32	0.11	0.26	0.58
14		11	30	0.10	0.24	0.53
15			0	0.00	0.00	0.00
16		22	59	0.19	0.48	1.06
17		15	41	0.13	0.33	0.72
18			0	0.00	0.00	0.00
19		20	54	0.18	0.44	0.96
TOTAL ONSITE	**55**	**129**	**535**	**1.73**	**4.34**	**9.54**

Water Demand Parameters - As per City of Ottawa Guidelines

Single Residential Units	3.4	persons/unit
Townhouse Residential Units	2.7	persons/unit

Water Demand Parameters (Local Demand as per City of Ottawa Guidelines - Water Distribution Systems)

Residential Demand - Single (low density)	280.0	L/c/day
Residential Demand - Street Town (med. density)	280.0	L/c/day
Residential Max Day	2.5	x Avg Day
Residential Peak Hour	2.2	x Max Day
Residential Fire Flow (151-154), Node 17	233.3	L/s
Residential Fire Flow Cap (Typical)	167.0	L/s

Notes:
1) Fireflows of 167L/s have been applied as per City of Ottawa Technical Bulletin ISDTB-2014-02.
2) Fireflow values have been distributed over several hydrants as per Technical Bulletin ISTB-2018-02.
3) Residential demand has been revised to 280.0 L/c/day as per Technical Bulletin ISTB-2018-01 and City of Ottawa Comment A5, December 21, 2018.
4) Units 15-19 are assumed to be able to achieve 10m rear yard seperation or will have fire breaks to meet requirements City of Ottawa Technical Bulletin ISDTB-2014-02. Assumption will be confirmed at detailed design.

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi	Age hours
Resvr R1	162.10	-0.85	162.10	0.00	0.00	0.00	0.0
Resvr R2	162.10	-0.89	162.10	0.00	0.00	0.00	0.0
Junc 1	97.90	0.03	162.10	64.20	629.80	91.35	10.4
Junc 2	97.72	0.09	162.10	64.38	631.57	91.60	9.9
Junc 3	97.76	0.11	162.10	64.34	631.18	91.54	5.5
Junc 4	97.65	0.15	162.10	64.45	632.25	91.70	3.0
Junc 5	97.55	0.00	162.10	64.55	633.24	91.84	0.9
Junc 6	97.42	0.09	162.10	64.68	634.51	92.03	0.7
Junc 7	97.47	0.00	162.10	64.63	634.02	91.96	3.1
Junc 8	97.39	0.17	162.10	64.71	634.81	92.07	4.3
Junc 9	97.53	0.18	162.10	64.57	633.43	91.87	5.1
Junc 10	97.70	0.00	162.10	64.40	631.76	91.63	7.3
Junc 11	97.52	0.11	162.10	64.58	633.53	91.89	9.0
Junc 12	97.98	0.10	162.10	64.12	629.02	91.23	23.1
Junc 13	97.95	0.11	162.10	64.15	629.31	91.27	13.2
Junc 14	97.75	0.10	162.10	64.35	631.27	91.56	4.7
Junc 15	97.55	0.00	162.10	64.55	633.24	91.84	3.0
Junc 16	97.78	0.19	162.10	64.32	630.98	91.52	8.2
Junc 17	97.36	0.13	162.10	64.74	635.10	92.11	1.7
Junc 18	97.25	0.00	162.10	64.85	636.18	92.27	1.1
Junc 19	97.02	0.18	162.10	65.08	638.43	92.60	0.7

(orange)	Maximum Pressure Offsite
(blue)	Maximum Age

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.03	0.02	0.02	0.081
Pipe 2	58.00	204	110	-0.12	0.00	0.00	0.095
Pipe 3	64.00	204	110	-0.23	0.01	0.00	0.047
Pipe 4	87.00	204	110	-0.38	0.01	0.00	0.057
Pipe 5	17.50	204	110	-0.76	0.02	0.01	0.055
Pipe 6	67.00	204	110	-0.85	0.03	0.01	0.049
Pipe 7	78.50	204	110	0.38	0.01	0.00	0.056
Pipe 8	12.00	204	110	-0.02	0.00	0.00	0.000
Pipe 9	85.50	204	110	0.40	0.01	0.00	0.052
Pipe 10	53.00	204	110	0.22	0.01	0.00	0.062
Pipe 11	39.00	204	110	0.20	0.01	0.00	0.103
Pipe 12	77.00	204	110	0.09	0.00	0.00	0.000
Pipe 13	81.00	204	110	-0.01	0.00	0.00	0.000
Pipe 14	113.50	204	110	-0.12	0.00	0.00	0.048
Pipe 15	40.00	204	110	-0.22	0.01	0.00	0.081
Pipe 16	53.00	204	110	0.17	0.01	0.00	0.053
Pipe 17	44.50	204	110	-0.02	0.00	0.00	0.000
Pipe 18	56.00	204	110	-0.39	0.01	0.00	0.056
Pipe 19	34.50	204	110	-0.52	0.02	0.00	0.051
Pipe 20	66.00	204	110	-0.19	0.01	0.00	0.068
Pipe 21	32.50	204	110	-0.71	0.02	0.01	0.049
Pipe 22	66.50	204	110	-0.89	0.03	0.01	0.05

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	156.70	-4.68	156.70	0.00	0.00	0.00
Resvr R2	156.70	-4.86	156.70	0.00	0.00	0.00
Junc 1	97.90	0.18	156.66	58.76	576.44	83.60
Junc 2	97.72	0.48	156.68	58.96	578.40	83.89
Junc 3	97.76	0.61	156.68	58.92	578.01	83.83
Junc 4	97.65	0.85	156.68	59.03	579.08	83.99
Junc 5	97.55	0.00	156.68	59.13	580.07	84.13
Junc 6	97.42	0.48	156.69	59.27	581.44	84.33
Junc 7	97.47	0.00	156.68	59.21	580.85	84.25
Junc 8	97.39	0.92	156.68	59.29	581.63	84.36
Junc 9	97.53	1.01	156.68	59.15	580.26	84.16
Junc 10	97.70	0.00	156.68	58.98	578.59	83.92
Junc 11	97.52	0.63	156.67	59.15	580.26	84.16
Junc 12	97.98	0.53	156.67	58.69	575.75	83.51
Junc 13	97.95	0.58	156.67	58.72	576.04	83.55
Junc 14	97.75	0.53	156.68	58.93	578.10	83.85
Junc 15	97.55	0.00	156.68	59.13	580.07	84.13
Junc 16	97.78	1.06	156.68	58.90	577.81	83.80
Junc 17	97.36	0.72	156.68	59.32	581.93	84.40
Junc 18	97.25	0.00	156.68	59.43	583.01	84.56
Junc 19	97.02	0.96	156.69	59.67	585.36	84.90

Minimum Pressure

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.18	0.09	0.53	0.062
Pipe 2	58.00	204	110	-0.66	0.02	0.01	0.054
Pipe 3	64.00	204	110	-1.27	0.04	0.02	0.047
Pipe 4	87.00	204	110	-2.12	0.06	0.05	0.043
Pipe 5	17.50	204	110	-4.20	0.13	0.16	0.039
Pipe 6	67.00	204	110	-4.68	0.14	0.20	0.039
Pipe 7	78.50	204	110	2.08	0.06	0.04	0.044
Pipe 8	12.00	204	110	-0.13	0.00	0.00	0.000
Pipe 9	85.50	204	110	2.21	0.07	0.05	0.043
Pipe 10	53.00	204	110	1.20	0.04	0.02	0.047
Pipe 11	39.00	204	110	1.08	0.03	0.01	0.047
Pipe 12	77.00	204	110	0.45	0.01	0.00	0.057
Pipe 13	81.00	204	110	-0.08	0.00	0.00	0.147
Pipe 14	113.50	204	110	-0.66	0.02	0.01	0.051
Pipe 15	40.00	204	110	-1.19	0.04	0.02	0.048
Pipe 16	53.00	204	110	0.94	0.03	0.01	0.049
Pipe 17	44.50	204	110	-0.12	0.00	0.00	0.000
Pipe 18	56.00	204	110	-2.13	0.07	0.05	0.043
Pipe 19	34.50	204	110	-2.85	0.09	0.08	0.041
Pipe 20	66.00	204	110	-1.05	0.03	0.01	0.048
Pipe 21	32.50	204	110	-3.90	0.12	0.14	0.040
Pipe 22	66.50	204	110	-4.86	0.15	0.21	0.038

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-62.67	141.40	0.00	0.00	0.00
Resvr R2	153.30	-108.67	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	113.75	15.85	155.49	22.55
Junc 2	97.72	95.22	113.76	16.04	157.35	22.82
Junc 3	97.76	72.28	116.80	19.04	186.78	27.09
Junc 4	97.65	0.39	126.34	28.69	281.45	40.82
Junc 5	97.55	0.00	139.36	41.81	410.16	59.49
Junc 6	97.42	0.22	139.78	42.36	415.55	60.27
Junc 7	97.47	0.00	144.33	46.86	459.70	66.67
Junc 8	97.39	0.42	144.69	47.30	464.01	67.30
Junc 9	97.53	0.46	145.03	47.50	465.98	67.58
Junc 10	97.70	0.00	145.48	47.78	468.72	67.98
Junc 11	97.52	0.28	145.52	48.00	470.88	68.30
Junc 12	97.98	0.24	145.60	47.62	467.15	67.75
Junc 13	97.95	0.26	145.69	47.74	468.33	67.93
Junc 14	97.75	0.24	145.83	48.08	471.66	68.41
Junc 15	97.55	0.00	145.88	48.33	474.12	68.76
Junc 16	97.78	0.48	145.65	47.87	469.60	68.11
Junc 17	97.36	0.33	146.38	49.02	480.89	69.75
Junc 18	97.25	0.00	146.70	49.45	485.10	70.36
Junc 19	97.02	0.44	148.86	51.84	508.55	73.76

Minimum Pressure
Applied Fireflow (sum) - 167 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-95.30	2.92	52.41	0.025
Pipe 3	64.00	204	110	-167.58	5.13	149.08	0.023
Pipe 4	87.00	204	110	-167.97	5.14	149.72	0.023
Pipe 5	17.50	204	110	-62.45	1.91	23.96	0.026
Pipe 6	67.00	204	110	-62.67	1.92	24.12	0.026
Pipe 7	78.50	204	110	-105.52	3.23	63.29	0.024
Pipe 8	12.00	204	110	-70.58	2.16	30.06	0.026
Pipe 9	85.50	204	110	-34.93	1.07	8.17	0.029
Pipe 10	53.00	204	110	-35.39	1.08	8.37	0.029
Pipe 11	39.00	204	110	-11.53	0.35	1.05	0.034
Pipe 12	77.00	204	110	-11.81	0.36	1.10	0.034
Pipe 13	81.00	204	110	-12.05	0.37	1.14	0.034
Pipe 14	113.50	204	110	-12.31	0.38	1.18	0.033
Pipe 15	40.00	204	110	-12.55	0.38	1.23	0.033
Pipe 16	53.00	204	110	24.34	0.74	4.18	0.030
Pipe 17	44.50	204	110	23.86	0.73	4.03	0.030
Pipe 18	56.00	204	110	-36.89	1.13	9.04	0.028
Pipe 19	34.50	204	110	-37.22	1.14	9.19	0.028
Pipe 20	66.00	204	110	-71.00	2.17	30.39	0.026
Pipe 21	32.50	204	110	-108.23	3.31	66.34	0.024
Pipe 22	66.50	204	110	-108.67	3.32	66.84	0.024

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-62.67	141.40	0.00	0.00	0.00
Resvr R2	153.30	-108.67	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	114.97	17.07	167.46	24.29
Junc 2	97.72	72.22	114.97	17.25	169.22	24.54
Junc 3	97.76	95.28	116.80	19.04	186.78	27.09
Junc 4	97.65	0.39	126.34	28.69	281.45	40.82
Junc 5	97.55	0.00	139.36	41.81	410.16	59.49
Junc 6	97.42	0.22	139.78	42.36	415.55	60.27
Junc 7	97.47	0.00	144.33	46.86	459.70	66.67
Junc 8	97.39	0.42	144.69	47.30	464.01	67.30
Junc 9	97.53	0.46	145.03	47.50	465.98	67.58
Junc 10	97.70	0.00	145.48	47.78	468.72	67.98
Junc 11	97.52	0.28	145.52	48.00	470.88	68.30
Junc 12	97.98	0.24	145.60	47.62	467.15	67.75
Junc 13	97.95	0.26	145.69	47.74	468.33	67.93
Junc 14	97.75	0.24	145.83	48.08	471.66	68.41
Junc 15	97.55	0.00	145.88	48.33	474.12	68.76
Junc 16	97.78	0.48	145.65	47.87	469.60	68.11
Junc 17	97.36	0.33	146.38	49.02	480.89	69.75
Junc 18	97.25	0.00	146.70	49.45	485.10	70.36
Junc 19	97.02	0.44	148.86	51.84	508.55	73.76

(orange)	Minimum Pressure
(green)	Applied Fireflow (sum) - 167 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-72.30	2.21	31.43	0.026
Pipe 3	64.00	204	110	-167.58	5.13	149.08	0.023
Pipe 4	87.00	204	110	-167.97	5.14	149.72	0.023
Pipe 5	17.50	204	110	-62.45	1.91	23.96	0.026
Pipe 6	67.00	204	110	-62.67	1.92	24.12	0.026
Pipe 7	78.50	204	110	-105.52	3.23	63.29	0.024
Pipe 8	12.00	204	110	-70.58	2.16	30.06	0.026
Pipe 9	85.50	204	110	-34.93	1.07	8.17	0.029
Pipe 10	53.00	204	110	-35.39	1.08	8.37	0.029
Pipe 11	39.00	204	110	-11.53	0.35	1.05	0.034
Pipe 12	77.00	204	110	-11.81	0.36	1.10	0.034
Pipe 13	81.00	204	110	-12.05	0.37	1.14	0.034
Pipe 14	113.50	204	110	-12.31	0.38	1.18	0.033
Pipe 15	40.00	204	110	-12.55	0.38	1.23	0.033
Pipe 16	53.00	204	110	24.34	0.74	4.18	0.030
Pipe 17	44.50	204	110	23.86	0.73	4.03	0.030
Pipe 18	56.00	204	110	-36.89	1.13	9.04	0.028
Pipe 19	34.50	204	110	-37.22	1.14	9.19	0.028
Pipe 20	66.00	204	110	-71.00	2.17	30.39	0.026
Pipe 21	32.50	204	110	-108.23	3.31	66.34	0.024
Pipe 22	66.50	204	110	-108.67	3.32	66.84	0.024

MAXIMUM DAY + FIREFLOW DEMAND AT 4

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-62.67	141.40	0.00	0.00	0.00
Resvr R2	153.30	-108.67	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	124.31	26.41	259.08	37.58
Junc 2	97.72	0.22	124.31	26.59	260.85	37.83
Junc 3	97.76	72.28	124.31	26.55	260.46	37.78
Junc 4	97.65	95.39	126.34	28.69	281.45	40.82
Junc 5	97.55	0.00	139.36	41.81	410.16	59.49
Junc 6	97.42	0.22	139.78	42.36	415.55	60.27
Junc 7	97.47	0.00	144.33	46.86	459.70	66.67
Junc 8	97.39	0.42	144.69	47.30	464.01	67.30
Junc 9	97.53	0.46	145.03	47.50	465.98	67.58
Junc 10	97.70	0.00	145.48	47.78	468.72	67.98
Junc 11	97.52	0.28	145.52	48.00	470.88	68.30
Junc 12	97.98	0.24	145.60	47.62	467.15	67.75
Junc 13	97.95	0.26	145.69	47.74	468.33	67.93
Junc 14	97.75	0.24	145.83	48.08	471.66	68.41
Junc 15	97.55	0.00	145.88	48.33	474.12	68.76
Junc 16	97.78	0.48	145.65	47.87	469.60	68.11
Junc 17	97.36	0.33	146.38	49.02	480.89	69.75
Junc 18	97.25	0.00	146.70	49.45	485.10	70.36
Junc 19	97.02	0.44	148.86	51.84	508.55	73.76

	Minimum Pressure
	Applied Fireflow (sum) - 167 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.053
Pipe 3	64.00	204	110	-72.58	2.22	31.65	0.026
Pipe 4	87.00	204	110	-167.97	5.14	149.72	0.023
Pipe 5	17.50	204	110	-62.45	1.91	23.96	0.026
Pipe 6	67.00	204	110	-62.67	1.92	24.12	0.026
Pipe 7	78.50	204	110	-105.52	3.23	63.29	0.024
Pipe 8	12.00	204	110	-70.58	2.16	30.06	0.026
Pipe 9	85.50	204	110	-34.93	1.07	8.17	0.029
Pipe 10	53.00	204	110	-35.39	1.08	8.37	0.029
Pipe 11	39.00	204	110	-11.53	0.35	1.05	0.034
Pipe 12	77.00	204	110	-11.81	0.36	1.10	0.034
Pipe 13	81.00	204	110	-12.05	0.37	1.14	0.034
Pipe 14	113.50	204	110	-12.31	0.38	1.18	0.033
Pipe 15	40.00	204	110	-12.55	0.38	1.23	0.033
Pipe 16	53.00	204	110	24.34	0.74	4.18	0.030
Pipe 17	44.50	204	110	23.86	0.73	4.03	0.030
Pipe 18	56.00	204	110	-36.89	1.13	9.04	0.028
Pipe 19	34.50	204	110	-37.22	1.14	9.19	0.028
Pipe 20	66.00	204	110	-71.00	2.17	30.39	0.026
Pipe 21	32.50	204	110	-108.23	3.31	66.34	0.024
Pipe 22	66.50	204	110	-108.67	3.32	66.84	0.024

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-61.85	141.40	0.00	0.00	0.00
Resvr R2	153.30	-109.49	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	137.75	39.85	390.93	56.70
Junc 2	97.72	0.22	137.76	40.04	392.79	56.97
Junc 3	97.76	0.28	137.76	40.00	392.40	56.91
Junc 4	97.65	63.69	137.76	40.11	393.48	57.07
Junc 5	97.55	0.00	139.95	42.40	415.94	60.33
Junc 6	97.42	95.22	139.82	42.40	415.94	60.33
Junc 7	97.47	0.00	144.26	46.79	459.01	66.57
Junc 8	97.39	9.12	144.55	47.16	462.64	67.10
Junc 9	97.53	0.46	144.95	47.42	465.19	67.47
Junc 10	97.70	0.00	145.39	47.69	467.84	67.85
Junc 11	97.52	0.28	145.43	47.91	470.00	68.17
Junc 12	97.98	0.24	145.52	47.54	466.37	67.64
Junc 13	97.95	0.26	145.61	47.66	467.54	67.81
Junc 14	97.75	0.24	145.74	47.99	470.78	68.28
Junc 15	97.55	0.00	145.79	48.24	473.23	68.64
Junc 16	97.78	0.48	145.57	47.79	468.82	68.00
Junc 17	97.36	0.33	146.29	48.93	480.00	69.62
Junc 18	97.25	0.00	146.61	49.36	484.22	70.23
Junc 19	97.02	0.44	148.79	51.77	507.86	73.66

(orange)	Minimum Pressure
(green)	Applied Fireflow (sum) - 167 L/s

MAXIMUM DAY + FIREFLOW DEMAND AT 6

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.053
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.054
Pipe 4	87.00	204	110	-64.27	1.97	25.27	0.026
Pipe 5	17.50	204	110	33.37	1.02	7.51	0.029
Pipe 6	67.00	204	110	-61.85	1.89	23.53	0.026
Pipe 7	78.50	204	110	-97.64	2.99	54.82	0.025
Pipe 8	12.00	204	110	-62.86	1.92	24.25	0.026
Pipe 9	85.50	204	110	-34.78	1.06	8.10	0.029
Pipe 10	53.00	204	110	-35.24	1.08	8.30	0.029
Pipe 11	39.00	204	110	-11.48	0.35	1.04	0.034
Pipe 12	77.00	204	110	-11.76	0.36	1.09	0.034
Pipe 13	81.00	204	110	-12.00	0.37	1.13	0.034
Pipe 14	113.50	204	110	-12.26	0.38	1.18	0.033
Pipe 15	40.00	204	110	-12.50	0.38	1.22	0.033
Pipe 16	53.00	204	110	24.24	0.74	4.15	0.030
Pipe 17	44.50	204	110	23.76	0.73	4.00	0.030
Pipe 18	56.00	204	110	-36.74	1.12	8.97	0.028
Pipe 19	34.50	204	110	-37.07	1.13	9.12	0.028
Pipe 20	66.00	204	110	-71.98	2.20	31.17	0.026
Pipe 21	32.50	204	110	-109.05	3.34	67.27	0.024
Pipe 22	66.50	204	110	-109.49	3.35	67.78	0.024

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-34.95	141.40	0.00	0.00	0.00
Resvr R2	153.30	-136.39	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	140.76	42.86	420.46	60.98
Junc 2	97.72	0.22	140.77	43.05	422.32	61.25
Junc 3	97.76	0.28	140.77	43.01	421.93	61.20
Junc 4	97.65	0.39	140.77	43.12	423.01	61.35
Junc 5	97.55	0.00	140.77	43.22	423.99	61.49
Junc 6	97.42	8.92	140.85	43.43	426.05	61.79
Junc 7	97.47	0.00	140.42	42.95	421.34	61.11
Junc 8	97.39	95.42	140.41	43.02	422.03	61.21
Junc 9	97.53	63.76	140.27	42.74	419.28	60.81
Junc 10	97.70	0.00	141.07	43.37	425.46	61.71
Junc 11	97.52	0.28	141.15	43.63	428.01	62.08
Junc 12	97.98	0.24	141.30	43.32	424.97	61.64
Junc 13	97.95	0.26	141.47	43.52	426.93	61.92
Junc 14	97.75	0.24	141.70	43.95	431.15	62.53
Junc 15	97.55	0.00	141.79	44.24	433.99	62.95
Junc 16	97.78	0.48	141.40	43.62	427.91	62.06
Junc 17	97.36	0.33	142.68	45.32	444.59	64.48
Junc 18	97.25	0.00	143.24	45.99	451.16	65.44
Junc 19	97.02	0.44	146.53	49.51	485.69	70.44

Minimum Pressure
Applied Fireflow (sum) - 167 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.061
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.052
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-26.03	0.80	4.74	0.030
Pipe 6	67.00	204	110	-34.95	1.07	8.18	0.029
Pipe 7	78.50	204	110	25.06	0.77	4.42	0.030
Pipe 8	12.00	204	110	9.95	0.30	0.80	0.034
Pipe 9	85.50	204	110	15.11	0.46	1.73	0.032
Pipe 10	53.00	204	110	-48.65	1.49	15.09	0.027
Pipe 11	39.00	204	110	-15.96	0.49	1.92	0.032
Pipe 12	77.00	204	110	-16.24	0.50	1.98	0.032
Pipe 13	81.00	204	110	-16.48	0.50	2.03	0.032
Pipe 14	113.50	204	110	-16.74	0.51	2.09	0.032
Pipe 15	40.00	204	110	-16.98	0.52	2.15	0.032
Pipe 16	53.00	204	110	33.17	1.01	7.42	0.029
Pipe 17	44.50	204	110	32.69	1.00	7.23	0.029
Pipe 18	56.00	204	110	-50.15	1.53	15.96	0.027
Pipe 19	34.50	204	110	-50.48	1.54	16.16	0.027
Pipe 20	66.00	204	110	-85.47	2.61	42.84	0.025
Pipe 21	32.50	204	110	-135.95	4.16	101.20	0.023
Pipe 22	66.50	204	110	-136.39	4.17	101.81	0.023

MAXIMUM DAY + FIREFLOW DEMAND AT 9

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-28.35	141.40	0.00	0.00	0.00
Resvr R2	153.30	-142.99	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	140.93	43.03	422.12	61.22
Junc 2	97.72	0.22	140.93	43.21	423.89	61.48
Junc 3	97.76	0.28	140.93	43.17	423.50	61.42
Junc 4	97.65	0.39	140.93	43.28	424.58	61.58
Junc 5	97.55	0.00	140.93	43.38	425.56	61.72
Junc 6	97.42	0.22	141.03	43.61	427.81	62.05
Junc 7	97.47	0.00	140.53	43.06	422.42	61.27
Junc 8	97.39	9.12	140.74	43.35	425.26	61.68
Junc 9	97.53	95.46	137.26	39.73	389.75	56.53
Junc 10	97.70	0.00	137.35	39.65	388.97	56.41
Junc 11	97.52	63.58	137.04	39.52	387.69	56.23
Junc 12	97.98	0.24	137.49	39.51	387.59	56.22
Junc 13	97.95	0.26	137.97	40.02	392.60	56.94
Junc 14	97.75	0.24	138.65	40.90	401.23	58.19
Junc 15	97.55	0.00	138.89	41.34	405.55	58.82
Junc 16	97.78	0.48	138.05	40.27	395.05	57.30
Junc 17	97.36	0.33	141.01	43.65	428.21	62.11
Junc 18	97.25	0.00	142.32	45.07	442.14	64.13
Junc 19	97.02	0.44	145.91	48.89	479.61	69.56

	Minimum Pressure
	Applied Fireflow (sum) - 167 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.053
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.054
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-28.13	0.86	5.47	0.030
Pipe 6	67.00	204	110	-28.35	0.87	5.55	0.030
Pipe 7	78.50	204	110	27.16	0.83	5.13	0.030
Pipe 8	12.00	204	110	-53.22	1.63	17.82	0.027
Pipe 9	85.50	204	110	80.39	2.46	38.24	0.025
Pipe 10	53.00	204	110	-15.07	0.46	1.72	0.032
Pipe 11	39.00	204	110	34.51	1.06	7.99	0.029
Pipe 12	77.00	204	110	-29.07	0.89	5.81	0.029
Pipe 13	81.00	204	110	-29.31	0.90	5.90	0.029
Pipe 14	113.50	204	110	-29.57	0.90	6.00	0.029
Pipe 15	40.00	204	110	-29.81	0.91	6.09	0.029
Pipe 16	53.00	204	110	50.06	1.53	15.91	0.027
Pipe 17	44.50	204	110	49.58	1.52	15.63	0.027
Pipe 18	56.00	204	110	-79.87	2.44	37.79	0.025
Pipe 19	34.50	204	110	-80.20	2.45	38.08	0.025
Pipe 20	66.00	204	110	-62.34	1.91	23.89	0.026
Pipe 21	32.50	204	110	-142.55	4.36	110.48	0.023
Pipe 22	66.50	204	110	-142.99	4.37	111.12	0.023

MAXIMUM DAY + FIREFLOW DEMAND AT 11

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-25.58	141.40	0.00	0.00	0.00
Resvr R2	153.30	-145.76	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	141.01	43.11	422.91	61.34
Junc 2	97.72	0.22	141.01	43.29	424.67	61.59
Junc 3	97.76	0.28	141.01	43.25	424.28	61.54
Junc 4	97.65	0.39	141.01	43.36	425.36	61.69
Junc 5	97.55	0.00	141.01	43.46	426.34	61.84
Junc 6	97.42	0.22	141.09	43.67	428.40	62.13
Junc 7	97.47	0.00	140.68	43.21	423.89	61.48
Junc 8	97.39	0.42	140.87	43.48	426.54	61.86
Junc 9	97.53	0.46	137.88	40.35	395.83	57.41
Junc 10	97.70	0.00	136.16	38.46	377.29	54.72
Junc 11	97.52	95.28	133.55	36.03	353.45	51.26
Junc 12	97.98	63.54	133.44	35.46	347.86	50.45
Junc 13	97.95	0.26	134.73	36.78	360.81	52.33
Junc 14	97.75	0.24	136.55	38.80	380.63	55.21
Junc 15	97.55	0.00	137.20	39.65	388.97	56.41
Junc 16	97.78	9.18	136.53	38.75	380.14	55.13
Junc 17	97.36	0.33	140.11	42.75	419.38	60.83
Junc 18	97.25	0.00	141.92	44.67	438.21	63.56
Junc 19	97.02	0.44	145.64	48.62	476.96	69.18

(orange)	Minimum Pressure
(green)	Applied Fireflow (sum) - 167 L/s

MAXIMUM DAY + FIREFLOW DEMAND AT 11

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.061
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.052
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-25.36	0.78	4.51	0.030
Pipe 6	67.00	204	110	-25.58	0.78	4.59	0.030
Pipe 7	78.50	204	110	24.39	0.75	4.20	0.030
Pipe 8	12.00	204	110	-49.64	1.52	15.66	0.027
Pipe 9	85.50	204	110	74.02	2.26	32.83	0.026
Pipe 10	53.00	204	110	73.56	2.25	32.45	0.026
Pipe 11	39.00	204	110	108.75	3.33	66.93	0.024
Pipe 12	77.00	204	110	13.47	0.41	1.40	0.033
Pipe 13	81.00	204	110	-50.07	1.53	15.91	0.027
Pipe 14	113.50	204	110	-50.33	1.54	16.07	0.027
Pipe 15	40.00	204	110	-50.57	1.55	16.21	0.027
Pipe 16	53.00	204	110	44.37	1.36	12.72	0.028
Pipe 17	44.50	204	110	35.19	1.08	8.28	0.029
Pipe 18	56.00	204	110	-94.94	2.90	52.04	0.025
Pipe 19	34.50	204	110	-95.27	2.91	52.38	0.025
Pipe 20	66.00	204	110	-50.06	1.53	15.91	0.027
Pipe 21	32.50	204	110	-145.32	4.45	114.50	0.023
Pipe 22	66.50	204	110	-145.76	4.46	115.14	0.023

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-25.03	141.40	0.00	0.00	0.00
Resvr R2	153.30	-146.31	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	141.02	43.12	423.01	61.35
Junc 2	97.72	0.22	141.03	43.31	424.87	61.62
Junc 3	97.76	0.28	141.03	43.27	424.48	61.57
Junc 4	97.65	0.39	141.03	43.38	425.56	61.72
Junc 5	97.55	0.00	141.03	43.48	426.54	61.86
Junc 6	97.42	0.22	141.10	43.68	428.50	62.15
Junc 7	97.47	0.00	140.71	43.24	424.18	61.52
Junc 8	97.39	0.42	140.88	43.49	426.64	61.88
Junc 9	97.53	0.46	138.11	40.58	398.09	57.74
Junc 10	97.70	0.00	136.52	38.82	380.82	55.23
Junc 11	97.52	8.98	134.60	37.08	363.75	52.76
Junc 12	97.98	95.24	131.48	33.50	328.64	47.66
Junc 13	97.95	63.56	131.57	33.62	329.81	47.84
Junc 14	97.75	0.24	135.46	37.71	369.94	53.65
Junc 15	97.55	0.00	136.84	39.29	385.43	55.90
Junc 16	97.78	0.48	136.66	38.88	381.41	55.32
Junc 17	97.36	0.33	139.93	42.57	417.61	60.57
Junc 18	97.25	0.00	141.84	44.59	437.43	63.44
Junc 19	97.02	0.44	145.59	48.57	476.47	69.11

	Minimum Pressure
	Applied Fireflow (sum) - 167 L/s

MAXIMUM DAY + FIREFLOW DEMAND AT 12

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.061
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.052
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-24.81	0.76	4.34	0.030
Pipe 6	67.00	204	110	-25.03	0.77	4.41	0.030
Pipe 7	78.50	204	110	23.84	0.73	4.03	0.030
Pipe 8	12.00	204	110	-47.22	1.44	14.28	0.027
Pipe 9	85.50	204	110	71.06	2.17	30.44	0.026
Pipe 10	53.00	204	110	70.60	2.16	30.07	0.026
Pipe 11	39.00	204	110	91.98	2.81	49.09	0.025
Pipe 12	77.00	204	110	83.00	2.54	40.58	0.025
Pipe 13	81.00	204	110	-12.24	0.37	1.17	0.033
Pipe 14	113.50	204	110	-75.80	2.32	34.30	0.026
Pipe 15	40.00	204	110	-76.04	2.33	34.50	0.026
Pipe 16	53.00	204	110	21.86	0.67	3.43	0.031
Pipe 17	44.50	204	110	21.38	0.65	3.29	0.031
Pipe 18	56.00	204	110	-97.90	3.00	55.09	0.025
Pipe 19	34.50	204	110	-98.23	3.01	55.43	0.025
Pipe 20	66.00	204	110	-47.64	1.46	14.52	0.027
Pipe 21	32.50	204	110	-145.87	4.46	115.30	0.023
Pipe 22	66.50	204	110	-146.31	4.48	115.95	0.023

MAXIMUM DAY + FIREFLOW DEMAND AT 13

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-24.91	141.40	0.00	0.00	0.00
Resvr R2	153.30	-146.43	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	141.03	43.13	423.11	61.37
Junc 2	97.72	0.22	141.03	43.31	424.87	61.62
Junc 3	97.76	0.28	141.03	43.27	424.48	61.57
Junc 4	97.65	0.39	141.03	43.38	425.56	61.72
Junc 5	97.55	0.00	141.03	43.48	426.54	61.86
Junc 6	97.42	0.22	141.11	43.69	428.60	62.16
Junc 7	97.47	0.00	140.72	43.25	424.28	61.54
Junc 8	97.39	0.42	140.89	43.50	426.74	61.89
Junc 9	97.53	0.46	138.16	40.63	398.58	57.81
Junc 10	97.70	0.00	136.59	38.89	381.51	55.33
Junc 11	97.52	0.28	134.94	37.42	367.09	53.24
Junc 12	97.98	63.54	131.69	33.71	330.70	47.96
Junc 13	97.95	95.26	131.42	33.47	328.34	47.62
Junc 14	97.75	8.94	135.15	37.40	366.89	53.21
Junc 15	97.55	0.00	136.77	39.22	384.75	55.80
Junc 16	97.78	0.48	136.67	38.89	381.51	55.33
Junc 17	97.36	0.33	139.89	42.53	417.22	60.51
Junc 18	97.25	0.00	141.83	44.58	437.33	63.43
Junc 19	97.02	0.44	145.58	48.56	476.37	69.09

(orange)	Minimum Pressure
(green)	Applied Fireflow (sum) - 167 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.053
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.054
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-24.69	0.76	4.30	0.030
Pipe 6	67.00	204	110	-24.91	0.76	4.37	0.030
Pipe 7	78.50	204	110	23.72	0.73	3.99	0.030
Pipe 8	12.00	204	110	-46.70	1.43	13.99	0.027
Pipe 9	85.50	204	110	70.42	2.15	29.93	0.026
Pipe 10	53.00	204	110	69.96	2.14	29.57	0.026
Pipe 11	39.00	204	110	85.07	2.60	42.48	0.025
Pipe 12	77.00	204	110	84.79	2.59	42.22	0.025
Pipe 13	81.00	204	110	21.25	0.65	3.26	0.031
Pipe 14	113.50	204	110	-74.01	2.26	32.81	0.026
Pipe 15	40.00	204	110	-82.95	2.54	40.53	0.025
Pipe 16	53.00	204	110	15.59	0.48	1.83	0.032
Pipe 17	44.50	204	110	15.11	0.46	1.73	0.032
Pipe 18	56.00	204	110	-98.54	3.01	55.76	0.025
Pipe 19	34.50	204	110	-98.87	3.02	56.11	0.025
Pipe 20	66.00	204	110	-47.12	1.44	14.22	0.027
Pipe 21	32.50	204	110	-145.99	4.47	115.47	0.023
Pipe 22	66.50	204	110	-146.43	4.48	116.12	0.023

MAXIMUM DAY + FIREFLOW DEMAND AT 14

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-24.66	141.40	0.00	0.00	0.00
Resvr R2	153.30	-146.68	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	141.03	43.13	423.11	61.37
Junc 2	97.72	0.22	141.04	43.32	424.97	61.64
Junc 3	97.76	0.28	141.04	43.28	424.58	61.58
Junc 4	97.65	0.39	141.04	43.39	425.66	61.74
Junc 5	97.55	0.00	141.04	43.49	426.64	61.88
Junc 6	97.42	0.22	141.11	43.69	428.60	62.16
Junc 7	97.47	0.00	140.73	43.26	424.38	61.55
Junc 8	97.39	0.42	140.89	43.50	426.74	61.89
Junc 9	97.53	0.46	138.27	40.74	399.66	57.97
Junc 10	97.70	0.00	136.76	39.06	383.18	55.58
Junc 11	97.52	0.28	136.14	38.62	378.86	54.95
Junc 12	97.98	0.24	134.95	36.97	362.68	52.60
Junc 13	97.95	63.56	133.70	35.75	350.71	50.87
Junc 14	97.75	95.24	133.88	36.13	354.44	51.41
Junc 15	97.55	0.00	136.60	39.05	383.08	55.56
Junc 16	97.78	9.18	136.64	38.86	381.22	55.29
Junc 17	97.36	0.33	139.80	42.44	416.34	60.38
Junc 18	97.25	0.00	141.79	44.54	436.94	63.37
Junc 19	97.02	0.44	145.55	48.53	476.08	69.05

(orange)	Minimum Pressure
(green)	Applied Fireflow (sum) - 167 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.053
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.054
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-24.44	0.75	4.22	0.030
Pipe 6	67.00	204	110	-24.66	0.75	4.29	0.030
Pipe 7	78.50	204	110	23.47	0.72	3.91	0.030
Pipe 8	12.00	204	110	-45.56	1.39	13.36	0.028
Pipe 9	85.50	204	110	69.03	2.11	28.85	0.026
Pipe 10	53.00	204	110	68.57	2.10	28.49	0.026
Pipe 11	39.00	204	110	49.69	1.52	15.69	0.027
Pipe 12	77.00	204	110	49.41	1.51	15.53	0.027
Pipe 13	81.00	204	110	49.17	1.50	15.39	0.027
Pipe 14	113.50	204	110	-14.39	0.44	1.58	0.033
Pipe 15	40.00	204	110	-109.63	3.35	67.94	0.024
Pipe 16	53.00	204	110	-9.71	0.30	0.76	0.035
Pipe 17	44.50	204	110	-18.89	0.58	2.62	0.031
Pipe 18	56.00	204	110	-99.93	3.06	57.22	0.025
Pipe 19	34.50	204	110	-100.26	3.07	57.57	0.025
Pipe 20	66.00	204	110	-45.98	1.41	13.59	0.028
Pipe 21	32.50	204	110	-146.24	4.47	115.84	0.023
Pipe 22	66.50	204	110	-146.68	4.49	116.48	0.023

MAXIMUM DAY + FIREFLOW DEMAND AT 16

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	-25.50	141.40	0.00	0.00	0.00
Resvr R2	153.30	-145.84	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	141.01	43.11	422.91	61.34
Junc 2	97.72	0.22	141.01	43.29	424.67	61.59
Junc 3	97.76	0.28	141.01	43.25	424.28	61.54
Junc 4	97.65	0.39	141.01	43.36	425.36	61.69
Junc 5	97.55	0.00	141.02	43.47	426.44	61.85
Junc 6	97.42	0.22	141.09	43.67	428.40	62.13
Junc 7	97.47	0.00	140.69	43.22	423.99	61.49
Junc 8	97.39	0.42	140.87	43.48	426.54	61.86
Junc 9	97.53	0.46	137.91	40.38	396.13	57.45
Junc 10	97.70	0.00	136.21	38.51	377.78	54.79
Junc 11	97.52	63.58	135.79	38.27	375.43	54.45
Junc 12	97.98	0.24	136.09	38.11	373.86	54.22
Junc 13	97.95	0.26	136.41	38.46	377.29	54.72
Junc 14	97.75	8.94	136.86	39.11	383.67	55.65
Junc 15	97.55	0.00	137.15	39.60	388.48	56.34
Junc 16	97.78	95.48	135.88	38.10	373.76	54.21
Junc 17	97.36	0.33	140.09	42.73	419.18	60.80
Junc 18	97.25	0.00	141.91	44.66	438.11	63.54
Junc 19	97.02	0.44	145.64	48.62	476.96	69.18

(orange)	Minimum Pressure
(green)	Applied Fireflow (sum) - 167.0 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.053
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.054
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-25.28	0.77	4.49	0.030
Pipe 6	67.00	204	110	-25.50	0.78	4.56	0.030
Pipe 7	78.50	204	110	24.31	0.74	4.18	0.030
Pipe 8	12.00	204	110	-49.32	1.51	15.48	0.027
Pipe 9	85.50	204	110	73.64	2.25	32.51	0.026
Pipe 10	53.00	204	110	73.18	2.24	32.13	0.026
Pipe 11	39.00	204	110	40.26	1.23	10.63	0.028
Pipe 12	77.00	204	110	-23.32	0.71	3.87	0.030
Pipe 13	81.00	204	110	-23.56	0.72	3.94	0.030
Pipe 14	113.50	204	110	-23.82	0.73	4.02	0.030
Pipe 15	40.00	204	110	-32.76	1.00	7.25	0.029
Pipe 16	53.00	204	110	62.57	1.91	24.04	0.026
Pipe 17	44.50	204	110	-32.91	1.01	7.32	0.029
Pipe 18	56.00	204	110	-95.32	2.92	52.44	0.025
Pipe 19	34.50	204	110	-95.65	2.93	52.78	0.025
Pipe 20	66.00	204	110	-49.74	1.52	15.72	0.027
Pipe 21	32.50	204	110	-145.40	4.45	114.61	0.023
Pipe 22	66.50	204	110	-145.84	4.46	115.25	0.023

MAXIMUM DAY + FIREFLOW DEMAND AT 17

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	126.60	-30.41	126.60	0.00	0.00	0.00
Resvr R2	148.50	-207.23	148.50	0.00	0.00	0.00
Junc 1	97.90	0.08	126.06	28.16	276.25	40.07
Junc 2	97.72	0.22	126.07	28.35	278.11	40.34
Junc 3	97.76	0.28	126.07	28.31	277.72	40.28
Junc 4	97.65	0.39	126.07	28.42	278.80	40.44
Junc 5	97.55	0.00	126.07	28.52	279.78	40.58
Junc 6	97.42	0.22	126.18	28.76	282.14	40.92
Junc 7	97.47	0.00	125.61	28.14	276.05	40.04
Junc 8	97.39	0.42	125.77	28.38	278.41	40.38
Junc 9	97.53	0.46	122.76	25.23	247.51	35.90
Junc 10	97.70	0.00	121.01	23.31	228.67	33.17
Junc 11	97.52	0.28	120.79	23.27	228.28	33.11
Junc 12	97.98	0.24	120.36	22.38	219.55	31.84
Junc 13	97.95	0.26	119.92	21.97	215.53	31.26
Junc 14	97.75	95.24	119.31	21.56	211.50	30.68
Junc 15	97.55	0.00	120.41	22.86	224.26	32.53
Junc 16	97.78	43.78	120.42	22.64	222.10	32.21
Junc 17	97.36	95.33	121.88	24.52	240.54	34.89
Junc 18	97.25	0.00	126.66	29.41	288.51	41.85
Junc 19	97.02	0.44	133.81	36.79	360.91	52.35

(orange)	Minimum Pressure
(green)	Applied Fireflow (sum) - 233.3 L/s

Pipe Report

Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.053
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.054
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	-30.19	0.92	6.24	0.029
Pipe 6	67.00	204	110	-30.41	0.93	6.32	0.029
Pipe 7	78.50	204	110	29.22	0.89	5.87	0.029
Pipe 8	12.00	204	110	-45.41	1.39	13.28	0.028
Pipe 9	85.50	204	110	74.64	2.28	33.33	0.026
Pipe 10	53.00	204	110	74.18	2.27	32.95	0.026
Pipe 11	39.00	204	110	28.63	0.88	5.65	0.029
Pipe 12	77.00	204	110	28.35	0.87	5.55	0.030
Pipe 13	81.00	204	110	28.11	0.86	5.46	0.030
Pipe 14	113.50	204	110	27.85	0.85	5.37	0.030
Pipe 15	40.00	204	110	-67.39	2.06	27.59	0.026
Pipe 16	53.00	204	110	-1.77	0.05	0.03	0.045
Pipe 17	44.50	204	110	-45.55	1.39	13.36	0.028
Pipe 18	56.00	204	110	-65.62	2.01	26.26	0.026
Pipe 19	34.50	204	110	-160.95	4.92	138.35	0.023
Pipe 20	66.00	204	110	-45.83	1.40	13.51	0.028
Pipe 21	32.50	204	110	-206.79	6.33	220.05	0.022
Pipe 22	66.50	204	110	-207.23	6.34	220.91	0.022

Junction Report

Node ID	Elevation m	Demand LPS	Total Head m	Pressure m	Pressure kPa	Pressure psi
Resvr R1	141.40	1.03	141.40	0.00	0.00	0.00
Resvr R2	153.30	-172.37	153.30	0.00	0.00	0.00
Junc 1	97.90	0.08	141.40	43.50	426.74	61.89
Junc 2	97.72	0.22	141.40	43.68	428.50	62.15
Junc 3	97.76	0.28	141.40	43.64	428.11	62.09
Junc 4	97.65	0.39	141.40	43.75	429.19	62.25
Junc 5	97.55	0.00	141.40	43.85	430.17	62.39
Junc 6	97.42	0.22	141.40	43.98	431.44	62.58
Junc 7	97.47	0.00	141.41	43.94	431.05	62.52
Junc 8	97.39	9.12	141.43	44.04	432.03	62.66
Junc 9	97.53	0.46	141.29	43.76	429.29	62.26
Junc 10	97.70	0.00	141.22	43.52	426.93	61.92
Junc 11	97.52	0.28	141.21	43.69	428.60	62.16
Junc 12	97.98	0.24	141.20	43.22	423.99	61.49
Junc 13	97.95	0.26	141.19	43.24	424.18	61.52
Junc 14	97.75	0.24	141.17	43.42	425.95	61.78
Junc 15	97.55	0.00	141.17	43.62	427.91	62.06
Junc 16	97.78	0.48	141.20	43.42	425.95	61.78
Junc 17	97.36	63.63	141.11	43.75	429.19	62.25
Junc 18	97.25	0.00	141.71	44.46	436.15	63.26
Junc 19	97.02	95.44	142.85	45.83	449.59	65.21

	Minimum Pressure
	Applied Fireflow (sum) - 167 L/s

Pipe Report

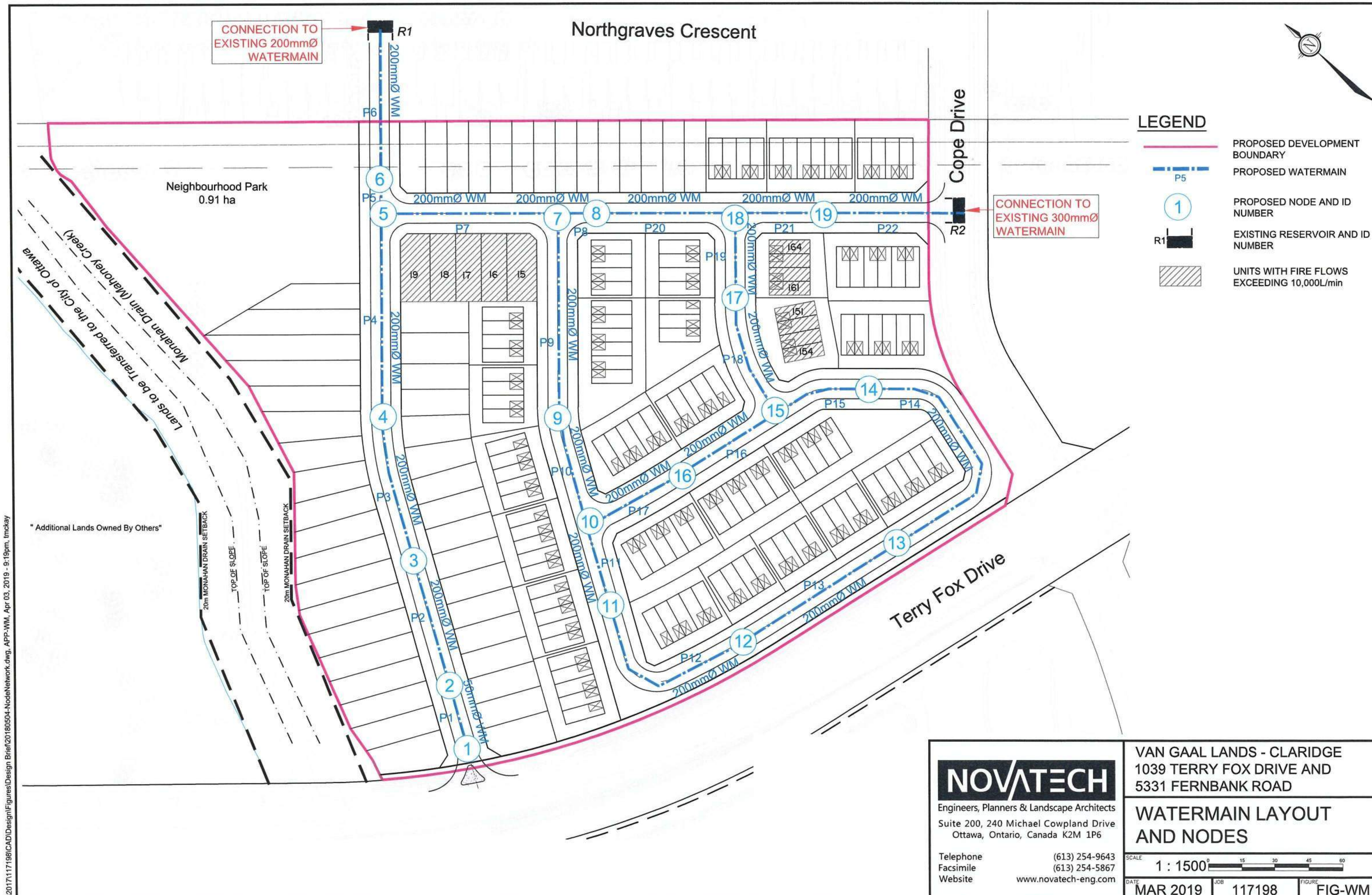
Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Headloss m/km	Friction Factor
Pipe 1	28.00	50	100	-0.08	0.04	0.12	0.070
Pipe 2	58.00	204	110	-0.30	0.01	0.00	0.061
Pipe 3	64.00	204	110	-0.58	0.02	0.00	0.052
Pipe 4	87.00	204	110	-0.97	0.03	0.01	0.049
Pipe 5	17.50	204	110	1.25	0.04	0.02	0.046
Pipe 6	67.00	204	110	1.03	0.03	0.01	0.048
Pipe 7	78.50	204	110	-2.22	0.07	0.05	0.043
Pipe 8	12.00	204	110	-15.49	0.47	1.81	0.032
Pipe 9	85.50	204	110	13.26	0.41	1.36	0.033
Pipe 10	53.00	204	110	12.80	0.39	1.27	0.033
Pipe 11	39.00	204	110	4.55	0.14	0.19	0.039
Pipe 12	77.00	204	110	4.27	0.13	0.17	0.039
Pipe 13	81.00	204	110	4.03	0.12	0.15	0.039
Pipe 14	113.50	204	110	3.77	0.12	0.13	0.040
Pipe 15	40.00	204	110	3.53	0.11	0.12	0.040
Pipe 16	53.00	204	110	-7.77	0.24	0.51	0.036
Pipe 17	44.50	204	110	-8.25	0.25	0.56	0.035
Pipe 18	56.00	204	110	11.30	0.35	1.01	0.034
Pipe 19	34.50	204	110	-52.33	1.60	17.27	0.027
Pipe 20	66.00	204	110	-24.61	0.75	4.27	0.030
Pipe 21	32.50	204	110	-76.93	2.35	35.26	0.025
Pipe 22	66.50	204	110	-172.37	5.27	157.08	0.023

MAXIMUM DAY + FIREFLOW DEMAND SUMMARY

Maximum day plus fire flow demand was modeled for each hydrant node.
The following is a summary of the minimum pressures that occurred for each operating condition.

Fire at Junction	Demand (L/s) Maximum Daily	Fire Flow	Max Day + Fire^3	Minimum Pressure (m)	kPa	psi	Node
2	0.22	167.00	167.22	15.85	155.49	22.55	1
3	0.28	167.00	167.28	17.07	167.46	24.29	1
4	0.39	167.00	167.39	26.41	259.08	37.58	1
6	0.22	167.00	167.22	39.85	390.93	56.70	1
8	0.42	167.00	167.42	42.74	419.28	60.81	9
9	0.46	167.00	167.46	39.51	387.59	56.22	12
11	0.28	167.00	167.28	35.46	347.86	50.45	12
12	0.24	167.00	167.24	33.50	328.64	47.66	12
13	0.26	167.00	167.26	33.47	328.34	47.62	13
14	0.24	167.00	167.24	35.75	350.71	50.87	13
16	0.48	167.00	167.48	38.10	373.76	54.21	16
17	0.33	233.30	233.63	21.56	211.50	30.68	14
19	0.44	167.00	167.44	43.22	423.99	61.49	12

Note:
1) Fireflows of 167L/s have been applied based on City of Ottawa Technical Bulletin ISDTB-2014-02.
2) Fireflows have been calculated as per FUS for Units not meeting the criteria of Technical Bulletin ISDTB-20
Residential Fire Flow (Units 151-154), Node 17: 233 L/s
3) Fireflow values have been distributed over several hydrants as per Technical Bulletin ISTB-2018-02.



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VAN GAAL LANDS - CLARIDGE
1039 TERRY FOX DRIVE AND
5331 FERNBANK ROAD

WATERMAIN LAYOUT AND NODES

SCALE 1 : 1500 (0 15 30 45 60)

DATE	JOB	FIGURE
MAR 2019	117198	FIG-WM

SHT11X17.DWG - 279mmX432mm

Appendix D

STM Design Sheets, SWM Excerpts &
PCSWMM Modelling Info

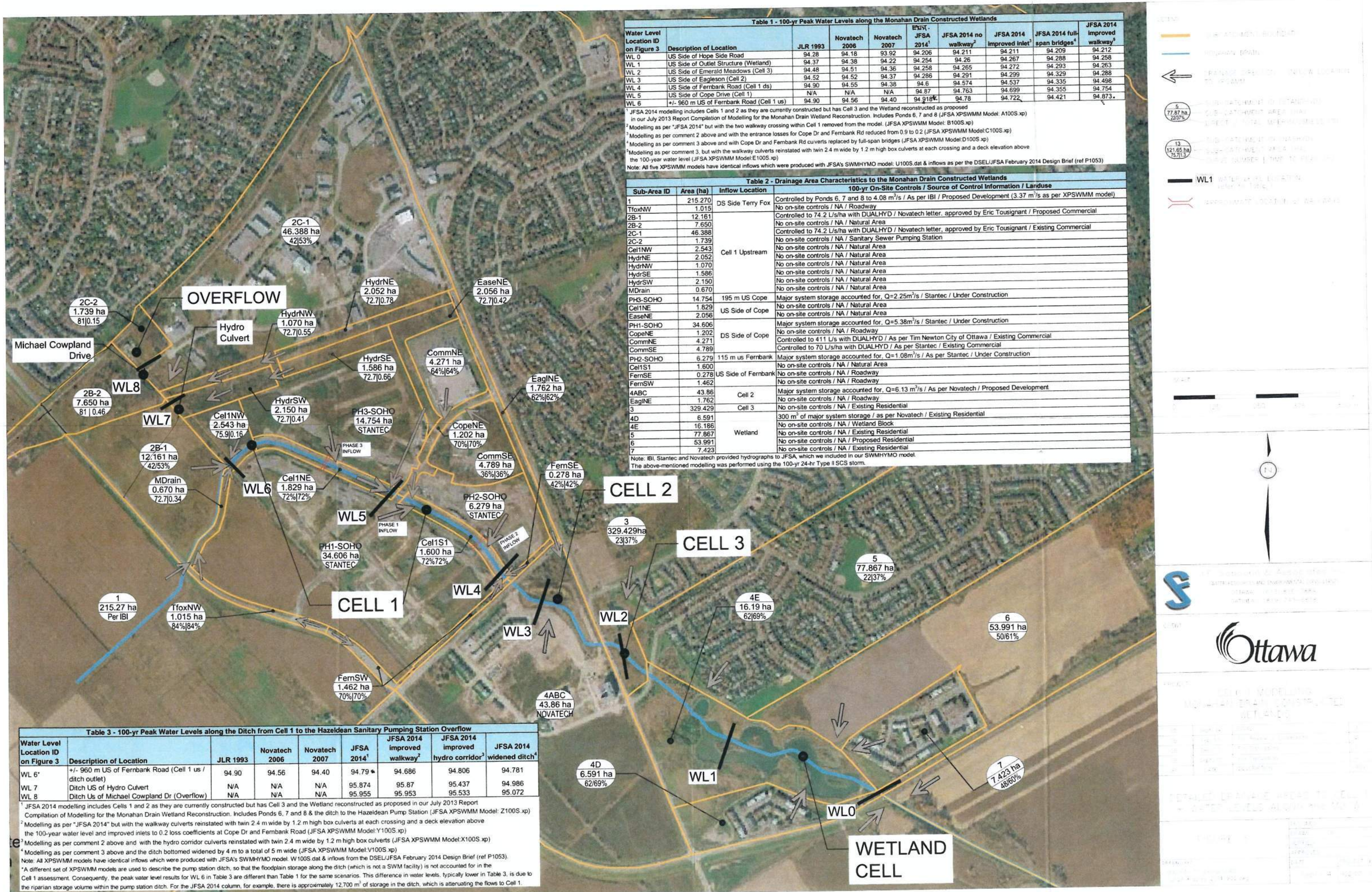

Table 1 - 100-yr Peak Water Levels along the Monahan Drain Constructed Wetlands

Water Level Location ID on Figure 3	Description of Location	JLR 1993	Novatech 2006	Novatech 2007	JFSA 2014[1]	JFSA 2014 no walkway[2]	JFSA 2014 improved inlet[3]	JFSA 2014 full-span bridges[4]	JFSA 2014 improved walkway[5]
WL 0	US Side of Hope Side Road	94.28	94.18	93.92	94.206	94.211	94.211	94.209	94.212
WL 1	US Side of Outlet Structure (Wetland)	94.37	94.38	94.22	94.254	94.26	94.267	94.288	94.258
WL 2	US Side of Emerald Meadows (Cell 3)	94.48	94.51	94.36	94.258	94.265	94.272	94.293	94.263
WL 3	US Side of Eagleson (Cell 2)	94.52	94.52	94.37	94.286	94.291	94.299	94.329	94.288
WL 4	US Side of Fernbank Road (Cell 1 ds)	94.90	94.55	94.38	94.6	94.574	94.537	94.335	94.498
WL 5	US Side of Cope Drive (Cell 1)	N/A	N/A	N/A	94.87	94.763	94.699	94.355	94.754
WL 6	+/- 960 m US of Fernbank Road (Cell 1 us)	94.90	94.56	94.40	94.918*	94.78	94.722	94.421	94.873*

[1] JFSA 2014 modelling includes Cells 1 and 2 as they are currently constructed but has Cell 3 and the Wetland reconstructed as proposed in our July 2013 Report Compilation of Modelling for the Monahan Drain Wetland Reconstruction. Includes Ponds 6, 7 and 8 (JFSA XPSWMM Model: A100S.xp)

[2] Modelling as per "JFSA 2014" but with the two walkway crossing within Cell 1 removed from the model. (JFSA XPSWMM Model: B100S.xp)

[3] Modelling as per comment 2 above and with the entrance losses for Cope Dr and Fernbank Rd reduced from 0.9 to 0.2 (JFSA XPSWMM Model:C100S.xp)

[4] Modelling as per comment 3 above and with Cope Dr and Fernbank Rd culverts replaced by full-span bridges (JFSA XPSWMM Model:D100S.xp)

[5] Modelling as per comment 3, but with the walkway culverts reinstated with twin 2.4 m wide by 1.2 m high box culverts at each crossing and a deck elevation above the 100-year water level (JFSA XPSWMM Model:E100S.xp)

Note: All five XPSWMM models have identical inflows which were produced with JFSA's SWMHYMO model: U100S.dat & inflows as per the DSEL/JFSA February 2014 Design Brief (ref P1053)

Table 2 - Drainage Area Characteristics to the Monahan Drain Constructed Wetlands

Sub-Area ID	Area (ha)	Inflow Location	100-yr On-Site Controls / Source of Control Information / Landuse
1	215.270	DS Side Terry Fox	Controlled by Ponds 6, 7 and 8 to 4.08 m^3/s / As per IBI / Proposed Development (3.37 m^3/s as per XPSWMM model)
TfoxNW	1.015		No on-site controls / NA / Roadway
2B-1	12.161	Cell 1 Upstream	Controlled to 74.2 L/s/ha with DUALHYD / Novatech letter, approved by Eric Tousignant / Proposed Commercial
2B-2	7.650		No on-site controls / NA / Natural Area
2C-1	46.388		Controlled to 74.2 L/s/ha with DUALHYD / Novatech letter, approved by Eric Tousignant / Existing Commercial
2C-2	1.739		No on-site controls / NA / Sanitary Sewer Pumping Station
Cel1NW	2.543		No on-site controls / NA / Natural Area
HydrNE	2.052		No on-site controls / NA / Natural Area
HydrNW	1.070		No on-site controls / NA / Natural Area
HydrSE	1.586		No on-site controls / NA / Natural Area
HydrSW	2.150		No on-site controls / NA / Natural Area
MDrain	0.670		No on-site controls / NA / Natural Area
PH3-SOHO	14.754	195 m US Cope	Major system storage accounted for, Q=2.25 m^3/s / Stantec / Under Construction
Cel1NE	1.829	US Side of Cope	No on-site controls / NA / Natural Area
EaseNE	2.056		No on-site controls / NA / Natural Area
PH1-SOHO	34.606	DS Side of Cope	Major system storage accounted for, Q=5.38 m^3/s / Stantec / Under Construction
CopeNE	1.202		No on-site controls / NA / Roadway
CommNE	4.271		Controlled to 411 L/s with DUALHYD / As per Tim Newton City of Ottawa / Existing Commercial
CommSE	4.789		Controlled to 70 L/s/ha with DUALHYD / As per Stantec / Existing Commercial
PH2-SOHO	6.279	115 m us Fernbank	Major system storage accounted for, Q=1.08 m^3/s / As per Stantec / Under Construction
Cel1S1	1.600	US Side of Fernbank	No on-site controls / NA / Natural Area
FernSE	0.278		No on-site controls / NA / Roadway
FernSW	1.462		No on-site controls / NA / Roadway
4ABC	43.86	Cell 2	Major system storage accounted for, Q=6.13 m^3/s / As per Novatech / Proposed Development
EaglNE	1.762		No on-site controls / NA / Roadway
3	329.429	Cell 3	No on-site controls / NA / Existing Residential
4D	6.591	Wetland	300 m^3 of major system storage / as per Novatech / Existing Residential
4E	16.186		No on-site controls / NA / Wetland Block
5	77.867		No on-site controls / NA / Existing Residential
6	53.991		No on-site controls / NA / Proposed Residential
7	7.423		No on-site controls / NA / Existing Residential

Note: IBI, Stantec and Novatech provided hydrographs to JFSA, which we included in our SWMHYMO model.
The above-mentioned modelling was performed using the 100-yr 24-hr Type II SCS storm.

Table 3 - 100-yr Peak Water Levels along the Ditch from Cell 1 to the Hazeldean Sanitary Pumping Station Overflow

Water Level Location ID on Figure 3	Description of Location	JLR 1993	Novatech 2006	Novatech 2007	JFSA 2014[1]	JFSA 2014 improved walkway[2]	JFSA 2014 improved hydro corridor[3]	JFSA 2014 widened ditch[4]
WL 6*	+/- 960 m US of Fernbank Road (Cell 1 us / ditch outlet)	94.90	94.56	94.40	94.79*	94.686	94.806	94.781
WL 7	Ditch US of Hydro Culvert	N/A	N/A	N/A	95.874	95.87	95.437	94.986
WL 8	Ditch Us of Michael Cowpland Dr (Overflow)	N/A	N/A	N/A	95.955	95.953	95.533	95.072

[1] JFSA 2014 modelling includes Cells 1 and 2 as they are currently constructed but has Cell 3 and the Wetland reconstructed as proposed in our July 2013 Report Compilation of Modelling for the Monahan Drain Wetland Reconstruction. Includes Ponds 6, 7 and 8 & the ditch to the Hazeldean Pump Station (JFSA XPSWMM Model: Z100S.xp)

[2] Modelling as per "JFSA 2014" but with the walkway culverts reinstated with twin 2.4 m wide by 1.2 m high box culverts at each crossing and a deck elevation above the 100-year water level and improved inlets to 0.2 loss coefficients at Cope Dr and Fernbank Road (JFSA XPSWMM Model:Y100S.xp)

[3] Modelling as per comment 2 above and with the hydro corridor culverts reinstated with twin 2.4 m wide by 1.2 m high box culverts (JFSA XPSWMM Model:X100S.xp)

[4] Modelling as per comment 3 above and the ditch bottomed widened by 4 m to a total of 5 m wide (JFSA XPSWMM Model:V100S.xp)

Note: All XPSWMM models have identical inflows which were produced with JFSA's SWMHYMO model. W100S.dat & inflows from the DSEL/JFSA February 2014 Design Brief (ref P1053).

*A different set of XPSWMM models are used to describe the pump station ditch, so that the floodplain storage along the ditch (which is not a SWM facility) is not accounted for in the Cell 1 assessment. Consequently, the peak water level results for WL 6 in Table 3 are different than Table 1 for the same scenarios. This difference in water levels, typically lower in Table 3, is due to the riparian storage volume within the pump station ditch. For the JFSA 2014 column, for example, there is approximately 12,700 m^3 of storage in the ditch, which is attenuating the flows to Cell 1.

Stantec

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www.stantec.com

Legend

2-11A / .125 / 1.95	DRAINAGE AREA NO. / RUNOFF COEFFICIENT / STORM DRAINAGE AREA (ha)
	DRAINAGE AREA BOUNDARY
	PROPOSED STORM SEWER & MANHOLE
	PROPOSED CATCH BASIN (ALL ROAD CB'S TO INCLUDE PERFORATED STUB DRAINS EXTENDING OUT FROM THE CB IN TWO DIRECTIONS PARALLEL TO THE ROADWAY. THESE DRAINS ARE TO BE INSTALLED AT THE BOTTOM OF THE SUBBASE LAYER.)
	PROPOSED SUBDRAIN CATCH BASIN
	PROPOSED 250ø PERFORATED PIPE
(IC)	STREET CATCHBASINS TO BE INTERCONNECTED WITH ONLY ONE CONNECTION TO STORM SEWER PER PAIR WHERE NOTED.
(A)	IPEX TYPE 'A' TO BE INSTALLED IN STREET AND REAR YARD CATCHBASINS WHERE NOTED.
	PROPOSED CATCH BASIN / MANHOLE c/w IPEX INLET-CONTROL DEVICE TYPE 'A' OR APPROVED EQUIVALENT
	PONDING AREA LIMITS
DEPTH=0.20m	MAXIMUM PONDING DEPTH
	DIRECTION OF OVERLAND FLOW
	FUTURE PHASE OF STORM DRAINAGE WORKS

Notes

1. IPEX TYPE 'A' TO RESTRICT FLOWS TO THE STORM SEWER TO 22L/s AT 1.8m HEAD

7	REVISED DRIVEWAY & SIDEWALK LOCATIONS, ISSUED FOR FINAL APPROVAL	KJK	JBL	09.02.25
5	REVISED LOT GRADING AND SERVICING	KJK	JBL	08.11.03
4	ISSUED FOR CONSTRUCTION	KJK	JBL	08.01.21
3	REVISED AS PER CITY COMMENTS AND FINAL APPROVAL	KJK	JBL	07.10.29
2	REVISED AS PER CITY COMMENTS	KJK	JBL	07.08.17
1	ISSUED FOR CITY COMMENTS	KJK	JBL	07.07.12
Revision		By	Appd	YY.MM.DD

File Name: 160400502C-SD	KJK	JBL	KJK	07.03.14
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

CAVANAGH CONSTRUCTION LTD.

SOHO - KANATA SOUTH

Ottawa ON Canada

Title

OVERALL STORM DRAINAGE PLAN

Project No.	Scale
160400502C	1:2000 (0 20 60 100m)

Drawing No.	Sheet	Revision
OSD	49 of 58	7

Van Gaal Lands - Claridge Development - 1039 Terry Fox Drive & 5331 Fernabnk Road
Claridge Homes
Project No.: 117198

STORM SEWER DESIGN SHEET
(Claridge Homes)
FLOW RATES BASED ON RATIONAL METHOD

NOVATECH
Engineers, Planners & Landscape Architects

LOCATION				AREA (ha)			FLOW							TOTAL FLOW	SEWER DATA								
Street	Catchment ID	From Manhole	To Manhole	Area (ha)	C	AC (ha)	Indiv 2.78 AC	Accum 2.78 AC	Time of Concentration	Rainfall Intensity 2 Year (mm/hr)	Rainfall Intensity 5 Year (mm/hr)	Rainfall Intensity 10 Year (mm/hr)	Peak Flow (L/s)	Total Peak Flow, Q (L/s)	Dia. (m) Actual	Dia. (mm)	Type	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Flow Time (min)	Ratio Q/Q full
Street 4	A1	400	402	0.43	0.55	0.24	0.657	0.657	10.00	76.81			50.5	50.5	0.381	375	PVC	0.30	68.3	100.1	0.88	1.30	50%
						0.00	0.000	0.000	10.00														
						0.00	0.000	0.000	10.00														
Street 4	A2	402	404	0.77	0.60	0.46	1.284	1.942	11.30	72.16			140.1	140.1	0.533	525	Conc	0.22	64.2	210.3	0.94	1.14	67%
						0.00	0.000	0.000	11.30														
						0.00	0.000	0.000	11.30														
Street 4		404	406			0.00	0.000	1.942	12.43	68.57			133.2	133.2	0.533	525	Conc	0.24	20.7	219.6	0.98	0.35	61%
						0.00	0.000	0.000	12.43														
						0.00	0.000	0.000	12.43														
Street 4	A3	406	100	0.62	0.60	0.37	1.034	2.976	12.78	67.54			201.0	201.0	0.686	675	Conc	0.15	95.9	339.4	0.92	1.74	59%
						0.00	0.000	0.000	12.78														
						0.00	0.000	0.000	12.78														
									14.52														
Street 4	A4	408	100	0.24	0.55	0.13	0.367	0.367	10.00	76.81			28.2	28.2	0.305	300	PVC	0.56	18.3	75.4	1.03	0.30	37%
						0.00	0.000	0.000	10.00														
						0.00	0.000	0.000	10.00														
									10.30														
Street 1	A5	100	102	0.33	0.55	0.18	0.505	3.848	14.52	62.91			242.1	242.1	0.762	750	Conc	0.12	78.0	402.1	0.88	1.47	60%
						0.00	0.000	0.000	14.52														
						0.00	0.000	0.000	14.52														
									16.00														
Street 2	A6	214	216	0.16	0.65	0.10	0.289	0.289	10.00	76.81			22.2	22.2	0.457	450	Conc	0.30	46.3	162.8	0.99	0.78	14%
						0.00	0.000	0.000	10.00														
						0.00	0.000	0.000	10.00														
Street 2		216	218			0.00	0.000	0.289	10.78	73.94			21.4	21.4	0.457	450	Conc	0.30	17.5	162.8	0.99	0.29	13%
						0.00	0.000	0.000	10.78														
						0.00	0.000	0.000	10.78														
Street 2	A7	218	220	0.53	0.65	0.34	0.958	1.247	11.07	72.92			90.9	90.9	0.457	450	Conc	0.25	67.2	148.6	0.91	1.24	61%
						0.00	0.000	0.000	11.07														
						0.00	0.000	0.000	11.07														
Street 2		220	222			0.00	0.000	1.247	12.31	68.94			86.0	86.0	0.457	450	Conc	0.25	35.9	148.6	0.91	0.66	58%
						0.00	0.000	0.000	12.31														
						0.00	0.000	0.000	12.31														
Street 2	A8	222	224	0.30	0.65	0.20	0.542	1.789	12.97	67.01			119.9	119.9	0.533	525	Conc	0.20	18.8	200.5	0.90	0.35	60%
						0.00	0.000	0.000	12.97														
						0.00	0.000	0.000	12.97														
Street 2	A9	224	102	0.32	0.65	0.21	0.578	2.367	13.32	66.04			156.3	156.3	0.533	525	Conc	0.20	86.2	200.5	0.90	1.60	78%
						0.00	0.000	0.000	13.32														
						0.00	0.000	0.000	13.32														
									14.92														

LICENSED PROFESSIONAL ENGINEER
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100125708
March 29/19
PROVINCE OF ONTARIO

M:\2017\117198\DATA\Calculations\Sewer Calcs\STM\20190304-STM Design.xls

Van Gaal Lands - Claridge Development - 1039 Terry Fox Drive & 5331 Fernabnk Road
Claridge Homes
Project No.: 117198

STORM SEWER DESIGN SHEET
(Claridge Homes)
FLOW RATES BASED ON RATIONAL METHOD

NOVATECH
Engineers, Planners & Landscape Architects

LOCATION				AREA (ha)			FLOW							TOTAL FLOW	SEWER DATA								
Street	Catchment ID	From Manhole	To Manhole	Area (ha)	C	AC (ha)	Indiv 2.78 AC	Accum 2.78 AC	Time of Concentration	Rainfall Intensity 2 Year (mm/hr)	Rainfall Intensity 5 Year (mm/hr)	Rainfall Intensity 10 Year (mm/hr)	Peak Flow (L/s)	Total Peak Flow, Q (L/s)	Dia. (m) Actual	Dia. (mm)	Type	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Flow Time (min)	Ratio Q/Q full
Street 1	A10	102	104	0.50	0.60	0.30	0.834	7.049	16.00	59.51			419.5	419.5	0.914	900	Conc	0.12	78.4	653.9	1.00	1.31	64%
						0.00	0.000	0.000	16.00														
						0.00	0.000	0.000	16.00														
									17.31														
Street 2	A11	214	212	0.42	0.65	0.27	0.759	0.759	10.00	76.81			58.3	58.3	0.457	450	Conc	0.24	119.7	145.6	0.89	2.25	40%
						0.00	0.000	0.000	10.00														
						0.00	0.000	0.000	10.00														
Street 2		212	210			0.00	0.000	0.759	12.25	69.13			52.5	52.5	0.457	450	Conc	0.24	13.9	145.6	0.89	0.26	36%
						0.00	0.000	0.000	12.25														
						0.00	0.000	0.000	12.25														
Street 2	A12	210	208A	0.43	0.65	0.28	0.777	1.536	12.51	68.34			105.0	105.0	0.533	525	Conc	0.24	35.1	219.6	0.98	0.60	48%
						0.00	0.000	0.000	12.51														
						0.00	0.000	0.000	12.51														
Street 2		208A	208			0.00	0.000	0.759	13.11	66.63			50.6	50.6	0.533	525	Conc	0.24	10.3	219.6	0.98	0.17	23%
						0.00	0.000	0.000	13.11														
						0.00	0.000	0.000	13.11														
Street 2		208	206			0.00	0.000	1.536	13.28	66.15			101.6	101.6	0.533	525	Conc	0.24	49.2	219.6	0.98	0.83	46%
						0.00	0.000	0.000	13.28														
						0.00	0.000	0.000	13.28														
Street 2	A13	206	204	0.14	0.65	0.09	0.253	1.789	14.11	63.94			114.4	114.4	0.533	525	Conc	0.24	22.2	219.6	0.98	0.38	52%
						0.00	0.000	0.000	14.11														
						0.00	0.000	0.000	14.11														
									14.49														
Street 2	A14	200	202	0.14	0.65	0.09	0.253	0.253	10.00	76.81			19.4	19.4	0.254	250	PVC	0.50	30.3	43.8	0.86	0.58	44%
						0.00	0.000	0.000	10.00														
						0.00	0.000	0.000	10.00														
Street 2	A15	202	204	0.24	0.65	0.16	0.434	0.687	10.58	74.63			51.2	51.2	0.381	375	PVC	0.30	56.0	100.1	0.88	1.06	51%
						0.00	0.000	0.000	10.58														
						0.00	0.000	0.000	10.58														
									11.65														
Street 3		204	300			0.00	0.000	2.476	14.49	63.00			156.0	156.0	0.610	600	Conc	0.24	20.4	313.6	1.07	0.32	50%
						0.00	0.000	0.000	14.49														
						0.00	0.000	0.000	14.49														
Street 3	A16	300	302	0.31	0.65	0.20	0.560	3.036	14.81	62.23			188.9	188.9	0.610	600	Conc	0.22	23.0	300.3	1.03	0.37	63%
						0.00	0.000	0.000	14.81														
						0.00	0.000	0.000	14.81														
Street 3	A17	302	104	0.06	0.65	0.04	0.108	3.144	15.18	61.35			192.9	192.9	0.610	600	Conc	0.18	50.3	271.6	0.93	0.90	71%
						0.00	0.000	0.000	15.18														
						0.00	0.000	0.000	15.18														
									16.08														

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Van Gaal Lands - Claridge Development - 1039 Terry Fox Drive & 5331 Fernabnk Road
Claridge Homes
Project No.: 117198

STORM SEWER DESIGN SHEET
(Claridge Homes)
FLOW RATES BASED ON RATIONAL METHOD

NOVATECH
Engineers, Planners & Landscape Architects

LOCATION				AREA (ha)			FLOW							TOTAL FLOW	SEWER DATA								
Street	Catchment ID	From Manhole	To Manhole	Area (ha)	C	AC (ha)	Indiv 2.78 AC	Accum 2.78 AC	Time of Concentration	Rainfall Intensity 2 Year (mm/hr)	Rainfall Intensity 5 Year (mm/hr)	Rainfall Intensity 10 Year (mm/hr)	Peak Flow (L/s)	Total Peak Flow, Q (L/s)	Dia. (m) Actual	Dia. (mm)	Type	Slope (%)	Length (m)	Capacity (L/s)	Velocity (m/s)	Flow Time (min)	Ratio Q/Q full
Street 1	A18	104	106	0.76	0.65	0.49	1.373	11.566	17.31	56.80			657.0	657.0	1.067	1050	Conc	0.12	84.6	986.4	1.10	1.28	67%
						0.00	0.000	0.000	17.31														
						0.00	0.000	0.000	17.31														
Street 1	COPE DRIVE	106	EX 1013			0.00	0.000	11.566	18.59	54.42			629.4	629.4	1.067	1050	Conc	0.15	13.6	1,102.8	1.23	0.18	57%
						0.00	0.000	0.000	18.59														
						0.00	0.000	0.000	18.59														
									18.77														

Q = 2.78 AIC, where	Consultant:	Novatech	
Q = Peak Flow in Litres per Second (L/s)	Date:	September 7, 2018, Revised: March 4, 2019	
A = Area in hectares (ha)	Design By:	Steve Zorgel	
I = Rainfall Intensity (mm/hr), 5 year storm	Client:	Dwg. Reference:	Checked By:
C = Runoff Coefficient	Claridge Homes	Figure 7 - Storm Sewer Layout (Design Brief)	DDB

Legend:

*	Indicates 100 Year intensity for storm sewers
10.00	Storm sewers designed to the 2 year event (without ponding) for local roads
10.00	Storm sewers designed to the 5 year event (without ponding) for collector roads
10.00	Storm sewers designed to the 10 year event (without ponding) for arterial roads

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March 29/19
PROVINCE OF ONTARIO

Claridge Van Gaal Lands (117198)
Subcatchment Runoff Coefficients / Percent Impervious Values

NOVATECH
Engineers, Planners & Landscape Architects

Area ID	Drainage Area (ha)	% of Land Use			Weighted Runoff Coefficient(1)	Percent Impervious(2)
		Townhomes	Single Family Homes	Park Land		
A01	0.43	0%	100%	0%	**0.55**	**50.0%**
A02	0.77	50%	50%	0%	**0.60**	**57.1%**
A03	0.62	50%	50%	0%	**0.60**	**57.1%**
A04	0.24	0%	100%	0%	**0.55**	**50.0%**
A05	0.33	0%	100%	0%	**0.55**	**50.0%**
A06	0.16	100%	0%	0%	**0.65**	**64.3%**
A07	0.53	100%	0%	0%	**0.65**	**64.3%**
A08	0.30	100%	0%	0%	**0.65**	**64.3%**
A09	0.32	100%	0%	0%	**0.65**	**64.3%**
A10	0.50	50%	50%	0%	**0.60**	**57.1%**
A11A	0.24	100%	0%	0%	**0.65**	**64.3%**
A11B	0.18	100%	0%	0%	**0.65**	**64.3%**
A12	0.43	100%	0%	0%	**0.65**	**64.3%**
A13	0.14	100%	0%	0%	**0.65**	**64.3%**
A14	0.14	100%	0%	0%	**0.65**	**64.3%**
A15	0.24	100%	0%	0%	**0.65**	**64.3%**
A16	0.31	100%	0%	0%	**0.65**	**64.3%**
A17	0.06	100%	0%	0%	**0.65**	**64.3%**
A18	0.76	100%	0%	0%	**0.65**	**64.3%**
OFF1	1.38	0%	50%	50%	**0.38**	**25.0%**
OFF2	0.05	100%	0%	0%	**0.65**	**64.3%**
TOTAL	**8.13**	**59%**	**32%**	**8%**	**0.58**	**54.2%**

[1] *Based on typical runoff coefficients: Townhomes (0.65); Single Family Homes (0.55); Park Lands (0.20)*

[2] *Percent impervious values used in PCSWMM model: % Imp. = (C - 0.20) / 0.70*

Date: 3/28/2019
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Claridge Van Gaal Lands (117198)
Conceptual PCSWMM Model

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Equivalent Orifice Sizing for 104.8 L/s/ha Flow Rate

Name	Inlet / Outlet Node	Area ID	Drainage Area (ha)	Static Ponding Depth (m)	85 L/s/ha Flow Rate[1] (L/s)	104.8 L/s/ha Flow Rate[2] (L/s)	Artificial Orific Dia.[3] (m)
Orifices (CB's In-Sag)							
O-CB01-02	CB01-02	A01	0.43	0.20	36.6	45.1	0.125
O-CB03-04	CB03-04	A02	0.77	0.19	65.5	80.7	0.167
O-CB05-06	CB05-06	A03	0.62	0.20	52.7	65.0	0.150
O-CB07-08	CB07-08	A04	0.24	0.15	20.4	25.1	0.094
O-CB09-10	CB09-10	A05	0.33	0.11	28.1	34.6	0.111
O-CB11-12	CB11-12	A10	0.50	0.14	42.5	52.4	0.136
O-CB13-14	CB13-14	A18	0.76	0.23	64.6	79.6	0.165
O-CB17-18	CB17-18	A14	0.14	0.18	11.9	14.7	0.071
O-CB19-20	CB19-20	A15	0.24	0.13	20.4	25.1	0.094
O-CB23-24	CB23-24	A12	0.43	0.20	36.6	45.1	0.125
O-CB25-26	CB25-26	A11A	0.24	0.15	20.4	25.1	0.094
O-CB25A-26A	CB25A-26A	A11B	0.18	0.20	15.3	18.9	0.081
O-CB29-30	CB29-30	A07	0.53	0.20	45.1	55.5	0.139
O-CB31-32	CB31-32	A08	0.30	0.24	25.5	31.4	0.104
O-CB33-34	CB33-34	A09	0.32	0.23	27.2	33.5	0.107
O-CB35-36	CB35-36	A16	0.31	0.25	26.4	32.5	0.105
Outlets (CB's On-Grade)							
O-CB21-22	CB21-22	A13	0.14	-	11.9	14.7	-
O-CB27-28	CB27-28	A06	0.16	-	13.6	16.8	-
O-CB37-38	CB37-38	A17	0.06	-	5.1	6.3	-
TOTAL (To MH1013 on COPE Drive)			**6.70**	**-**	**569.5**	**702.1**	**-**

[1] *Flow rate = drainage area (ha) x 85 L/s/ha (allowable release rate to Cope Drive based on 8.26 ha area).*

[2] *Flow rate = drainage area (ha) x 104.8 L/s/ha (allowable release rate to Cope Drive based on 6.70 ha area).*

[3] *Equivalent orifice diameter corresponding to 104.8 L/s/ha flow rate; based on 1.60m of head (CB T/G - CB Inv.) + static ponding depth*

Date: 3/29/2019
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Claridge Van Gaal Lands (117190)
100-year HGL Elevations (Minor System)

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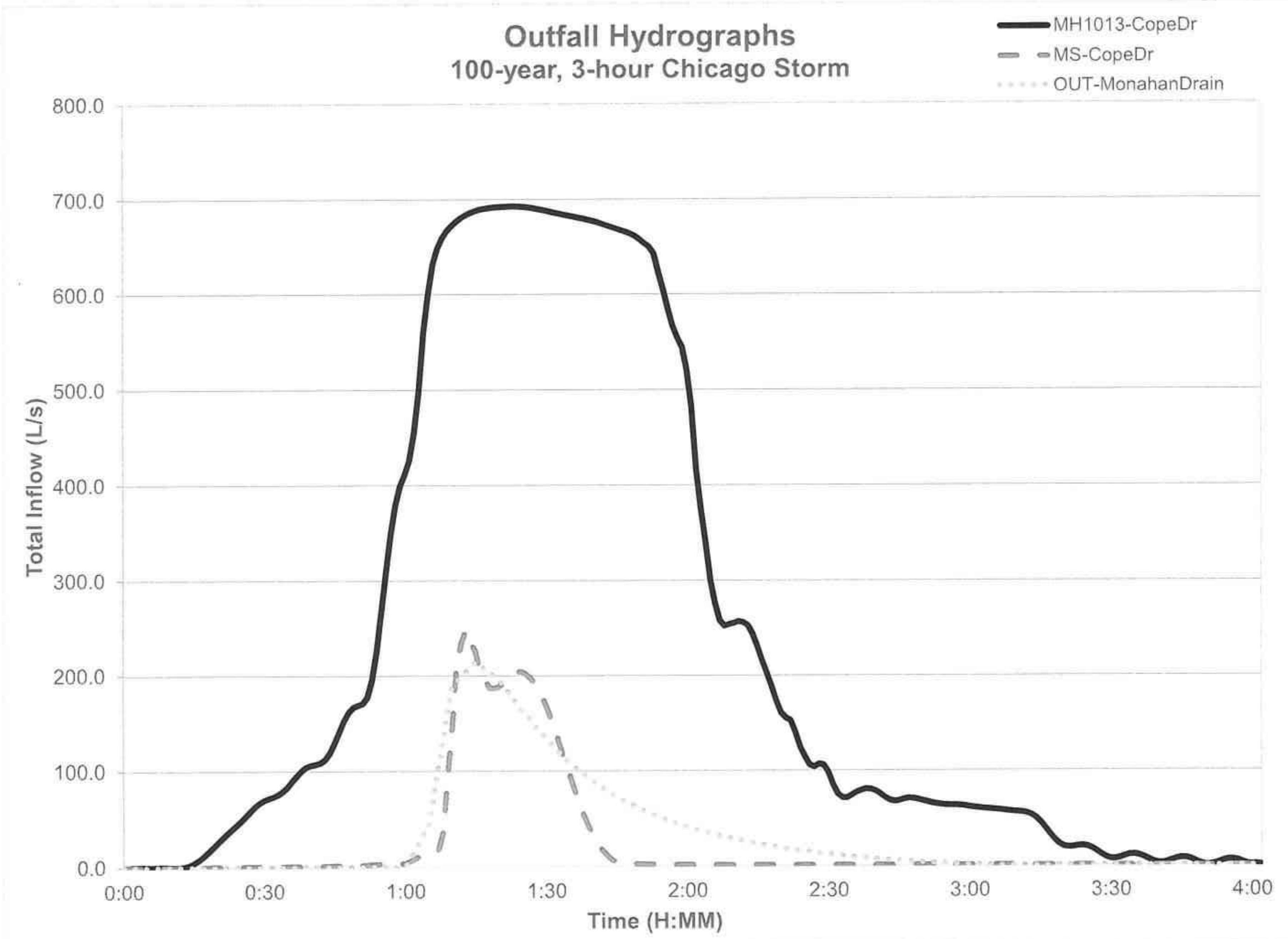
MH ID	Pipe / MH / USF Information				HGL Information[1]		Surcharge Depth Above Pipe Obvert	
	D/S Pipe Size (mm)	D/S Pipe Invert Elev. (m)	D/S Pipe Obvert Elev. (m)	MH T/G Elev. (m)	100-year (m)	100-year (+20%) (m)	100-year (m)	100-year (+20%) (m)
MH100	750	94.46	95.21	97.49	95.15	95.15	0.00	0.00
MH102	900	94.22	95.12	97.41	95.12	95.12	0.00	0.00
MH104	1050	93.98	95.03	97.22	95.07	95.07	0.04	0.04
MH106	1050	93.88	94.93	97.02	95.01	95.01	0.08	0.08
MH200	250	95.36	95.61	97.51	95.46	95.46	0.00	0.00
MH202	375	95.09	95.47	97.74	95.27	95.27	0.00	0.00
MH204	600	94.69	95.29	97.49	95.17	95.17	0.00	0.00
MH206	525	94.82	95.35	97.52	95.20	95.21	0.00	0.00
MH208	525	94.97	95.50	97.56	95.25	95.25	0.00	0.00
MH208A	525	95.03	95.56	97.52	95.30	95.30	0.00	0.00
MH210	525	95.13	95.66	97.70	95.39	95.39	0.00	0.00
MH212	450	95.24	95.69	97.63	95.43	95.44	0.00	0.00
MH214(E)	450	95.56	96.01	97.96	95.74	95.74	0.00	0.00
MH214(W)	450	95.41	95.86	97.96	95.51	95.51	0.00	0.00
MH216	450	95.24	95.69	97.64	95.39	95.39	0.00	0.00
MH218	450	95.16	95.61	97.59	95.39	95.39	0.00	0.00
MH220	450	94.99	95.44	97.65	95.26	95.26	0.00	0.00
MH222	525	94.82	95.35	97.38	95.23	95.23	0.00	0.00
MH224	525	94.77	95.30	97.51	95.21	95.22	0.00	0.00
MH300	600	94.63	95.23	97.29	95.15	95.16	0.00	0.00
MH302	600	94.57	95.17	97.21	95.14	95.14	0.00	0.00
MH400	375	95.38	95.76	97.41	95.56	95.56	0.00	0.00
MH402	525	95.02	95.55	97.65	95.33	95.33	0.00	0.00
MH404	525	94.88	95.41	97.47	95.24	95.24	0.00	0.00
MH406	675	94.68	95.36	97.58	95.21	95.21	0.00	0.00
MH408	300	95.01	95.31	97.37	95.17	95.17	0.00	0.00

(1) *HGL information is for a 3-hour Chicago Storm Distribution.*

Claridge Van Gaal Lands (117198)
PCSWMM Outfall Hydrographs



Date: 03/29/19
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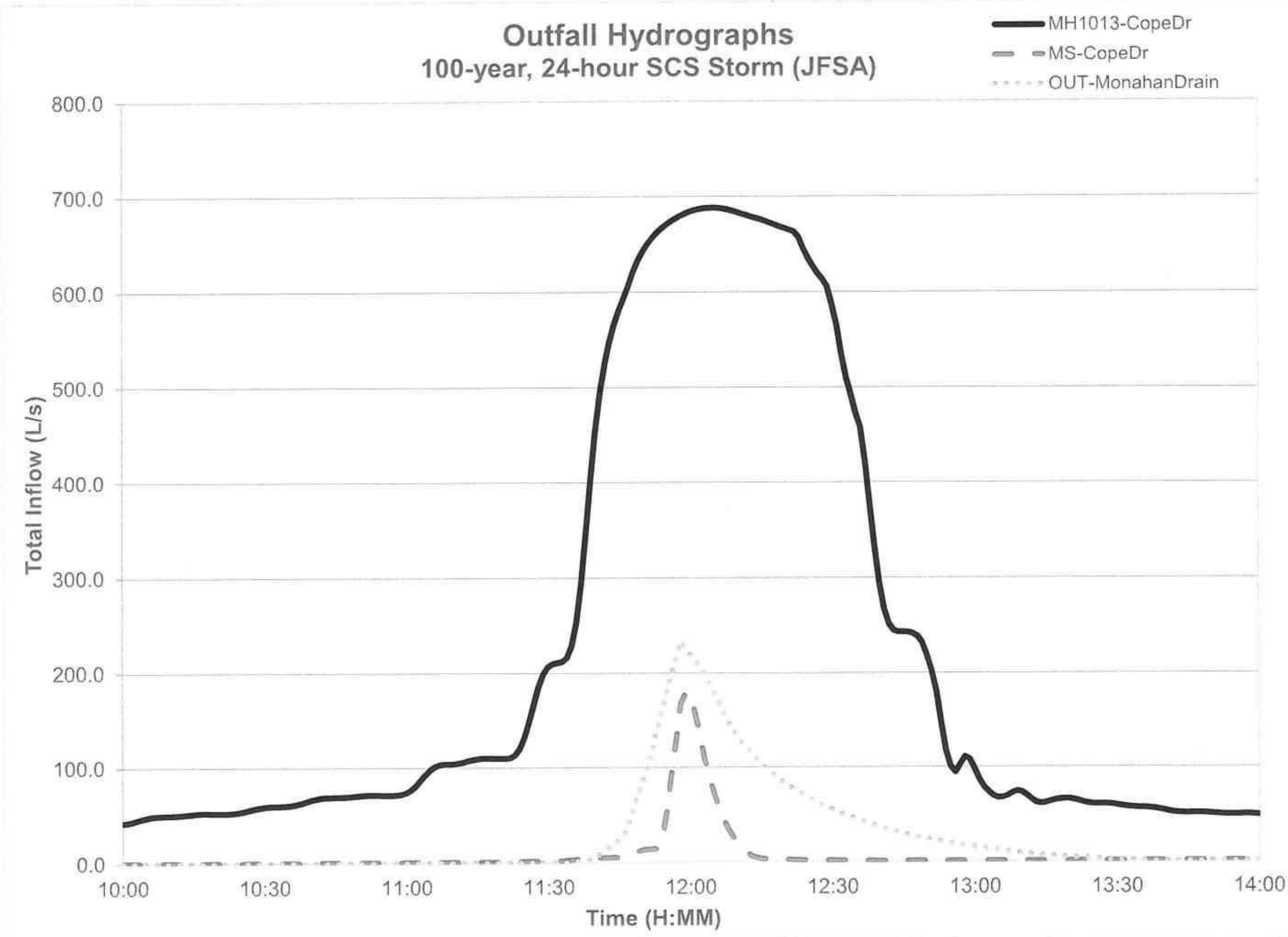
Claridge Van Gaal Lands (117198)
PCSWMM Outfall Hydrographs



Date: 03/29/19
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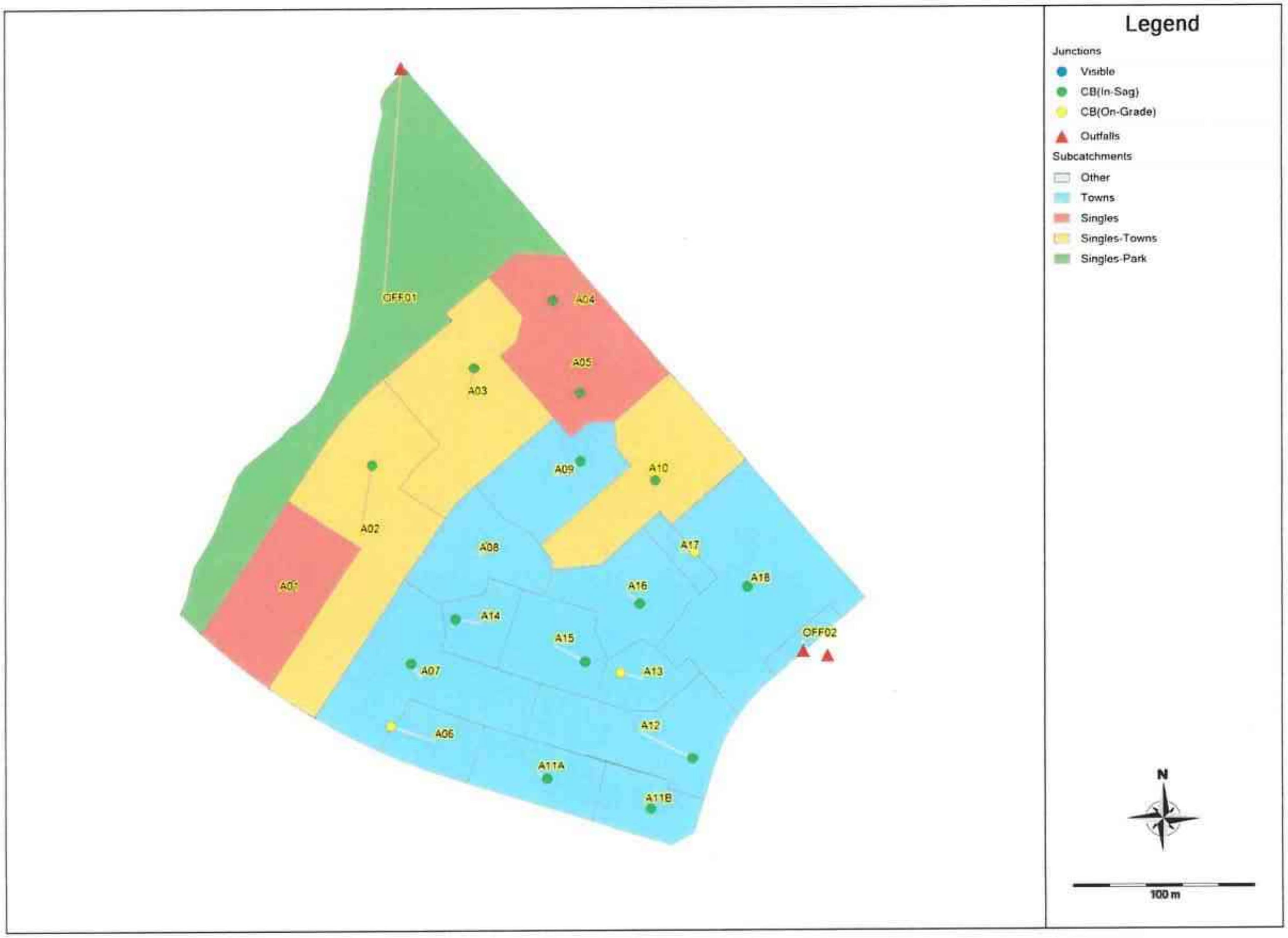
Overall Model Schematic

Claridge Van Gaal Lands (117198)
PCSWMM Model Schematics

Subcatchments



Date: 2019-03-28
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Claridge Van Gaal Lands (117198)
PCSWMM Model Schematics

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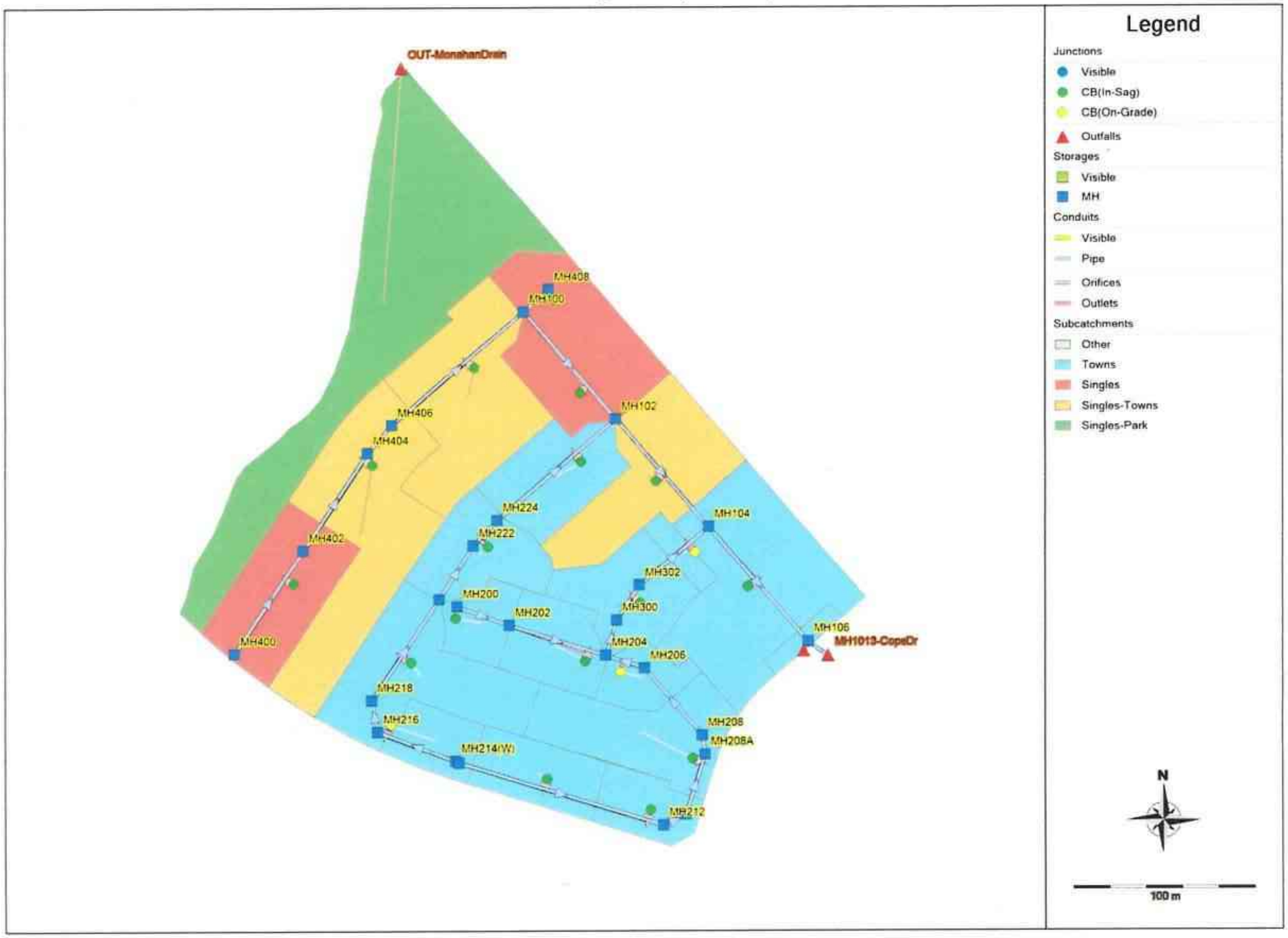
Minor System (MH IDs)



Date: 2019-03-28
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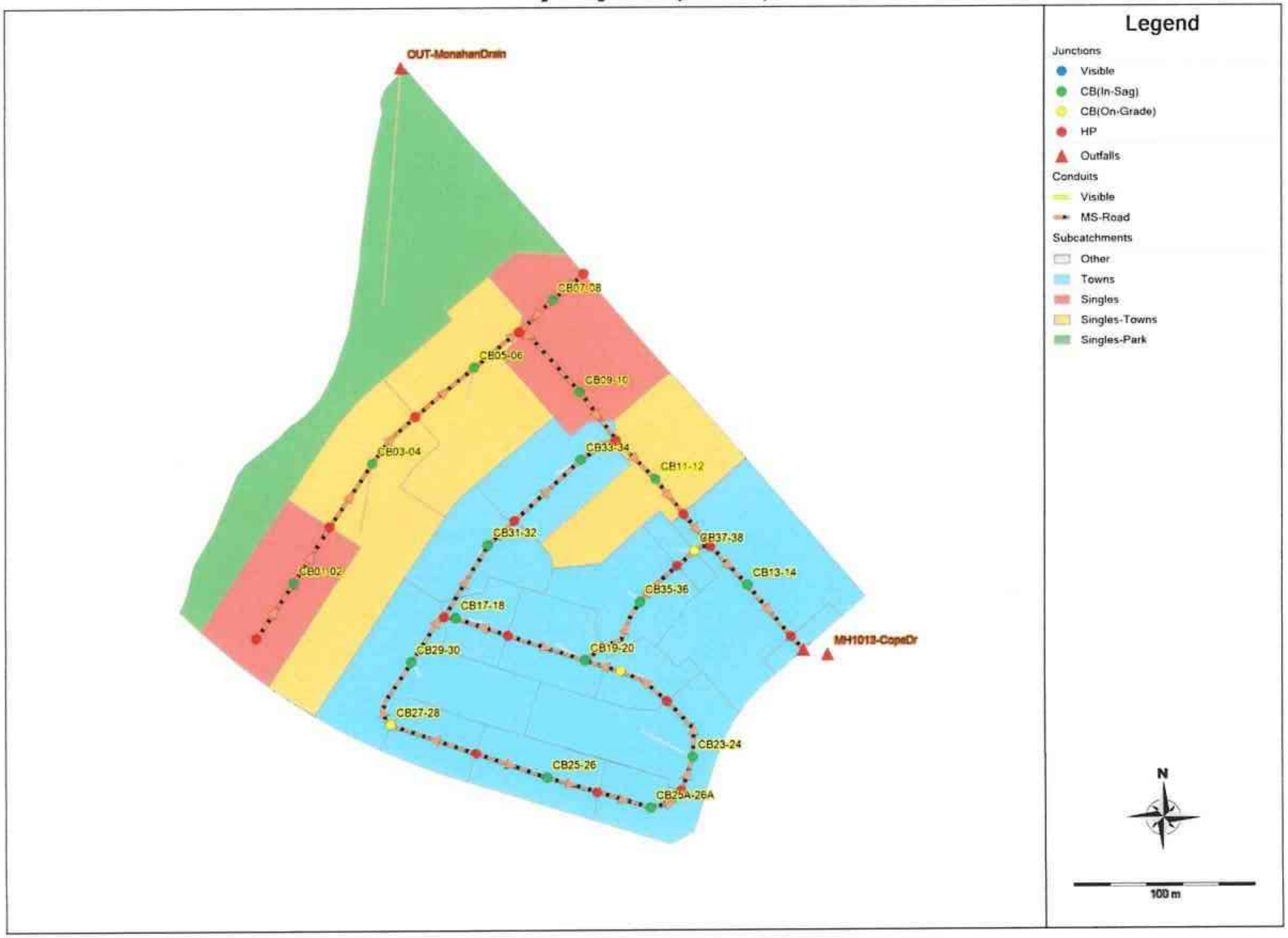
Claridge Van Gaal Lands (117198)
PCSWMM Model Schematics

Major System (CB IDs)



Date: 2019-03-28
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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

WARNING 02: maximum depth increased for Node CB25-26
WARNING 02: maximum depth increased for Node CB29-30

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 21
Number of nodes ........... 66
Number of links ........... 84
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                      Data       Recording
Name             Data Source                          Type       Interval
------------------------------------------------------------------------
RG               C3hr-100yr                           INTENSITY  10 min.


********************
Subcatchment Summary
********************
Name                      Area     Width   %Imperv    %Slope Rain Gage            Outlet
-----------------------------------------------------------------------------------------------------------
A01                       0.43     96.75     50.00    0.5000 RG                   CB01-02
A02                       0.77    173.25     57.10    0.5000 RG                   CB03-04
A03                       0.62    139.50     57.10    0.5000 RG                   CB05-06
A04                       0.24     54.00     50.00    0.5000 RG                   CB07-08
A05                       0.33     74.25     50.00    0.5000 RG                   CB09-10
A06                       0.16     36.00     64.30    0.5000 RG                   CB27-28
A07                       0.53    119.25     64.30    0.5000 RG                   CB29-30
A08                       0.30     67.50     64.30    0.5000 RG                   CB31-32
A09                       0.32     72.00     64.30    0.5000 RG                   CB33-34
A10                       0.50    112.50     57.10    0.5000 RG                   CB11-12
A11A                      0.24     54.00     64.30    0.5000 RG                   CB25-26
A11B                      0.18     40.50     64.30    0.5000 RG                   CB25A-26A
A12                       0.43     96.75     64.30    0.5000 RG                   CB23-24
A13                       0.14     31.50     64.30    0.5000 RG                   CB21-22
A14                       0.14     31.50     64.30    0.5000 RG                   CB17-18
A15                       0.24     54.00     64.30    0.5000 RG                   CB19-20
A16                       0.31     69.75     64.30    0.5000 RG                   CB35-36
A17                       0.06     13.50     64.30    0.5000 RG                   CB37-38
A18                       0.76    171.00     64.30    0.5000 RG                   CB13-14
OFF01                     1.38    310.50     25.00    0.5000 RG                   OUT-MonahanDrain
OFF02                     0.05     11.25     64.30    0.5000 RG                   MS-CopeDr


************
Node Summary
************
                                           Invert      Max.    Ponded    External
Name                 Type                   Elev.     Depth      Area    Inflow
-------------------------------------------------------------------------------
CB01-02              JUNCTION               95.87      2.60       0.0
CB03-04              JUNCTION               95.78      2.60       0.0
CB05-06              JUNCTION               95.62      2.60       0.0
CB07-08              JUNCTION               95.67      2.60       0.0
CB09-10              JUNCTION               95.53      2.60       0.0
CB11-12              JUNCTION               95.53      2.60       0.0
CB13-14              JUNCTION               95.29      2.60       0.0
CB17-18              JUNCTION               95.79      2.60       0.0
CB19-20              JUNCTION               95.72      2.60       0.0
CB21-22              JUNCTION               97.41      1.00       0.0
CB23-24              JUNCTION               95.82      2.60       0.0
CB25-26              JUNCTION               96.07      2.60       0.0
CB25A-26A            JUNCTION               95.92      2.60       0.0
CB27-28              JUNCTION               97.64      1.00       0.0
CB29-30              JUNCTION               95.77      2.60       0.0
CB31-32              JUNCTION               95.67      2.60       0.0
CB33-34              JUNCTION               95.50      2.60       0.0
CB35-36              JUNCTION               95.49      2.60       0.0
CB37-38              JUNCTION               97.23      1.00       0.0
HP01                 JUNCTION               97.77      1.00       0.0
HP02                 JUNCTION               97.67      1.00       0.0
HP03                 JUNCTION               97.57      1.00       0.0
HP04                 JUNCTION               97.42      1.00       0.0
HP05                 JUNCTION               97.47      1.00       0.0
HP06                 JUNCTION               97.34      1.00       0.0
HP07                 JUNCTION               97.27      1.00       0.0
HP08                 JUNCTION               97.12      1.00       0.0
HP09                 JUNCTION               97.12      1.00       0.0
HP10                 JUNCTION               97.47      1.00       0.0
HP11                 JUNCTION               97.57      1.00       0.0
HP12                 JUNCTION               97.92      1.00       0.0
```

HP13	JUNCTION	97.72	1.00	0.0
HP14	JUNCTION	97.62	1.00	0.0
HP16	JUNCTION	97.45	1.00	0.0
HP17	JUNCTION	97.67	1.00	0.0
HP18	JUNCTION	97.32	1.00	0.0
HP19	JUNCTION	97.82	1.00	0.0
MH1013-CopeDr	OUTFALL	93.86	1.05	0.0
MS-CopeDr	OUTFALL	96.87	1.00	0.0
OUT-MonahanDrain	OUTFALL	96.00	0.00	0.0
MH100	STORAGE	94.46	3.03	0.0
MH102	STORAGE	94.22	3.19	0.0
MH104	STORAGE	93.98	3.24	0.0
MH106	STORAGE	93.88	3.14	0.0
MH200	STORAGE	95.36	2.15	0.0
MH202	STORAGE	95.09	2.65	0.0
MH204	STORAGE	94.69	2.80	0.0
MH206	STORAGE	94.81	2.71	0.0
MH208	STORAGE	94.87	2.69	0.0
MH208A	STORAGE	94.92	2.60	0.0
MH210	STORAGE	95.02	2.68	0.0
MH212	STORAGE	95.15	2.48	0.0
MH214(E)	STORAGE	95.41	2.55	0.0
MH214(W)	STORAGE	95.36	2.60	0.0
MH216	STORAGE	95.24	2.40	0.0
MH218	STORAGE	95.16	2.43	0.0
MH220	STORAGE	94.99	2.66	0.0
MH222	STORAGE	94.82	2.56	0.0
MH224	STORAGE	94.77	2.74	0.0
MH300	STORAGE	94.63	2.66	0.0
MH302	STORAGE	94.57	2.64	0.0
MH400	STORAGE	95.38	2.03	0.0
MH402	STORAGE	95.02	2.63	0.0
MH404	STORAGE	94.88	2.59	0.0
MH406	STORAGE	94.68	2.90	0.0
MH408	STORAGE	95.01	2.36	0.0

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
MH100-102	MH100	MH102	CONDUIT	78.0	0.1154	0.0130
MH102-104	MH102	MH104	CONDUIT	78.4	0.1148	0.0130
MH104-106	MH104	MH106	CONDUIT	84.6	0.1182	0.0130
MH106-1013	MH106	MH1013-CopeDr	CONDUIT	13.6	0.1473	0.0130
MH200-202	MH200	MH202	CONDUIT	30.3	0.4951	0.0130
MH202-204	MH202	MH204	CONDUIT	56.0	0.3036	0.0130
MH204-300	MH204	MH300	CONDUIT	20.4	0.2449	0.0130
MH206-204	MH206	MH204	CONDUIT	22.1	0.2257	0.0130
MH208-206	MH208	MH206	CONDUIT	49.2	0.2439	0.0130
MH208A-208	MH208A	MH208	CONDUIT	10.3	0.2901	0.0130
MH210-208A	MH210	MH208A	CONDUIT	35.1	0.2280	0.0130
MH212-210	MH212	MH210	CONDUIT	13.9	0.2163	0.0130
MH214-212	MH214(E)	MH212	CONDUIT	119.7	0.2422	0.0130
MH214-216	MH214(W)	MH216	CONDUIT	46.3	0.3022	0.0130
MH216-218	MH216	MH218	CONDUIT	17.5	0.2864	0.0130
MH218-220	MH218	MH220	CONDUIT	67.2	0.2531	0.0130
MH220-222	MH220	MH222	CONDUIT	35.9	0.2509	0.0130
MH222-224	MH222	MH224	CONDUIT	18.8	0.2124	0.0130
MH224-102	MH224	MH102	CONDUIT	86.2	0.1973	0.0130
MH300-302	MH300	MH302	CONDUIT	23.0	0.2173	0.0130
MH302-104	MH302	MH104	CONDUIT	50.3	0.1790	0.0130
MH400-402	MH400	MH402	CONDUIT	68.3	0.3075	0.0130
MH402-404	MH402	MH404	CONDUIT	64.2	0.2182	0.0130
MH404-406	MH404	MH406	CONDUIT	20.7	0.2415	0.0130
MH406-100	MH406	MH100	CONDUIT	95.9	0.1459	0.0130
MH408-100	MH408	MH100	CONDUIT	18.3	0.5465	0.0130
MS01	HP01	CB01-02	CONDUIT	36.2	0.8288	0.0150
MS02	CB01-02	HP02	CONDUIT	37.2	-0.5376	0.0150
MS03	HP02	CB03-04	CONDUIT	41.8	0.6938	0.0150
MS04	CB03-04	HP03	CONDUIT	35.9	-0.5293	0.0150
MS05	HP03	CB05-06	CONDUIT	42.2	0.8294	0.0150
MS06	CB05-06	HP04	CONDUIT	31.8	-0.6289	0.0150
MS07	HP05	CB07-08	CONDUIT	22.6	0.8850	0.0150
MS08	CB07-08	HP04	CONDUIT	25.7	-0.5837	0.0150
MS09	HP04	CB09-10	CONDUIT	48.2	0.6017	0.0150
MS10	CB09-10	HP06	CONDUIT	33.6	-0.6250	0.0150
MS11	HP06	CB11-12	CONDUIT	30.5	0.6885	0.0150
MS12	CB11-12	HP07	CONDUIT	24.6	-0.5691	0.0150
MS13	HP07	HP08	CONDUIT	23.1	0.6494	0.0150
MS14	HP08	CB13-14	CONDUIT	30.0	0.7667	0.0150
MS16	CB13-14	HP09	CONDUIT	36.8	-0.6250	0.0150
MS17	HP09	MS-CopeDr	CONDUIT	10.1	2.4760	0.0150
MS18	CB33-34	HP06	CONDUIT	22.8	-1.0527	0.0150
MS19	HP10	CB33-34	CONDUIT	49.2	0.7521	0.0150
MS20	CB31-32	HP10	CONDUIT	20.2	-0.9901	0.0150
MS21	HP11	CB31-32	CONDUIT	46.1	0.6508	0.0150
MS22	CB29-30	HP11	CONDUIT	31.3	-0.6390	0.0150
MS23	CB27-28	CB29-30	CONDUIT	40.9	0.6602	0.0150
MS24	HP12	CB27-28	CONDUIT	49.7	0.5634	0.0150
MS25	HP12	CB25-26	CONDUIT	41.4	0.6039	0.0150

MS26	CB25A-26A	HP13	CONDUIT	20.5	-0.9757	0.0150
MS27	HP13	CB23-24	CONDUIT	19.5	1.5386	0.0150
MS28	CB23-24	HP14	CONDUIT	36.9	-0.5420	0.0150
MS29	HP14	CB21-22	CONDUIT	31.1	0.6753	0.0150
MS30	CB21-22	CB19-20	CONDUIT	20.5	0.4390	0.0150
MS31	CB19-20	HP16	CONDUIT	11.9	-1.0925	0.0150
MS32	HP17	CB19-20	CONDUIT	44.7	0.7830	0.0150
MS33	HP17	CB17-18	CONDUIT	30.6	0.9151	0.0150
MS34	CB17-18	HP11	CONDUIT	6.3	-2.8583	0.0150
MS35	HP16	CB35-36	CONDUIT	34.4	1.0466	0.0150
MS36	CB35-36	HP18	CONDUIT	28.8	-0.7986	0.0150
MS37	HP18	CB37-38	CONDUIT	13.0	0.6923	0.0150
MS38	CB37-38	HP08	CONDUIT	9.2	1.1957	0.0150
MS39	CB25-26	HP19	CONDUIT	29.0	-0.5172	0.0150
MS40	HP19	CB25A-26A	CONDUIT	30.7	0.9772	0.0150
O-CB01-02	CB01-02	MH400	ORIFICE			
O-CB03-04	CB03-04	MH402	ORIFICE			
O-CB05-06	CB05-06	MH406	ORIFICE			
O-CB07-08	CB07-08	MH408	ORIFICE			
O-CB09-10	CB09-10	MH100	ORIFICE			
O-CB11-12	CB11-12	MH102	ORIFICE			
O-CB13-14	CB13-14	MH104	ORIFICE			
O-CB17-18	CB17-18	MH200	ORIFICE			
O-CB19-20	CB19-20	MH202	ORIFICE			
O-CB23-24	CB23-24	MH210	ORIFICE			
O-CB25-26	CB25-26	MH214(E)	ORIFICE			
O-CB25A-26A	CB25A-26A	MH214(E)	ORIFICE			
O-CB29-30	CB29-30	MH218	ORIFICE			
O-CB31-32	CB31-32	MH222	ORIFICE			
O-CB33-34	CB33-34	MH224	ORIFICE			
O-CB35-36	CB35-36	MH300	ORIFICE			
O-CB21-22	CB21-22	MH206	OUTLET			
O-CB27-28	CB27-28	MH214(W)	OUTLET			
O-CB37-38	CB37-38	MH302	OUTLET			

****
Cross Section Summary
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Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
MH100-102	CIRCULAR	0.75	0.44	0.19	0.75	1	378.18
MH102-104	CIRCULAR	0.90	0.64	0.23	0.90	1	613.32
MH104-106	CIRCULAR	1.05	0.87	0.26	1.05	1	939.07
MH106-1013	CIRCULAR	1.05	0.87	0.26	1.05	1	1047.94
MH200-202	CIRCULAR	0.25	0.05	0.06	0.25	1	41.84
MH202-204	CIRCULAR	0.38	0.11	0.09	0.38	1	96.61
MH204-300	CIRCULAR	0.60	0.28	0.15	0.60	1	303.85
MH206-204	CIRCULAR	0.53	0.22	0.13	0.53	1	204.34
MH208-206	CIRCULAR	0.53	0.22	0.13	0.53	1	212.38
MH208A-208	CIRCULAR	0.53	0.22	0.13	0.53	1	231.66
MH210-208A	CIRCULAR	0.53	0.22	0.13	0.53	1	205.36
MH212-210	CIRCULAR	0.45	0.16	0.11	0.45	1	132.60
MH214-212	CIRCULAR	0.45	0.16	0.11	0.45	1	140.32
MH214-216	CIRCULAR	0.45	0.16	0.11	0.45	1	156.74
MH216-218	CIRCULAR	0.45	0.16	0.11	0.45	1	152.58
MH218-220	CIRCULAR	0.45	0.16	0.11	0.45	1	143.45
MH220-222	CIRCULAR	0.45	0.16	0.11	0.45	1	142.82
MH222-224	CIRCULAR	0.53	0.22	0.13	0.53	1	198.23
MH224-102	CIRCULAR	0.53	0.22	0.13	0.53	1	191.03
MH300-302	CIRCULAR	0.60	0.28	0.15	0.60	1	286.24
MH302-104	CIRCULAR	0.60	0.28	0.15	0.60	1	259.82
MH400-402	CIRCULAR	0.38	0.11	0.09	0.38	1	97.23
MH402-404	CIRCULAR	0.53	0.22	0.13	0.53	1	200.92
MH404-406	CIRCULAR	0.53	0.22	0.13	0.53	1	211.38
MH406-100	CIRCULAR	0.68	0.36	0.17	0.68	1	321.12
MH408-100	CIRCULAR	0.30	0.07	0.07	0.30	1	71.49
MS01	18.0mROW	1.00	15.07	0.37	18.00	1	47060.74
MS02	18.0mROW	1.00	15.07	0.37	18.00	1	37904.57
MS03	18.0mROW	1.00	15.07	0.37	18.00	1	43058.71
MS04	18.0mROW	1.00	15.07	0.37	18.00	1	37607.77
MS05	18.0mROW	1.00	15.07	0.37	18.00	1	47079.32
MS06	18.0mROW	1.00	15.07	0.37	18.00	1	40996.87
MS07	18.0mROW	1.00	15.07	0.37	18.00	1	48631.11
MS08	18.0mROW	1.00	15.07	0.37	18.00	1	39493.69
MS09	18.0mROW	1.00	15.07	0.37	18.00	1	40098.15
MS10	18.0mROW	1.00	15.07	0.37	18.00	1	40868.55
MS11	18.0mROW	1.00	15.07	0.37	18.00	1	42895.31
MS12	18.0mROW	1.00	15.07	0.37	18.00	1	38998.23
MS13	18.0mROW	1.00	15.07	0.37	18.00	1	41657.11
MS14	18.0mROW	1.00	15.07	0.37	18.00	1	45264.17
MS16	18.0mROW	1.00	15.07	0.37	18.00	1	40868.55
MS17	18.0mROW	1.00	15.07	0.37	18.00	1	81343.11
MS18	18.0mROW	1.00	15.07	0.37	18.00	1	53038.98
MS19	18.0mROW	1.00	15.07	0.37	18.00	1	44830.07
MS20	18.0mROW	1.00	15.07	0.37	18.00	1	51439.28
MS21	18.0mROW	1.00	15.07	0.37	18.00	1	41702.27
MS22	18.0mROW	1.00	15.07	0.37	18.00	1	41323.03
MS23	18.0mROW	1.00	15.07	0.37	18.00	1	42001.99
MS24	16.5mROW	1.00	13.94	0.41	16.50	1	38526.52
MS25	16.5mROW	1.00	13.94	0.41	16.50	1	39886.81

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MS26            16.5mROW            1.00     13.94     0.41     16.50         1 50699.53
MS27            18.0mROW            1.00     15.07     0.37     18.00         1 64123.02
MS28            18.0mROW            1.00     15.07     0.37     18.00         1 38058.35
MS29            18.0mROW            1.00     15.07     0.37     18.00         1 42479.49
MS30            18.0mROW            1.00     15.07     0.37     18.00         1 34252.43
MS31            18.0mROW            1.00     15.07     0.37     18.00         1 54032.63
MS32            18.0mROW            1.00     15.07     0.37     18.00         1 45743.76
MS33            18.0mROW            1.00     15.07     0.37     18.00         1 49450.69
MS34            18.0mROW            1.00     15.07     0.37     18.00         1 87397.61
MS35            18.0mROW            1.00     15.07     0.37     18.00         1 52884.55
MS36            18.0mROW            1.00     15.07     0.37     18.00         1 46197.61
MS37            18.0mROW            1.00     15.07     0.37     18.00         1 43013.00
MS38            18.0mROW            1.00     15.07     0.37     18.00         1 56527.90
MS39            16.5mROW            1.00     13.94     0.41     16.50         1 36915.19
MS40            16.5mROW            1.00     13.94     0.41     16.50         1 50740.80


****************
Transect Summary
****************

Transect 16.5mROW
Area:
           0.0009     0.0038     0.0085     0.0150     0.0235
           0.0338     0.0458     0.0582     0.0715     0.0860
           0.1017     0.1185     0.1364     0.1555     0.1757
           0.1971     0.2196     0.2431     0.2667     0.2903
           0.3140     0.3376     0.3613     0.3849     0.4086
           0.4322     0.4559     0.4795     0.5032     0.5268
           0.5505     0.5741     0.5978     0.6214     0.6451
           0.6687     0.6924     0.7160     0.7397     0.7634
           0.7870     0.8107     0.8343     0.8580     0.8817
           0.9053     0.9290     0.9527     0.9763     1.0000
Hrad:
           0.0236     0.0472     0.0708     0.0944     0.1179
           0.1415     0.1765     0.2223     0.2629     0.2979
           0.3279     0.3538     0.3760     0.3951     0.4117
           0.4260     0.4384     0.4499     0.4625     0.4762
           0.4908     0.5059     0.5216     0.5377     0.5541
           0.5708     0.5877     0.6048     0.6220     0.6394
           0.6570     0.6746     0.6923     0.7101     0.7279
           0.7458     0.7638     0.7818     0.7998     0.8179
           0.8360     0.8542     0.8723     0.8905     0.9087
           0.9269     0.9452     0.9634     0.9817     1.0000
Width:
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           0.0794     0.1588     0.2382     0.3177     0.3971
           0.4765     0.5163     0.5405     0.5887     0.6370
           0.6852     0.7335     0.7817     0.8299     0.8782
           0.9264     0.9747     0.9988     0.9988     0.9989
           0.9989     0.9990     0.9990     0.9990     0.9991
           0.9991     0.9991     0.9992     0.9992     0.9993
           0.9993     0.9993     0.9994     0.9994     0.9994
           0.9995     0.9995     0.9996     0.9996     0.9996
           0.9997     0.9997     0.9997     0.9998     0.9998
           0.9999     0.9999     0.9999     1.0000     1.0000

Transect 18.0mROW
Area:
           0.0009     0.0035     0.0078     0.0139     0.0217
           0.0313     0.0424     0.0539     0.0664     0.0802
           0.0953     0.1117     0.1292     0.1481     0.1682
           0.1895     0.2121     0.2359     0.2597     0.2836
           0.3075     0.3313     0.3552     0.3791     0.4029
           0.4268     0.4507     0.4746     0.4984     0.5223
           0.5462     0.5701     0.5939     0.6178     0.6417
           0.6656     0.6895     0.7133     0.7372     0.7611
           0.7850     0.8089     0.8328     0.8567     0.8805
           0.9044     0.9283     0.9522     0.9761     1.0000
Hrad:
           0.0262     0.0524     0.0787     0.1049     0.1311
           0.1573     0.1962     0.2469     0.2908     0.3274
           0.3577     0.3829     0.4038     0.4212     0.4357
           0.4478     0.4579     0.4670     0.4779     0.4901
           0.5034     0.5175     0.5323     0.5476     0.5632
           0.5793     0.5956     0.6121     0.6289     0.6458
           0.6629     0.6801     0.6974     0.7148     0.7323
           0.7498     0.7674     0.7851     0.8029     0.8206
           0.8384     0.8563     0.8742     0.8921     0.9100
           0.9280     0.9460     0.9640     0.9820     1.0000
Width:
           0.0728     0.1456     0.2184     0.2912     0.3640
           0.4368     0.4733     0.4996     0.5522     0.6047
           0.6573     0.7098     0.7624     0.8149     0.8675
           0.9201     0.9726     0.9989     0.9989     0.9990
           0.9990     0.9990     0.9991     0.9991     0.9991
           0.9992     0.9992     0.9992     0.9993     0.9993
           0.9994     0.9994     0.9994     0.9995     0.9995
           0.9995     0.9996     0.9996     0.9996     0.9997
           0.9997     0.9997     0.9998     0.9998     0.9998
           0.9999     0.9999     0.9999     1.0000     1.0000
```

```
*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Starting Date ............ 06/18/2018 00:00:00
Ending Date .............. 06/25/2018 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 2.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m

**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial LID Storage ......         0.003         0.320
Total Precipitation ......         0.583        71.667
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.179        22.076
Surface Runoff ...........         0.408        50.133
Final Storage ............         0.003         0.320
Continuity Error (%) .....        -0.753
```

```
**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.408         4.076
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.408         4.079
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.022         0.217
Final Stored Volume ......         0.022         0.217
Continuity Error (%) .....        -0.064

*************************
Highest Continuity Errors
*************************
Node CB27-28 (-1.75%)

***************************
Time-Step Critical Elements
***************************
None

********************************
Highest Flow Instability Indexes
********************************
All links are stable.

*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     1.01 sec
Average Time Step           :     2.00 sec
Maximum Time Step           :     2.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.01
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
A01	71.67	0.00	0.00	23.61	48.54	0.21	138.95	0.677
A02	71.67	0.00	0.00	20.07	52.14	0.40	273.52	0.728
A03	71.67	0.00	0.00	20.07	52.14	0.32	220.24	0.728
A04	71.67	0.00	0.00	23.61	48.54	0.12	77.55	0.677
A05	71.67	0.00	0.00	23.61	48.54	0.16	106.63	0.677
A06	71.67	0.00	0.00	16.53	55.73	0.09	61.89	0.778
A07	71.67	0.00	0.00	16.53	55.73	0.30	205.00	0.778
A08	71.67	0.00	0.00	16.53	55.73	0.17	116.04	0.778
A09	71.67	0.00	0.00	16.53	55.73	0.18	123.77	0.778
A10	71.67	0.00	0.00	20.07	52.14	0.26	177.61	0.728
A11A	71.67	0.00	0.00	16.53	55.73	0.13	92.83	0.778
A11B	71.67	0.00	0.00	16.53	55.73	0.10	69.62	0.778
A12	71.67	0.00	0.00	16.53	55.73	0.24	166.32	0.778
A13	71.67	0.00	0.00	16.53	55.73	0.08	54.15	0.778
A14	71.67	0.00	0.00	16.53	55.73	0.08	54.15	0.778
A15	71.67	0.00	0.00	16.53	55.73	0.13	92.83	0.778
A16	71.67	0.00	0.00	16.53	55.73	0.17	119.90	0.778
A17	71.67	0.00	0.00	16.53	55.73	0.03	23.21	0.778
A18	71.67	0.00	0.00	16.53	55.73	0.42	293.96	0.778
OFF01	71.67	0.00	0.00	39.24	32.87	0.45	213.70	0.459
OFF02	71.67	0.00	0.00	16.53	55.71	0.03	19.35	0.777

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days	Time of Max Occurrence hr:min	Reported Max Depth Meters
CB01-02	JUNCTION	0.01	1.83	97.70	0	01:20	1.83
CB03-04	JUNCTION	0.01	1.87	97.65	0	01:12	1.87
CB05-06	JUNCTION	0.01	1.88	97.50	0	01:14	1.88
CB07-08	JUNCTION	0.01	1.83	97.50	0	01:16	1.83
CB09-10	JUNCTION	0.02	1.89	97.42	0	01:24	1.89
CB11-12	JUNCTION	0.01	1.83	97.36	0	01:25	1.83
CB13-14	JUNCTION	0.01	1.92	97.21	0	01:12	1.92
CB17-18	JUNCTION	0.01	1.85	97.64	0	01:14	1.85
CB19-20	JUNCTION	0.01	1.80	97.52	0	01:14	1.80
CB21-22	JUNCTION	0.00	0.11	97.52	0	01:14	0.11
CB23-24	JUNCTION	0.01	1.86	97.68	0	01:13	1.86
CB25-26	JUNCTION	0.01	1.79	97.86	0	01:14	1.79
CB25A-26A	JUNCTION	0.01	1.83	97.75	0	01:21	1.83
CB27-28	JUNCTION	0.00	0.05	97.69	0	01:10	0.05
CB29-30	JUNCTION	0.01	1.87	97.64	0	01:14	1.87
CB31-32	JUNCTION	0.01	1.87	97.54	0	01:18	1.87
CB33-34	JUNCTION	0.02	1.92	97.42	0	01:24	1.92
CB35-36	JUNCTION	0.02	1.90	97.39	0	01:19	1.90
CB37-38	JUNCTION	0.00	0.06	97.29	0	01:19	0.06
HP01	JUNCTION	0.00	0.00	97.77	0	00:00	0.00
HP02	JUNCTION	0.00	0.03	97.70	0	01:21	0.03
HP03	JUNCTION	0.00	0.07	97.64	0	01:13	0.07
HP04	JUNCTION	0.00	0.08	97.50	0	01:16	0.08
HP05	JUNCTION	0.00	0.03	97.50	0	01:16	0.03
HP06	JUNCTION	0.00	0.08	97.42	0	01:24	0.08
HP07	JUNCTION	0.00	0.08	97.35	0	01:25	0.08
HP08	JUNCTION	0.00	0.09	97.21	0	01:11	0.09
HP09	JUNCTION	0.00	0.08	97.20	0	01:13	0.08
HP10	JUNCTION	0.00	0.07	97.54	0	01:18	0.07
HP11	JUNCTION	0.00	0.07	97.64	0	01:13	0.07
HP12	JUNCTION	0.00	0.00	97.92	0	00:00	0.00
HP13	JUNCTION	0.00	0.03	97.75	0	01:21	0.03
HP14	JUNCTION	0.00	0.06	97.68	0	01:13	0.06
HP16	JUNCTION	0.00	0.06	97.51	0	01:14	0.06
HP17	JUNCTION	0.00	0.00	97.67	0	00:00	0.00
HP18	JUNCTION	0.00	0.07	97.39	0	01:19	0.07
HP19	JUNCTION	0.00	0.04	97.86	0	01:14	0.04
MH1013-CopeDr	OUTFALL	1.11	1.11	94.97	0	00:00	1.11
MS-CopeDr	OUTFALL	0.00	0.08	96.95	0	01:13	0.08
OUT-MonahanDrain	OUTFALL	0.00	0.00	96.00	0	00:00	0.00
MH100	STORAGE	0.51	0.69	95.15	0	01:22	0.69
MH102	STORAGE	0.75	0.90	95.12	0	01:22	0.90
MH104	STORAGE	0.99	1.09	95.07	0	01:22	1.09
MH106	STORAGE	1.09	1.13	95.01	0	01:22	1.13
MH200	STORAGE	0.00	0.10	95.46	0	01:14	0.10
MH202	STORAGE	0.00	0.18	95.27	0	02:00	0.18
MH204	STORAGE	0.28	0.48	95.17	0	01:22	0.48
MH206	STORAGE	0.16	0.39	95.20	0	01:22	0.39
MH208	STORAGE	0.10	0.38	95.25	0	01:22	0.38
MH208A	STORAGE	0.11	0.37	95.30	0	01:21	0.37
MH210	STORAGE	0.11	0.37	95.39	0	01:20	0.37

MH212	STORAGE	0.09	0.28	95.43	0	01:20	0.28
MH214(E)	STORAGE	0.15	0.33	95.74	0	01:20	0.33
MH214(W)	STORAGE	0.05	0.15	95.51	0	01:17	0.15
MH216	STORAGE	0.00	0.15	95.39	0	01:15	0.15
MH218	STORAGE	0.00	0.23	95.39	0	01:15	0.23
MH220	STORAGE	0.00	0.27	95.26	0	01:21	0.27
MH222	STORAGE	0.15	0.41	95.23	0	01:21	0.41
MH224	STORAGE	0.20	0.44	95.21	0	01:21	0.44
MH300	STORAGE	0.34	0.52	95.15	0	01:22	0.52
MH302	STORAGE	0.40	0.57	95.14	0	01:22	0.57
MH400	STORAGE	0.00	0.18	95.56	0	01:21	0.18
MH402	STORAGE	0.00	0.31	95.33	0	01:19	0.31
MH404	STORAGE	0.09	0.36	95.24	0	01:22	0.36
MH406	STORAGE	0.29	0.53	95.21	0	01:22	0.53
MH408	STORAGE	0.00	0.16	95.17	0	01:22	0.16

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
CB01-02	JUNCTION	138.95	138.95	0	01:10	0.209	0.21	-0.141
CB03-04	JUNCTION	273.52	273.52	0	01:10	0.401	0.413	-0.283
CB05-06	JUNCTION	220.24	277.80	0	01:11	0.323	0.403	-0.161
CB07-08	JUNCTION	77.55	104.54	0	01:11	0.117	0.125	-0.238
CB09-10	JUNCTION	106.63	174.86	0	01:16	0.16	0.278	0.458
CB11-12	JUNCTION	177.61	196.49	0	01:23	0.261	0.398	-0.317
CB13-14	JUNCTION	293.96	376.30	0	01:10	0.424	0.678	-0.090
CB17-18	JUNCTION	54.15	128.27	0	01:11	0.078	0.089	0.131
CB19-20	JUNCTION	92.83	143.30	0	01:11	0.134	0.205	0.120
CB21-22	JUNCTION	54.15	97.30	0	01:12	0.078	0.13	-0.250
CB23-24	JUNCTION	166.32	166.32	0	01:10	0.24	0.255	-0.352
CB25-26	JUNCTION	92.83	92.83	0	01:10	0.134	0.134	-0.394
CB25A-26A	JUNCTION	69.62	70.06	0	01:10	0.1	0.116	0.071
CB27-28	JUNCTION	61.89	61.89	0	01:10	0.0892	0.0892	-1.723
CB29-30	JUNCTION	205.00	246.61	0	01:10	0.295	0.333	0.332
CB31-32	JUNCTION	116.04	171.89	0	01:12	0.167	0.242	0.109
CB33-34	JUNCTION	123.77	143.94	0	01:16	0.178	0.257	0.121
CB35-36	JUNCTION	119.90	154.58	0	01:12	0.173	0.254	0.191
CB37-38	JUNCTION	23.21	94.92	0	01:19	0.0334	0.111	-0.074
HP01	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 ltr
HP02	JUNCTION	0.00	38.06	0	01:12	0	0.0119	8.595
HP03	JUNCTION	0.00	118.57	0	01:11	0	0.0793	0.559
HP04	JUNCTION	0.00	149.83	0	01:12	0	0.124	-1.101
HP05	JUNCTION	0.00	22.76	0	01:12	0	0.00254	4.603
HP06	JUNCTION	0.00	149.04	0	01:23	0	0.142	0.727
HP07	JUNCTION	0.00	137.37	0	01:24	0	0.168	0.093
HP08	JUNCTION	0.00	205.10	0	01:24	0	0.254	-0.043
HP09	JUNCTION	0.00	239.07	0	01:12	0	0.303	0.138
HP10	JUNCTION	0.00	87.99	0	01:17	0	0.0777	-0.560
HP11	JUNCTION	0.00	191.53	0	01:11	0	0.0855	-0.550
HP12	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 ltr
HP13	JUNCTION	0.00	21.06	0	01:13	0	0.0153	1.890
HP14	JUNCTION	0.00	69.21	0	01:11	0	0.0513	0.762
HP16	JUNCTION	0.00	89.94	0	01:13	0	0.0812	-0.735
HP17	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 ltr
HP18	JUNCTION	0.00	86.50	0	01:18	0	0.0785	0.263
HP19	JUNCTION	0.00	27.84	0	01:10	0	0.0163	-0.152
MH1013-CopeDr	OUTFALL	0.00	692.77	0	01:23	0	3.52	0.000
MS-CopeDr	OUTFALL	19.35	248.60	0	01:13	0.0279	0.33	0.000
OUT-MonahanDrain	OUTFALL	213.70	213.70	0	01:15	0.454	0.454	0.000
MH100	STORAGE	0.00	247.24	0	01:20	0	1.22	-0.001
MH102	STORAGE	0.00	434.93	0	01:22	0	2.2	0.001
MH104	STORAGE	0.00	692.75	0	01:22	0	3.51	0.000
MH106	STORAGE	0.00	692.77	0	01:23	0	3.52	-0.000
MH200	STORAGE	0.00	14.42	0	01:14	0	0.0756	-0.002
MH202	STORAGE	0.00	39.25	0	01:14	0	0.197	0.057
MH204	STORAGE	0.00	141.54	0	01:20	0	0.694	0.003
MH206	STORAGE	0.00	102.41	0	01:21	0	0.489	-0.000
MH208	STORAGE	0.00	87.72	0	01:20	0	0.424	-0.024
MH208A	STORAGE	0.00	87.73	0	01:18	0	0.424	0.036
MH210	STORAGE	0.00	87.74	0	01:16	0	0.425	0.057
MH212	STORAGE	0.00	43.36	0	01:20	0	0.22	-0.026
MH214(E)	STORAGE	0.00	43.36	0	01:19	0	0.22	0.023
MH214(W)	STORAGE	0.00	16.80	0	01:02	0	0.0547	0.240
MH216	STORAGE	0.00	16.80	0	01:17	0	0.0545	-0.308
MH218	STORAGE	0.00	71.87	0	01:14	0	0.315	-0.009
MH220	STORAGE	0.00	71.86	0	01:15	0	0.315	0.012
MH222	STORAGE	0.00	102.62	0	01:19	0	0.484	-0.042
MH224	STORAGE	0.00	135.74	0	01:21	0	0.699	-0.005
MH300	STORAGE	0.00	173.32	0	01:21	0	0.875	-0.000
MH302	STORAGE	0.00	179.62	0	01:24	0	0.905	-0.001
MH400	STORAGE	0.00	44.11	0	01:20	0	0.198	-0.016
MH402	STORAGE	0.00	123.02	0	01:13	0	0.533	0.002
MH404	STORAGE	0.00	122.90	0	01:14	0	0.544	0.002
MH406	STORAGE	0.00	186.98	0	01:17	0	0.867	0.002

MH408	STORAGE	0.00	25.05	0	01:16	0	0.112	-0.000

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Node Surcharge Summary
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No nodes were surcharged.


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Node Flooding Summary
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No nodes were flooded.


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Storage Volume Summary
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Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
MH100	0.001	17	0	0	0.001	23	0 01:22	247.41
MH102	0.001	24	0	0	0.001	28	0 01:22	434.94
MH104	0.001	31	0	0	0.001	34	0 01:22	692.77
MH106	0.001	35	0	0	0.001	36	0 01:22	692.77
MH200	0.000	0	0	0	0.000	5	0 01:14	14.42
MH202	0.000	0	0	0	0.000	7	0 02:00	39.25
MH204	0.000	10	0	0	0.000	17	0 01:22	141.54
MH206	0.000	6	0	0	0.000	15	0 01:22	102.41
MH208	0.000	4	0	0	0.000	14	0 01:22	87.71
MH208A	0.000	4	0	0	0.000	14	0 01:21	87.72
MH210	0.000	4	0	0	0.000	14	0 01:20	87.73
MH212	0.000	4	0	0	0.000	11	0 01:20	44.02
MH214(E)	0.000	6	0	0	0.000	13	0 01:20	43.36
MH214(W)	0.000	2	0	0	0.000	6	0 01:17	16.80
MH216	0.000	0	0	0	0.000	6	0 01:15	16.81
MH218	0.000	0	0	0	0.000	9	0 01:15	71.86
MH220	0.000	0	0	0	0.000	10	0 01:21	71.67
MH222	0.000	6	0	0	0.000	16	0 01:21	102.57
MH224	0.000	7	0	0	0.000	16	0 01:21	135.71
MH300	0.000	13	0	0	0.001	20	0 01:22	173.32
MH302	0.000	15	0	0	0.001	21	0 01:22	179.65
MH400	0.000	0	0	0	0.000	9	0 01:21	44.11
MH402	0.000	0	0	0	0.000	12	0 01:19	122.90
MH404	0.000	4	0	0	0.000	14	0 01:22	122.74
MH406	0.000	10	0	0	0.001	18	0 01:22	186.85
MH408	0.000	0	0	0	0.000	7	0 01:22	25.03

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Outfall Loading Summary
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Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
MH1013-CopeDr	96.20	6.05	692.77	3.516
MS-CopeDr	2.10	25.95	248.60	0.330
OUT-MonahanDrain	1.29	58.35	213.70	0.454
System	33.20	90.35	1137.95	4.300

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Link Flow Summary
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Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
MH100-102	CONDUIT	247.41	0 01:25	0.57	0.65	0.96
MH102-104	CONDUIT	434.94	0 01:22	0.68	0.71	1.00
MH104-106	CONDUIT	692.77	0 01:23	0.80	0.74	1.00
MH106-1013	CONDUIT	692.77	0 01:23	0.80	0.66	1.00
MH200-202	CONDUIT	14.42	0 01:14	0.80	0.34	0.39
MH202-204	CONDUIT	39.25	0 01:15	0.79	0.41	0.55
MH204-300	CONDUIT	141.54	0 01:24	0.57	0.47	0.83
MH206-204	CONDUIT	102.41	0 01:24	0.61	0.50	0.74
MH208-206	CONDUIT	87.71	0 01:21	0.72	0.41	0.60
MH208A-208	CONDUIT	87.72	0 01:20	0.94	0.38	0.49
MH210-208A	CONDUIT	87.73	0 01:18	0.87	0.43	0.48
MH212-210	CONDUIT	44.02	0 01:57	0.84	0.33	0.42
MH214-212	CONDUIT	43.36	0 01:20	0.80	0.31	0.38

MH214-216	CONDUIT	16.80	0	01:17	0.59	0.11	0.24
MH216-218	CONDUIT	16.81	0	01:18	0.34	0.11	0.38
MH218-220	CONDUIT	71.86	0	01:15	0.88	0.50	0.55
MH220-222	CONDUIT	71.67	0	01:19	0.74	0.50	0.66
MH222-224	CONDUIT	102.57	0	01:20	0.57	0.52	0.80
MH224-102	CONDUIT	135.71	0	01:21	0.68	0.71	0.91
MH300-302	CONDUIT	173.32	0	01:24	0.65	0.61	0.90
MH302-104	CONDUIT	179.65	0	01:25	0.64	0.69	0.96
MH400-402	CONDUIT	44.11	0	01:21	0.93	0.45	0.45
MH402-404	CONDUIT	122.90	0	01:14	0.92	0.61	0.63
MH404-406	CONDUIT	122.74	0	01:17	0.81	0.58	0.70
MH406-100	CONDUIT	186.85	0	01:18	0.58	0.58	0.84
MH408-100	CONDUIT	25.03	0	01:16	0.72	0.35	0.67
MS01	CHANNEL	0.00	0	00:00	0.00	0.00	0.12
MS02	CHANNEL	38.06	0	01:12	0.12	0.00	0.13
MS03	CHANNEL	10.75	0	01:21	0.17	0.00	0.15
MS04	CHANNEL	118.57	0	01:11	0.15	0.00	0.17
MS05	CHANNEL	109.81	0	01:13	0.16	0.00	0.18
MS06	CHANNEL	149.83	0	01:12	0.17	0.00	0.18
MS07	CHANNEL	22.76	0	01:12	0.09	0.00	0.13
MS08	CHANNEL	38.16	0	01:11	0.15	0.00	0.16
MS09	CHANNEL	126.94	0	01:16	0.15	0.00	0.18
MS10	CHANNEL	85.25	0	01:23	0.11	0.00	0.19
MS11	CHANNEL	145.72	0	01:24	0.21	0.00	0.16
MS12	CHANNEL	137.37	0	01:24	0.18	0.00	0.16
MS13	CHANNEL	136.70	0	01:25	0.55	0.00	0.09
MS14	CHANNEL	204.10	0	01:24	0.22	0.00	0.21
MS16	CHANNEL	239.07	0	01:12	0.20	0.01	0.20
MS17	CHANNEL	236.29	0	01:13	1.18	0.00	0.08
MS18	CHANNEL	63.81	0	01:22	0.11	0.00	0.20
MS19	CHANNEL	85.88	0	01:18	0.10	0.00	0.19
MS20	CHANNEL	87.99	0	01:17	0.15	0.00	0.17
MS21	CHANNEL	97.18	0	01:13	0.12	0.00	0.17
MS22	CHANNEL	141.13	0	01:11	0.18	0.00	0.17
MS23	CHANNEL	42.12	0	01:10	0.26	0.00	0.16
MS24	CHANNEL	0.00	0	00:00	0.00	0.00	0.03
MS25	CHANNEL	0.00	0	00:00	0.00	0.00	0.09
MS26	CHANNEL	21.06	0	01:13	0.05	0.00	0.13
MS27	CHANNEL	18.75	0	01:21	0.14	0.00	0.14
MS28	CHANNEL	69.21	0	01:11	0.11	0.00	0.16
MS29	CHANNEL	60.60	0	01:13	0.27	0.00	0.08
MS30	CHANNEL	76.00	0	01:13	0.25	0.00	0.16
MS31	CHANNEL	89.94	0	01:13	0.16	0.00	0.13
MS32	CHANNEL	0.00	0	00:00	0.00	0.00	0.10
MS33	CHANNEL	0.00	0	00:00	0.00	0.00	0.13
MS34	CHANNEL	80.42	0	01:11	0.18	0.00	0.16
MS35	CHANNEL	87.63	0	01:14	0.09	0.00	0.18
MS36	CHANNEL	86.50	0	01:18	0.08	0.00	0.18
MS37	CHANNEL	86.16	0	01:19	0.62	0.00	0.06
MS38	CHANNEL	88.59	0	01:19	0.52	0.00	0.07
MS39	CHANNEL	27.84	0	01:10	0.10	0.00	0.11
MS40	CHANNEL	19.45	0	01:14	0.10	0.00	0.13
O-CB01-02	ORIFICE	44.11	0	01:20			1.00
O-CB03-04	ORIFICE	79.06	0	01:12			1.00
O-CB05-06	ORIFICE	64.25	0	01:14			1.00
O-CB07-08	ORIFICE	25.05	0	01:16			1.00
O-CB09-10	ORIFICE	35.47	0	01:24			1.00
O-CB11-12	ORIFICE	52.13	0	01:25			1.00
O-CB13-14	ORIFICE	78.38	0	01:12			1.00
O-CB17-18	ORIFICE	14.42	0	01:14			1.00
O-CB19-20	ORIFICE	24.83	0	01:14			1.00
O-CB23-24	ORIFICE	44.49	0	01:13			1.00
O-CB25-26	ORIFICE	24.74	0	01:14			1.00
O-CB25A-26A	ORIFICE	18.65	0	01:21			1.00
O-CB29-30	ORIFICE	55.09	0	01:14			1.00
O-CB31-32	ORIFICE	30.95	0	01:18			1.00
O-CB33-34	ORIFICE	33.23	0	01:24			1.00
O-CB35-36	ORIFICE	31.81	0	01:19			1.00
O-CB21-22	DUMMY	14.70	0	01:02			
O-CB27-28	DUMMY	16.80	0	01:02			
O-CB37-38	DUMMY	6.30	0	01:02			

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Flow Classification Summary
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Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
MH100-102	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH102-104	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH104-106	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH106-1013	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH200-202	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MH202-204	1.00	0.00	0.73	0.00	0.27	0.00	0.00	0.00	0.99	0.00
MH204-300	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH206-204	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH208-206	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.89	0.00
MH208A-208	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00

MH210-208A	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MH212-210	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MH214-212	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MH214-216	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MH216-218	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.01	0.00
MH218-220	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.09	0.00
MH220-222	1.00	0.00	0.72	0.00	0.28	0.00	0.00	0.00	0.99	0.00
MH222-224	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH224-102	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH300-302	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH302-104	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH400-402	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MH402-404	1.00	0.00	0.70	0.00	0.30	0.00	0.00	0.00	0.99	0.00
MH404-406	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH406-100	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH408-100	1.00	0.00	0.80	0.00	0.20	0.00	0.00	0.00	0.99	0.00
MS01	1.00	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS02	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS03	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS04	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS05	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS06	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS07	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS08	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS09	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS10	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS11	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS12	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS13	1.00	0.00	0.00	0.00	0.92	0.08	0.00	0.00	1.00	0.00
MS14	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS16	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS17	1.00	0.00	0.00	0.00	0.95	0.05	0.00	0.00	0.01	0.00
MS18	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS19	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS20	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS21	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS22	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS23	1.00	0.95	0.00	0.00	0.01	0.00	0.00	0.05	0.01	0.00
MS24	1.00	0.95	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS25	1.00	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS26	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS27	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS28	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS29	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.02	0.00
MS30	1.00	0.95	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00
MS31	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS32	1.00	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS33	1.00	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS34	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS35	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS36	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS37	1.00	0.00	0.00	0.00	0.98	0.02	0.00	0.00	0.01	0.00
MS38	1.00	0.00	0.96	0.00	0.03	0.01	0.00	0.00	0.99	0.00
MS39	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS40	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Full: Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
MH102-104	0.01	0.01	0.94	0.01	0.01
MH104-106	0.94	0.94	168.00	0.01	0.01
MH106-1013	168.00	168.00	168.00	0.01	0.97

Analysis begun on: Fri Mar 29 13:35:19 2019
Analysis ended on: Fri Mar 29 13:35:41 2019
Total elapsed time: 00:00:22

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
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WARNING 02: maximum depth increased for Node CB25-26
WARNING 02: maximum depth increased for Node CB29-30

*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 21
Number of nodes ........... 66
Number of links ........... 84
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                   Data       Recording
Name             Data Source                       Type       Interval
-----------------------------------------------------------------------
RG               S24hr-100yr_JFSA                  INTENSITY   12 min.


********************
Subcatchment Summary
********************
Name                       Area     Width   %Imperv    %Slope Rain Gage            Outlet
-------------------------------------------------------------------------------------------------------------
A01                        0.43     96.75     50.00    0.5000 RG                   CB01-02
A02                        0.77    173.25     57.10    0.5000 RG                   CB03-04
A03                        0.62    139.50     57.10    0.5000 RG                   CB05-06
A04                        0.24     54.00     50.00    0.5000 RG                   CB07-08
A05                        0.33     74.25     50.00    0.5000 RG                   CB09-10
A06                        0.16     36.00     64.30    0.5000 RG                   CB27-28
A07                        0.53    119.25     64.30    0.5000 RG                   CB29-30
A08                        0.30     67.50     64.30    0.5000 RG                   CB31-32
A09                        0.32     72.00     64.30    0.5000 RG                   CB33-34
A10                        0.50    112.50     57.10    0.5000 RG                   CB11-12
A11A                       0.24     54.00     64.30    0.5000 RG                   CB25-26
A11B                       0.18     40.50     64.30    0.5000 RG                   CB25A-26A
A12                        0.43     96.75     64.30    0.5000 RG                   CB23-24
A13                        0.14     31.50     64.30    0.5000 RG                   CB21-22
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A14                        0.14     31.50     64.30    0.5000 RG                   CB17-18
A15                        0.24     54.00     64.30    0.5000 RG                   CB19-20
A16                        0.31     69.75     64.30    0.5000 RG                   CB35-36
A17                        0.06     13.50     64.30    0.5000 RG                   CB37-38
A18                        0.76    171.00     64.30    0.5000 RG                   CB13-14
OFF01                      1.38    310.50     25.00    0.5000 RG                   OUT-MonahanDrain
OFF02                      0.05     11.25     64.30    0.5000 RG                   MS-CopeDr

************
Node Summary
************
                                           Invert      Max.    Ponded    External
Name                 Type                   Elev.     Depth      Area    Inflow
-------------------------------------------------------------------------------
CB01-02              JUNCTION               95.87      2.60       0.0
CB03-04              JUNCTION               95.78      2.60       0.0
CB05-06              JUNCTION               95.62      2.60       0.0
CB07-08              JUNCTION               95.67      2.60       0.0
CB09-10              JUNCTION               95.53      2.60       0.0
CB11-12              JUNCTION               95.53      2.60       0.0
CB13-14              JUNCTION               95.29      2.60       0.0
CB17-18              JUNCTION               95.79      2.60       0.0
CB19-20              JUNCTION               95.72      2.60       0.0
CB21-22              JUNCTION               97.41      1.00       0.0
CB23-24              JUNCTION               95.82      2.60       0.0
CB25-26              JUNCTION               96.07      2.60       0.0
CB25A-26A            JUNCTION               95.92      2.60       0.0
CB27-28              JUNCTION               97.64      1.00       0.0
CB29-30              JUNCTION               95.77      2.60       0.0
CB31-32              JUNCTION               95.67      2.60       0.0
CB33-34              JUNCTION               95.50      2.60       0.0
CB35-36              JUNCTION               95.49      2.60       0.0
CB37-38              JUNCTION               97.23      1.00       0.0
HP01                 JUNCTION               97.77      1.00       0.0
HP02                 JUNCTION               97.67      1.00       0.0
HP03                 JUNCTION               97.57      1.00       0.0
HP04                 JUNCTION               97.42      1.00       0.0
HP05                 JUNCTION               97.47      1.00       0.0
HP06                 JUNCTION               97.34      1.00       0.0
HP07                 JUNCTION               97.27      1.00       0.0
HP08                 JUNCTION               97.12      1.00       0.0
HP09                 JUNCTION               97.12      1.00       0.0
HP10                 JUNCTION               97.47      1.00       0.0
HP11                 JUNCTION               97.57      1.00       0.0
HP12                 JUNCTION               97.92      1.00       0.0
```

HP13	JUNCTION	97.72	1.00	0.0
HP14	JUNCTION	97.62	1.00	0.0
HP16	JUNCTION	97.45	1.00	0.0
HP17	JUNCTION	97.67	1.00	0.0
HP18	JUNCTION	97.32	1.00	0.0
HP19	JUNCTION	97.82	1.00	0.0
MH1013-CopeDr	OUTFALL	93.86	1.05	0.0
MS-CopeDr	OUTFALL	96.87	1.00	0.0
OUT-MonahanDrain	OUTFALL	96.00	0.00	0.0
MH100	STORAGE	94.46	3.03	0.0
MH102	STORAGE	94.22	3.19	0.0
MH104	STORAGE	93.98	3.24	0.0
MH106	STORAGE	93.88	3.14	0.0
MH200	STORAGE	95.36	2.15	0.0
MH202	STORAGE	95.09	2.65	0.0
MH204	STORAGE	94.69	2.80	0.0
MH206	STORAGE	94.81	2.71	0.0
MH208	STORAGE	94.87	2.69	0.0
MH208A	STORAGE	94.92	2.60	0.0
MH210	STORAGE	95.02	2.68	0.0
MH212	STORAGE	95.15	2.48	0.0
MH214(E)	STORAGE	95.41	2.55	0.0
MH214(W)	STORAGE	95.36	2.60	0.0
MH216	STORAGE	95.24	2.40	0.0
MH218	STORAGE	95.16	2.43	0.0
MH220	STORAGE	94.99	2.66	0.0
MH222	STORAGE	94.82	2.56	0.0
MH224	STORAGE	94.77	2.74	0.0
MH300	STORAGE	94.63	2.66	0.0
MH302	STORAGE	94.57	2.64	0.0
MH400	STORAGE	95.38	2.03	0.0
MH402	STORAGE	95.02	2.63	0.0
MH404	STORAGE	94.88	2.59	0.0
MH406	STORAGE	94.68	2.90	0.0
MH408	STORAGE	95.01	2.36	0.0

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Link Summary
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Name	From Node	To Node	Type	Length	%Slope	Roughness
MH100-102	MH100	MH102	CONDUIT	78.0	0.1154	0.0130
MH102-104	MH102	MH104	CONDUIT	78.4	0.1148	0.0130
MH104-106	MH104	MH106	CONDUIT	84.6	0.1182	0.0130
MH106-1013	MH106	MH1013-CopeDr	CONDUIT	13.6	0.1473	0.0130
MH200-202	MH200	MH202	CONDUIT	30.3	0.4951	0.0130
MH202-204	MH202	MH204	CONDUIT	56.0	0.3036	0.0130
MH204-300	MH204	MH300	CONDUIT	20.4	0.2449	0.0130
MH206-204	MH206	MH204	CONDUIT	22.1	0.2257	0.0130
MH208-206	MH208	MH206	CONDUIT	49.2	0.2439	0.0130
MH208A-208	MH208A	MH208	CONDUIT	10.3	0.2901	0.0130
MH210-208A	MH210	MH208A	CONDUIT	35.1	0.2280	0.0130
MH212-210	MH212	MH210	CONDUIT	13.9	0.2163	0.0130
MH214-212	MH214(E)	MH212	CONDUIT	119.7	0.2422	0.0130
MH214-216	MH214(W)	MH216	CONDUIT	46.3	0.3022	0.0130
MH216-218	MH216	MH218	CONDUIT	17.5	0.2864	0.0130
MH218-220	MH218	MH220	CONDUIT	67.2	0.2531	0.0130
MH220-222	MH220	MH222	CONDUIT	35.9	0.2509	0.0130
MH222-224	MH222	MH224	CONDUIT	18.8	0.2124	0.0130
MH224-102	MH224	MH102	CONDUIT	86.2	0.1973	0.0130
MH300-302	MH300	MH302	CONDUIT	23.0	0.2173	0.0130
MH302-104	MH302	MH104	CONDUIT	50.3	0.1790	0.0130
MH400-402	MH400	MH402	CONDUIT	68.3	0.3075	0.0130
MH402-404	MH402	MH404	CONDUIT	64.2	0.2182	0.0130
MH404-406	MH404	MH406	CONDUIT	20.7	0.2415	0.0130
MH406-100	MH406	MH100	CONDUIT	95.9	0.1459	0.0130
MH408-100	MH408	MH100	CONDUIT	18.3	0.5465	0.0130
MS01	HP01	CB01-02	CONDUIT	36.2	0.8288	0.0150
MS02	CB01-02	HP02	CONDUIT	37.2	-0.5376	0.0150
MS03	HP02	CB03-04	CONDUIT	41.8	0.6938	0.0150
MS04	CB03-04	HP03	CONDUIT	35.9	-0.5293	0.0150
MS05	HP03	CB05-06	CONDUIT	42.2	0.8294	0.0150
MS06	CB05-06	HP04	CONDUIT	31.8	-0.6289	0.0150
MS07	HP05	CB07-08	CONDUIT	22.6	0.8850	0.0150
MS08	CB07-08	HP04	CONDUIT	25.7	-0.5837	0.0150
MS09	HP04	CB09-10	CONDUIT	48.2	0.6017	0.0150
MS10	CB09-10	HP06	CONDUIT	33.6	-0.6250	0.0150
MS11	HP06	CB11-12	CONDUIT	30.5	0.6885	0.0150
MS12	CB11-12	HP07	CONDUIT	24.6	-0.5691	0.0150
MS13	HP07	HP08	CONDUIT	23.1	0.6494	0.0150
MS14	HP08	CB13-14	CONDUIT	30.0	0.7667	0.0150
MS16	CB13-14	HP09	CONDUIT	36.8	-0.6250	0.0150
MS17	HP09	MS-CopeDr	CONDUIT	10.1	2.4760	0.0150
MS18	CB33-34	HP06	CONDUIT	22.8	-1.0527	0.0150
MS19	HP10	CB33-34	CONDUIT	49.2	0.7521	0.0150
MS20	CB31-32	HP10	CONDUIT	20.2	-0.9901	0.0150
MS21	HP11	CB31-32	CONDUIT	46.1	0.6508	0.0150
MS22	CB29-30	HP11	CONDUIT	31.3	-0.6390	0.0150
MS23	CB27-28	CB29-30	CONDUIT	40.9	0.6602	0.0150
MS24	HP12	CB27-28	CONDUIT	49.7	0.5634	0.0150
MS25	HP12	CB25-26	CONDUIT	41.4	0.6039	0.0150

MS26	CB25A-26A	HP13	CONDUIT	20.5	-0.9757	0.0150
MS27	HP13	CB23-24	CONDUIT	19.5	1.5386	0.0150
MS28	CB23-24	HP14	CONDUIT	36.9	-0.5420	0.0150
MS29	HP14	CB21-22	CONDUIT	31.1	0.6753	0.0150
MS30	CB21-22	CB19-20	CONDUIT	20.5	0.4390	0.0150
MS31	CB19-20	HP16	CONDUIT	11.9	-1.0925	0.0150
MS32	HP17	CB19-20	CONDUIT	44.7	0.7830	0.0150
MS33	HP17	CB17-18	CONDUIT	30.6	0.9151	0.0150
MS34	CB17-18	HP11	CONDUIT	6.3	-2.8583	0.0150
MS35	HP16	CB35-36	CONDUIT	34.4	1.0466	0.0150
MS36	CB35-36	HP18	CONDUIT	28.8	-0.7986	0.0150
MS37	HP18	CB37-38	CONDUIT	13.0	0.6923	0.0150
MS38	CB37-38	HP08	CONDUIT	9.2	1.1957	0.0150
MS39	CB25-26	HP19	CONDUIT	29.0	-0.5172	0.0150
MS40	HP19	CB25A-26A	CONDUIT	30.7	0.9772	0.0150
O-CB01-02	CB01-02	MH400	ORIFICE			
O-CB03-04	CB03-04	MH402	ORIFICE			
O-CB05-06	CB05-06	MH406	ORIFICE			
O-CB07-08	CB07-08	MH408	ORIFICE			
O-CB09-10	CB09-10	MH100	ORIFICE			
O-CB11-12	CB11-12	MH102	ORIFICE			
O-CB13-14	CB13-14	MH104	ORIFICE			
O-CB17-18	CB17-18	MH200	ORIFICE			
O-CB19-20	CB19-20	MH202	ORIFICE			
O-CB23-24	CB23-24	MH210	ORIFICE			
O-CB25-26	CB25-26	MH214(E)	ORIFICE			
O-CB25A-26A	CB25A-26A	MH214(E)	ORIFICE			
O-CB29-30	CB29-30	MH218	ORIFICE			
O-CB31-32	CB31-32	MH222	ORIFICE			
O-CB33-34	CB33-34	MH224	ORIFICE			
O-CB35-36	CB35-36	MH300	ORIFICE			
O-CB21-22	CB21-22	MH206	OUTLET			
O-CB27-28	CB27-28	MH214(W)	OUTLET			
O-CB37-38	CB37-38	MH302	OUTLET			

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Cross Section Summary
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Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
MH100-102	CIRCULAR	0.75	0.44	0.19	0.75	1	378.18
MH102-104	CIRCULAR	0.90	0.64	0.23	0.90	1	613.32
MH104-106	CIRCULAR	1.05	0.87	0.26	1.05	1	939.07
MH106-1013	CIRCULAR	1.05	0.87	0.26	1.05	1	1047.94
MH200-202	CIRCULAR	0.25	0.05	0.06	0.25	1	41.84
MH202-204	CIRCULAR	0.38	0.11	0.09	0.38	1	96.61
MH204-300	CIRCULAR	0.60	0.28	0.15	0.60	1	303.85
MH206-204	CIRCULAR	0.53	0.22	0.13	0.53	1	204.34
MH208-206	CIRCULAR	0.53	0.22	0.13	0.53	1	212.38
MH208A-208	CIRCULAR	0.53	0.22	0.13	0.53	1	231.66
MH210-208A	CIRCULAR	0.53	0.22	0.13	0.53	1	205.36
MH212-210	CIRCULAR	0.45	0.16	0.11	0.45	1	132.60
MH214-212	CIRCULAR	0.45	0.16	0.11	0.45	1	140.32
MH214-216	CIRCULAR	0.45	0.16	0.11	0.45	1	156.74
MH216-218	CIRCULAR	0.45	0.16	0.11	0.45	1	152.58
MH218-220	CIRCULAR	0.45	0.16	0.11	0.45	1	143.45
MH220-222	CIRCULAR	0.45	0.16	0.11	0.45	1	142.82
MH222-224	CIRCULAR	0.53	0.22	0.13	0.53	1	198.23
MH224-102	CIRCULAR	0.53	0.22	0.13	0.53	1	191.03
MH300-302	CIRCULAR	0.60	0.28	0.15	0.60	1	286.24
MH302-104	CIRCULAR	0.60	0.28	0.15	0.60	1	259.82
MH400-402	CIRCULAR	0.38	0.11	0.09	0.38	1	97.23
MH402-404	CIRCULAR	0.53	0.22	0.13	0.53	1	200.92
MH404-406	CIRCULAR	0.53	0.22	0.13	0.53	1	211.38
MH406-100	CIRCULAR	0.68	0.36	0.17	0.68	1	321.12
MH408-100	CIRCULAR	0.30	0.07	0.07	0.30	1	71.49
MS01	18.0mROW	1.00	15.07	0.37	18.00	1	47060.74
MS02	18.0mROW	1.00	15.07	0.37	18.00	1	37904.57
MS03	18.0mROW	1.00	15.07	0.37	18.00	1	43058.71
MS04	18.0mROW	1.00	15.07	0.37	18.00	1	37607.77
MS05	18.0mROW	1.00	15.07	0.37	18.00	1	47079.32
MS06	18.0mROW	1.00	15.07	0.37	18.00	1	40996.87
MS07	18.0mROW	1.00	15.07	0.37	18.00	1	48631.11
MS08	18.0mROW	1.00	15.07	0.37	18.00	1	39493.69
MS09	18.0mROW	1.00	15.07	0.37	18.00	1	40098.15
MS10	18.0mROW	1.00	15.07	0.37	18.00	1	40868.55
MS11	18.0mROW	1.00	15.07	0.37	18.00	1	42895.31
MS12	18.0mROW	1.00	15.07	0.37	18.00	1	38998.23
MS13	18.0mROW	1.00	15.07	0.37	18.00	1	41657.11
MS14	18.0mROW	1.00	15.07	0.37	18.00	1	45264.17
MS16	18.0mROW	1.00	15.07	0.37	18.00	1	40868.55
MS17	18.0mROW	1.00	15.07	0.37	18.00	1	81343.11
MS18	18.0mROW	1.00	15.07	0.37	18.00	1	53038.98
MS19	18.0mROW	1.00	15.07	0.37	18.00	1	44830.07
MS20	18.0mROW	1.00	15.07	0.37	18.00	1	51439.28
MS21	18.0mROW	1.00	15.07	0.37	18.00	1	41702.27
MS22	18.0mROW	1.00	15.07	0.37	18.00	1	41323.03
MS23	18.0mROW	1.00	15.07	0.37	18.00	1	42001.99
MS24	16.5mROW	1.00	13.94	0.41	16.50	1	38526.52
MS25	16.5mROW	1.00	13.94	0.41	16.50	1	39886.81

MS26	16.5mROW	1.00	13.94	0.41	16.50	1	50699.53
MS27	18.0mROW	1.00	15.07	0.37	18.00	1	64123.02
MS28	18.0mROW	1.00	15.07	0.37	18.00	1	38058.35
MS29	18.0mROW	1.00	15.07	0.37	18.00	1	42479.49
MS30	18.0mROW	1.00	15.07	0.37	18.00	1	34252.43
MS31	18.0mROW	1.00	15.07	0.37	18.00	1	54032.63
MS32	18.0mROW	1.00	15.07	0.37	18.00	1	45743.76
MS33	18.0mROW	1.00	15.07	0.37	18.00	1	49450.69
MS34	18.0mROW	1.00	15.07	0.37	18.00	1	87397.61
MS35	18.0mROW	1.00	15.07	0.37	18.00	1	52884.55
MS36	18.0mROW	1.00	15.07	0.37	18.00	1	46197.61
MS37	18.0mROW	1.00	15.07	0.37	18.00	1	43013.00
MS38	18.0mROW	1.00	15.07	0.37	18.00	1	56527.90
MS39	16.5mROW	1.00	13.94	0.41	16.50	1	36915.19
MS40	16.5mROW	1.00	13.94	0.41	16.50	1	50740.80

****
Transect Summary
****

Transect 16.5mROW

Area:

0.0009	0.0038	0.0085	0.0150	0.0235
0.0338	0.0458	0.0582	0.0715	0.0860
0.1017	0.1185	0.1364	0.1555	0.1757
0.1971	0.2196	0.2431	0.2667	0.2903
0.3140	0.3376	0.3613	0.3849	0.4086
0.4322	0.4559	0.4795	0.5032	0.5268
0.5505	0.5741	0.5978	0.6214	0.6451
0.6687	0.6924	0.7160	0.7397	0.7634
0.7870	0.8107	0.8343	0.8580	0.8817
0.9053	0.9290	0.9527	0.9763	1.0000

Hrad:

0.0236	0.0472	0.0708	0.0944	0.1179
0.1415	0.1765	0.2223	0.2629	0.2979
0.3279	0.3538	0.3760	0.3951	0.4117
0.4260	0.4384	0.4499	0.4625	0.4762
0.4908	0.5059	0.5216	0.5377	0.5541
0.5708	0.5877	0.6048	0.6220	0.6394
0.6570	0.6746	0.6923	0.7101	0.7279
0.7456	0.7638	0.7818	0.7998	0.8179
0.8360	0.8542	0.8723	0.8905	0.9087
0.9269	0.9452	0.9634	0.9817	1.0000

Width:

0.0794	0.1588	0.2382	0.3177	0.3971
0.4765	0.5163	0.5405	0.5887	0.6370
0.6852	0.7335	0.7817	0.8299	0.8782
0.9264	0.9747	0.9988	0.9988	0.9989
0.9989	0.9990	0.9990	0.9990	0.9991
0.9991	0.9991	0.9992	0.9992	0.9993
0.9993	0.9993	0.9994	0.9994	0.9994
0.9995	0.9995	0.9996	0.9996	0.9996
0.9997	0.9997	0.9997	0.9998	0.9998
0.9999	0.9999	0.9999	1.0000	1.0000

Transect 18.0mROW

Area:

0.0009	0.0035	0.0078	0.0139	0.0217
0.0313	0.0424	0.0539	0.0664	0.0802
0.0953	0.1117	0.1292	0.1481	0.1682
0.1895	0.2121	0.2359	0.2597	0.2836
0.3075	0.3313	0.3552	0.3791	0.4029
0.4268	0.4507	0.4746	0.4984	0.5223
0.5462	0.5701	0.5939	0.6178	0.6417
0.6656	0.6895	0.7133	0.7372	0.7611
0.7850	0.8089	0.8328	0.8567	0.8805
0.9044	0.9283	0.9522	0.9761	1.0000

Hrad:

0.0262	0.0524	0.0787	0.1049	0.1311
0.1573	0.1962	0.2469	0.2908	0.3274
0.3577	0.3829	0.4038	0.4212	0.4357
0.4478	0.4579	0.4670	0.4779	0.4901
0.5034	0.5175	0.5323	0.5476	0.5632
0.5793	0.5956	0.6121	0.6289	0.6458
0.6629	0.6801	0.6974	0.7148	0.7323
0.7498	0.7674	0.7851	0.8029	0.8206
0.8384	0.8563	0.8742	0.8921	0.9100
0.9280	0.9460	0.9640	0.9820	1.0000

Width:

0.0728	0.1456	0.2184	0.2912	0.3640
0.4368	0.4733	0.4996	0.5522	0.6047
0.6573	0.7098	0.7624	0.8149	0.8675
0.9201	0.9726	0.9989	0.9989	0.9990
0.9990	0.9990	0.9991	0.9991	0.9991
0.9992	0.9992	0.9992	0.9993	0.9993
0.9994	0.9994	0.9994	0.9995	0.9995
0.9995	0.9996	0.9996	0.9996	0.9997
0.9997	0.9997	0.9998	0.9998	0.9998
0.9999	0.9999	0.9999	1.0000	1.0000

```
*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Starting Date ............ 06/18/2018 00:00:00
Ending Date .............. 06/25/2018 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Wet Time Step ............ 00:05:00
Dry Time Step ............ 00:05:00
Routing Time Step ........ 2.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 4
Head Tolerance ........... 0.001500 m

**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial LID Storage ......         0.003         0.320
Total Precipitation ......         0.839       103.232
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.314        38.664
Surface Runoff ...........         0.527        64.868
Final Storage ............         0.003         0.320
Continuity Error (%) .....        -0.290
```

```
**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.528         5.278
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.528         5.279
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.022         0.217
Final Stored Volume ......         0.022         0.217
Continuity Error (%) .....        -0.009

*************************
Highest Continuity Errors
*************************
Node CB27-28 (-1.07%)

***************************
Time-Step Critical Elements
***************************
None

********************************
Highest Flow Instability Indexes
********************************
All links are stable.

*************************
Routing Time Step Summary
*************************
Minimum Time Step           :      0.66 sec
Average Time Step           :      2.00 sec
Maximum Time Step           :      2.00 sec
Percent in Steady State     :      0.00
Average Iterations per Step :      2.00
Percent Not Converging      :      0.00
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff LPS	Runoff Coeff
A01	103.23	0.00	0.00	39.70	63.80	0.27	115.47	0.618
A02	103.23	0.00	0.00	33.86	69.69	0.54	220.91	0.675
A03	103.23	0.00	0.00	33.86	69.69	0.43	177.88	0.675
A04	103.23	0.00	0.00	39.70	63.80	0.15	64.45	0.618
A05	103.23	0.00	0.00	39.70	63.80	0.21	88.62	0.618
A06	103.23	0.00	0.00	27.99	75.59	0.12	48.65	0.732
A07	103.23	0.00	0.00	27.99	75.59	0.40	161.17	0.732
A08	103.23	0.00	0.00	27.99	75.59	0.23	91.23	0.732
A09	103.23	0.00	0.00	27.99	75.59	0.24	97.31	0.732
A10	103.23	0.00	0.00	33.86	69.69	0.35	143.45	0.675
A11A	103.23	0.00	0.00	27.99	75.59	0.18	72.98	0.732
A11B	103.23	0.00	0.00	27.99	75.59	0.14	54.74	0.732
A12	103.23	0.00	0.00	27.99	75.59	0.33	130.76	0.732
A13	103.23	0.00	0.00	27.99	75.59	0.11	42.57	0.732
A14	103.23	0.00	0.00	27.99	75.59	0.11	42.57	0.732
A15	103.23	0.00	0.00	27.99	75.59	0.18	72.98	0.732
A16	103.23	0.00	0.00	27.99	75.59	0.23	94.27	0.732
A17	103.23	0.00	0.00	27.99	75.59	0.05	18.25	0.732
A18	103.23	0.00	0.00	27.99	75.59	0.57	231.11	0.732
OFF01	103.23	0.00	0.00	74.37	29.05	0.40	233.24	0.281
OFF02	103.23	0.00	0.00	27.99	75.59	0.04	15.21	0.732

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days	Time of Max Occurrence hr:min	Reported Max Depth Meters
CB01-02	JUNCTION	0.01	1.81	97.68	0	12:05	1.81
CB03-04	JUNCTION	0.02	1.86	97.64	0	12:02	1.86
CB05-06	JUNCTION	0.02	1.87	97.49	0	12:04	1.87
CB07-08	JUNCTION	0.01	1.81	97.48	0	12:05	1.81
CB09-10	JUNCTION	0.02	1.84	97.37	0	12:11	1.84
CB11-12	JUNCTION	0.01	1.81	97.34	0	12:00	1.81
CB13-14	JUNCTION	0.02	1.91	97.20	0	12:02	1.91
CB17-18	JUNCTION	0.02	1.84	97.63	0	12:02	1.84
CB19-20	JUNCTION	0.02	1.79	97.51	0	12:04	1.79
CB21-22	JUNCTION	0.00	0.10	97.51	0	12:03	0.10
CB23-24	JUNCTION	0.02	1.85	97.67	0	12:02	1.85
CB25-26	JUNCTION	0.02	1.78	97.85	0	12:03	1.78
CB25A-26A	JUNCTION	0.02	1.80	97.72	0	12:08	1.80
CB27-28	JUNCTION	0.00	0.05	97.69	0	12:00	0.05
CB29-30	JUNCTION	0.02	1.86	97.63	0	12:03	1.86
CB31-32	JUNCTION	0.02	1.85	97.52	0	12:07	1.85
CB33-34	JUNCTION	0.02	1.86	97.36	0	12:15	1.86
CB35-36	JUNCTION	0.02	1.87	97.36	0	12:08	1.87
CB37-38	JUNCTION	0.00	0.04	97.27	0	12:08	0.04
HP01	JUNCTION	0.00	0.00	97.77	0	00:00	0.00
HP02	JUNCTION	0.00	0.02	97.69	0	12:03	0.02
HP03	JUNCTION	0.00	0.06	97.63	0	12:02	0.06
HP04	JUNCTION	0.00	0.06	97.48	0	12:05	0.06
HP05	JUNCTION	0.00	0.02	97.49	0	12:04	0.02
HP06	JUNCTION	0.00	0.03	97.37	0	12:11	0.03
HP07	JUNCTION	0.00	0.06	97.33	0	12:01	0.06
HP08	JUNCTION	0.00	0.08	97.20	0	12:01	0.08
HP09	JUNCTION	0.00	0.07	97.19	0	12:02	0.07
HP10	JUNCTION	0.00	0.04	97.51	0	12:07	0.04
HP11	JUNCTION	0.00	0.06	97.63	0	12:02	0.06
HP12	JUNCTION	0.00	0.00	97.92	0	00:00	0.00
HP13	JUNCTION	0.00	0.00	97.72	0	12:07	0.00
HP14	JUNCTION	0.00	0.05	97.67	0	12:03	0.05
HP16	JUNCTION	0.00	0.05	97.50	0	12:04	0.05
HP17	JUNCTION	0.00	0.00	97.67	0	00:00	0.00
HP18	JUNCTION	0.00	0.04	97.36	0	12:08	0.04
HP19	JUNCTION	0.00	0.03	97.85	0	12:04	0.03
MH1013-CopeDr	OUTFALL	1.11	1.11	94.97	0	00:00	1.11
MS-CopeDr	OUTFALL	0.00	0.07	96.94	0	12:02	0.07
OUT-MonahanDrain	OUTFALL	0.00	0.00	96.00	0	00:00	0.00
MH100	STORAGE	0.51	0.69	95.15	0	12:07	0.69
MH102	STORAGE	0.75	0.89	95.11	0	12:07	0.89
MH104	STORAGE	0.99	1.09	95.07	0	12:07	1.09
MH106	STORAGE	1.09	1.13	95.01	0	12:07	1.13
MH200	STORAGE	0.00	0.10	95.46	0	12:03	0.10
MH202	STORAGE	0.01	0.18	95.27	0	12:38	0.18
MH204	STORAGE	0.28	0.47	95.16	0	12:07	0.47
MH206	STORAGE	0.16	0.39	95.20	0	12:08	0.39
MH208	STORAGE	0.11	0.38	95.25	0	12:08	0.38
MH208A	STORAGE	0.11	0.37	95.29	0	12:07	0.37
MH210	STORAGE	0.12	0.37	95.39	0	12:05	0.37

MH212	STORAGE	0.10	0.28	95.43	0	12:05	0.28
MH214(E)	STORAGE	0.16	0.33	95.74	0	12:37	0.33
MH214(W)	STORAGE	0.05	0.15	95.51	0	12:05	0.15
MH216	STORAGE	0.00	0.15	95.39	0	12:04	0.15
MH218	STORAGE	0.01	0.22	95.38	0	12:04	0.22
MH220	STORAGE	0.01	0.27	95.26	0	12:06	0.27
MH222	STORAGE	0.15	0.40	95.22	0	12:06	0.40
MH224	STORAGE	0.20	0.44	95.21	0	12:07	0.44
MH300	STORAGE	0.34	0.52	95.15	0	12:07	0.52
MH302	STORAGE	0.40	0.56	95.13	0	12:07	0.56
MH400	STORAGE	0.01	0.18	95.56	0	12:05	0.18
MH402	STORAGE	0.01	0.31	95.33	0	12:05	0.31
MH404	STORAGE	0.09	0.35	95.23	0	12:06	0.35
MH406	STORAGE	0.29	0.53	95.21	0	12:07	0.53
MH408	STORAGE	0.00	0.16	95.17	0	12:07	0.16

```
*******************
Node Inflow Summary
*******************
```

Node	Type	Maximum Lateral Inflow LPS	Maximum Total Inflow LPS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
CB01-02	JUNCTION	115.47	115.47	0	12:00	0.275	0.275	-0.070
CB03-04	JUNCTION	220.91	220.91	0	12:00	0.537	0.54	-0.165
CB05-06	JUNCTION	177.88	222.52	0	12:00	0.432	0.472	-0.100
CB07-08	JUNCTION	64.45	83.97	0	12:01	0.153	0.16	-0.173
CB09-10	JUNCTION	88.62	114.14	0	12:03	0.211	0.254	0.371
CB11-12	JUNCTION	143.45	143.45	0	12:00	0.349	0.354	-0.214
CB13-14	JUNCTION	231.11	299.38	0	12:00	0.575	0.633	-0.015
CB17-18	JUNCTION	42.57	99.32	0	12:00	0.106	0.116	0.054
CB19-20	JUNCTION	72.98	107.58	0	12:00	0.182	0.216	0.084
CB21-22	JUNCTION	42.57	68.74	0	12:01	0.106	0.126	-0.231
CB23-24	JUNCTION	130.76	130.76	0	12:00	0.325	0.326	-0.139
CB25-26	JUNCTION	72.98	72.98	0	12:00	0.182	0.182	-0.083
CB25A-26A	JUNCTION	54.74	55.10	0	12:00	0.136	0.141	-0.076
CB27-28	JUNCTION	48.65	48.65	0	12:00	0.121	0.121	-1.061
CB29-30	JUNCTION	161.17	191.52	0	12:00	0.401	0.433	0.220
CB31-32	JUNCTION	91.23	121.86	0	12:01	0.227	0.26	0.167
CB33-34	JUNCTION	97.31	97.31	0	12:00	0.242	0.268	-0.042
CB35-36	JUNCTION	94.27	116.40	0	12:00	0.234	0.267	0.131
CB37-38	JUNCTION	18.25	30.82	0	12:08	0.0454	0.0609	-0.023
HP01	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 ltr
HP02	JUNCTION	0.00	25.81	0	12:02	0	0.00284	29.807
HP03	JUNCTION	0.00	87.49	0	12:00	0	0.0393	1.183
HP04	JUNCTION	0.00	105.32	0	12:02	0	0.0503	-1.444
HP05	JUNCTION	0.00	13.83	0	12:02	0	0.000771	15.356
HP06	JUNCTION	0.00	32.01	0	12:06	0	0.0116	6.955
HP07	JUNCTION	0.00	76.77	0	12:00	0	0.0358	-0.034
HP08	JUNCTION	0.00	84.41	0	12:01	0	0.0578	-0.196
HP09	JUNCTION	0.00	176.29	0	12:02	0	0.089	0.396
HP10	JUNCTION	0.00	36.98	0	12:01	0	0.0218	0.435
HP11	JUNCTION	0.00	137.33	0	12:01	0	0.044	-0.971
HP12	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 ltr
HP13	JUNCTION	0.00	5.76	0	12:05	0	0.000392	37.943
HP14	JUNCTION	0.00	47.90	0	12:00	0	0.0193	1.829
HP16	JUNCTION	0.00	56.26	0	12:02	0	0.0324	-1.537
HP17	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 ltr
HP18	JUNCTION	0.00	28.24	0	12:02	0	0.0163	1.101
HP19	JUNCTION	0.00	20.12	0	12:00	0	0.00524	1.954
MH1013-CopeDr	OUTFALL	0.00	688.29	0	12:08	0	4.87	0.000
MS-CopeDr	OUTFALL	15.21	183.68	0	12:02	0.0378	0.126	0.000
OUT-MonahanDrain	OUTFALL	233.24	233.24	0	12:00	0.402	0.402	0.000
MH100	STORAGE	0.00	245.95	0	12:10	0	1.65	-0.001
MH102	STORAGE	0.00	431.82	0	12:07	0	3	0.001
MH104	STORAGE	0.00	688.26	0	12:07	0	4.87	0.000
MH106	STORAGE	0.00	688.29	0	12:07	0	4.87	-0.000
MH200	STORAGE	0.00	14.37	0	12:02	0	0.11	-0.002
MH202	STORAGE	0.00	39.10	0	12:03	0	0.291	-0.039
MH204	STORAGE	0.00	141.03	0	12:07	0	1.02	0.012
MH206	STORAGE	0.00	102.02	0	12:07	0	0.721	0.001
MH208	STORAGE	0.00	87.37	0	12:05	0	0.625	-0.017
MH208A	STORAGE	0.00	87.41	0	12:04	0	0.625	0.025
MH210	STORAGE	0.00	87.42	0	12:04	0	0.625	0.037
MH212	STORAGE	0.00	43.15	0	12:06	0	0.316	-0.274
MH214(E)	STORAGE	0.00	43.15	0	12:04	0	0.318	0.393
MH214(W)	STORAGE	0.00	16.80	0	11:51	0	0.0927	0.147
MH216	STORAGE	0.00	16.80	0	12:05	0	0.0925	-0.148
MH218	STORAGE	0.00	71.66	0	12:03	0	0.486	-0.007
MH220	STORAGE	0.00	71.66	0	12:04	0	0.486	0.002
MH222	STORAGE	0.00	102.22	0	12:06	0	0.728	-0.034
MH224	STORAGE	0.00	134.61	0	12:06	0	1.01	-0.003
MH300	STORAGE	0.00	172.66	0	12:10	0	1.27	-0.000
MH302	STORAGE	0.00	179.02	0	12:10	0	1.32	-0.001
MH400	STORAGE	0.00	43.91	0	12:05	0	0.273	-0.010
MH402	STORAGE	0.00	122.65	0	12:02	0	0.775	-0.000
MH404	STORAGE	0.00	122.54	0	12:03	0	0.781	0.003
MH406	STORAGE	0.00	186.27	0	12:05	0	1.22	0.001

MH408	STORAGE	0.00	24.94	0 12:05	0	0.156	0.001

```
*********************
Node Surcharge Summary
*********************

No nodes were surcharged.

********************
Node Flooding Summary
********************

No nodes were flooded.

*********************
Storage Volume Summary
*********************
```

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow LPS
MH100	0.001	17	0	0	0.001	23	0 12:07	249.72
MH102	0.001	24	0	0	0.001	28	0 12:07	431.86
MH104	0.001	31	0	0	0.001	34	0 12:07	688.29
MH106	0.001	35	0	0	0.001	36	0 12:07	688.29
MH200	0.000	0	0	0	0.000	5	0 12:03	14.37
MH202	0.000	0	0	0	0.000	7	0 12:38	39.10
MH204	0.000	10	0	0	0.000	17	0 12:07	141.09
MH206	0.000	6	0	0	0.000	14	0 12:08	102.05
MH208	0.000	4	0	0	0.000	14	0 12:08	87.32
MH208A	0.000	4	0	0	0.000	14	0 12:07	87.37
MH210	0.000	4	0	0	0.000	14	0 12:05	87.41
MH212	0.000	4	0	0	0.000	11	0 12:05	43.94
MH214(E)	0.000	6	0	0	0.000	13	0 12:37	43.15
MH214(W)	0.000	2	0	0	0.000	6	0 12:05	16.80
MH216	0.000	0	0	0	0.000	6	0 12:04	16.81
MH218	0.000	0	0	0	0.000	9	0 12:04	71.66
MH220	0.000	0	0	0	0.000	10	0 12:06	71.47
MH222	0.000	6	0	0	0.000	16	0 12:06	102.15
MH224	0.000	7	0	0	0.000	16	0 12:07	134.59
MH300	0.000	13	0	0	0.001	20	0 12:07	172.72
MH302	0.000	15	0	0	0.001	21	0 12:07	179.10
MH400	0.000	0	0	0	0.000	9	0 12:05	43.90
MH402	0.000	0	0	0	0.000	12	0 12:05	122.54
MH404	0.000	4	0	0	0.000	14	0 12:06	122.37
MH406	0.000	10	0	0	0.001	18	0 12:07	186.17
MH408	0.000	0	0	0	0.000	7	0 12:07	24.92

```
**********************
Outfall Loading Summary
**********************
```

Outfall Node	Flow Freq Pcnt	Avg Flow LPS	Max Flow LPS	Total Volume 10^6 ltr
MH1013-CopeDr	95.45	8.43	688.29	4.867
MS-CopeDr	14.38	1.45	183.68	0.126
OUT-MonahanDrain	1.27	52.18	233.24	0.402
System	37.03	62.06	1083.07	5.395

```
*******************
Link Flow Summary
*******************
```

Link	Type	Maximum |Flow| LPS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
MH100-102	CONDUIT	249.72	0 12:26	0.59	0.66	0.95
MH102-104	CONDUIT	431.86	0 12:07	0.68	0.70	1.00
MH104-106	CONDUIT	688.29	0 12:07	0.79	0.73	1.00
MH106-1013	CONDUIT	688.29	0 12:08	0.79	0.66	1.00
MH200-202	CONDUIT	14.37	0 12:03	0.80	0.34	0.39
MH202-204	CONDUIT	39.10	0 12:04	0.81	0.40	0.55
MH204-300	CONDUIT	141.09	0 12:10	0.58	0.46	0.82
MH206-204	CONDUIT	102.05	0 12:10	0.61	0.50	0.74
MH208-206	CONDUIT	87.32	0 12:07	0.72	0.41	0.60
MH208A-208	CONDUIT	87.37	0 12:05	0.92	0.38	0.49
MH210-208A	CONDUIT	87.41	0 12:04	0.87	0.43	0.48
MH212-210	CONDUIT	43.94	0 12:34	0.84	0.33	0.41
MH214-212	CONDUIT	43.15	0 12:06	0.80	0.31	0.38

MH214-216	CONDUIT	16.80	0	12:05	0.58	0.11	0.24
MH216-218	CONDUIT	16.81	0	12:05	0.35	0.11	0.38
MH218-220	CONDUIT	71.66	0	12:04	0.86	0.50	0.55
MH220-222	CONDUIT	71.47	0	12:06	0.73	0.50	0.65
MH222-224	CONDUIT	102.15	0	12:06	0.58	0.52	0.79
MH224-102	CONDUIT	134.59	0	12:07	0.70	0.70	0.91
MH300-302	CONDUIT	172.72	0	12:10	0.66	0.60	0.90
MH302-104	CONDUIT	179.10	0	12:11	0.64	0.69	0.96
MH400-402	CONDUIT	43.90	0	12:05	0.93	0.45	0.45
MH402-404	CONDUIT	122.54	0	12:03	0.88	0.61	0.63
MH404-406	CONDUIT	122.37	0	12:05	0.81	0.58	0.70
MH406-100	CONDUIT	186.17	0	12:06	0.60	0.58	0.84
MH408-100	CONDUIT	24.92	0	12:06	0.80	0.35	0.66
MS01	CHANNEL	0.00	0	00:00	0.00	0.00	0.11
MS02	CHANNEL	25.81	0	12:02	0.12	0.00	0.12
MS03	CHANNEL	1.78	0	12:03	0.15	0.00	0.13
MS04	CHANNEL	87.49	0	12:00	0.16	0.00	0.16
MS05	CHANNEL	75.34	0	12:02	0.16	0.00	0.16
MS06	CHANNEL	105.32	0	12:02	0.16	0.00	0.17
MS07	CHANNEL	13.83	0	12:02	0.09	0.00	0.12
MS08	CHANNEL	31.41	0	12:01	0.15	0.00	0.14
MS09	CHANNEL	70.53	0	12:05	0.11	0.00	0.15
MS10	CHANNEL	32.01	0	12:06	0.10	0.00	0.13
MS11	CHANNEL	7.40	0	12:11	0.21	0.00	0.11
MS12	CHANNEL	76.77	0	12:00	0.13	0.00	0.14
MS13	CHANNEL	74.29	0	12:01	0.49	0.00	0.07
MS14	CHANNEL	100.78	0	12:01	0.23	0.00	0.19
MS16	CHANNEL	176.29	0	12:02	0.16	0.00	0.19
MS17	CHANNEL	173.81	0	12:02	1.09	0.00	0.07
MS18	CHANNEL	9.15	0	12:11	0.11	0.00	0.14
MS19	CHANNEL	30.93	0	12:07	0.10	0.00	0.15
MS20	CHANNEL	36.98	0	12:01	0.15	0.00	0.15
MS21	CHANNEL	58.77	0	12:02	0.09	0.00	0.15
MS22	CHANNEL	103.56	0	12:01	0.14	0.00	0.16
MS23	CHANNEL	30.47	0	12:00	0.26	0.00	0.15
MS24	CHANNEL	0.00	0	00:00	0.00	0.00	0.02
MS25	CHANNEL	0.00	0	00:00	0.00	0.00	0.09
MS26	CHANNEL	5.76	0	12:05	0.03	0.00	0.10
MS27	CHANNEL	0.12	0	12:08	0.06	0.00	0.13
MS28	CHANNEL	47.90	0	12:00	0.11	0.00	0.15
MS29	CHANNEL	38.53	0	12:03	0.22	0.00	0.07
MS30	CHANNEL	51.21	0	12:01	0.21	0.00	0.14
MS31	CHANNEL	56.26	0	12:02	0.14	0.00	0.12
MS32	CHANNEL	0.00	0	00:00	0.00	0.00	0.09
MS33	CHANNEL	0.00	0	00:00	0.00	0.00	0.12
MS34	CHANNEL	62.07	0	12:00	0.18	0.00	0.15
MS35	CHANNEL	54.03	0	12:04	0.09	0.00	0.16
MS36	CHANNEL	28.24	0	12:02	0.07	0.00	0.16
MS37	CHANNEL	26.23	0	12:08	0.47	0.00	0.04
MS38	CHANNEL	24.36	0	12:08	0.43	0.00	0.05
MS39	CHANNEL	20.12	0	12:00	0.10	0.00	0.10
MS40	CHANNEL	8.67	0	12:04	0.11	0.00	0.11
O-CB01-02	ORIFICE	43.91	0	12:05			1.00
O-CB03-04	ORIFICE	78.80	0	12:02			1.00
O-CB05-06	ORIFICE	63.93	0	12:04			1.00
O-CB07-08	ORIFICE	24.94	0	12:05			1.00
O-CB09-10	ORIFICE	34.91	0	12:11			1.00
O-CB11-12	ORIFICE	51.82	0	12:00			1.00
O-CB13-14	ORIFICE	78.10	0	12:02			1.00
O-CB17-18	ORIFICE	14.37	0	12:02			1.00
O-CB19-20	ORIFICE	24.74	0	12:04			1.00
O-CB23-24	ORIFICE	44.35	0	12:02			1.00
O-CB25-26	ORIFICE	24.67	0	12:03			1.00
O-CB25A-26A	ORIFICE	18.50	0	12:08			1.00
O-CB29-30	ORIFICE	54.88	0	12:03			1.00
O-CB31-32	ORIFICE	30.75	0	12:07			1.00
O-CB33-34	ORIFICE	32.67	0	12:15			1.00
O-CB35-36	ORIFICE	31.58	0	12:08			1.00
O-CB21-22	DUMMY	14.70	0	11:50			
O-CB27-28	DUMMY	16.80	0	11:51			
O-CB37-38	DUMMY	6.30	0	11:51			

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Flow Classification Summary
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Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------								
MH100-102	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH102-104	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH104-106	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH106-1013	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH200-202	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MH202-204	1.00	0.00	0.60	0.00	0.39	0.00	0.00	0.00	0.99	0.00
MH204-300	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH206-204	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH208-206	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.91	0.00
MH208A-208	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00

MH210-208A	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MH212-210	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MH214-212	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MH214-216	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MH216-218	1.00	0.00	0.00	0.00	0.04	0.00	0.00	0.96	0.02	0.00
MH218-220	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.19	0.00
MH220-222	1.00	0.00	0.60	0.00	0.40	0.00	0.00	0.00	0.99	0.00
MH222-224	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH224-102	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH300-302	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH302-104	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH400-402	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MH402-404	1.00	0.00	0.58	0.00	0.42	0.00	0.00	0.00	0.99	0.00
MH404-406	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH406-100	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
MH408-100	1.00	0.00	0.68	0.00	0.32	0.00	0.00	0.00	0.99	0.00
MS01	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS02	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS03	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS04	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS05	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS06	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS07	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS08	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS09	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS10	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS11	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS12	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS13	1.00	0.00	0.00	0.00	0.96	0.04	0.00	0.00	1.00	0.00
MS14	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS16	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS17	1.00	0.00	0.00	0.00	0.95	0.05	0.00	0.00	0.00	0.00
MS18	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS19	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS20	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS21	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS22	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS23	1.00	0.82	0.00	0.00	0.01	0.00	0.00	0.17	0.01	0.00
MS24	1.00	0.82	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS25	1.00	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS26	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS27	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS28	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
MS29	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.14	0.00
MS30	1.00	0.83	0.00	0.00	0.01	0.00	0.00	0.16	0.00	0.00
MS31	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS32	1.00	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS33	1.00	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MS34	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS35	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00
MS36	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
MS37	1.00	0.00	0.00	0.00	0.90	0.10	0.00	0.00	0.14	0.00
MS38	1.00	0.00	0.84	0.00	0.07	0.09	0.00	0.00	0.97	0.00
MS39	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00
MS40	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01	0.00

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Conduit Surcharge Summary
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Conduit	--------- Hours Full -------- Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
MH102-104	0.01	0.01	0.84	0.01	0.01
MH104-106	0.84	0.84	168.00	0.01	0.01
MH106-1013	168.00	168.00	168.00	0.01	0.89

Analysis begun on: Fri Mar 29 13:50:59 2019
Analysis ended on: Fri Mar 29 13:51:22 2019
Total elapsed time: 00:00:23

Appendix E

Erosion and Sediment Control, F-1004

EROSION AND SEDIMENT CONTROL PLAN, MONITORING, AND MEASURES

Scope of Work

The work under the applicable items includes the preparation, implementation and monitoring of an Erosion and Sediment Control Plan to prevent sediment-laden runoff resulting from the Contractor's construction operations from entering all sewers and watercourses both within and downstream from the Working Area. The plan shall include management and monitoring of water discharged from dewatering operations. The specification is limited to the management of sediment laden water and the management of contaminants such as hydrocarbons and volatile organic compounds present within groundwater at the site shall be managed as described elsewhere in the contract documents.

General

The Contractor acknowledges that surface erosion and sediment runoff resulting from construction operations has potential to cause a detrimental impact to any downstream watercourse, and that all construction operations that may impact upon water quality shall be carried out in a manner that strictly meets the requirements of all applicable legislation and regulations.

Accordingly, the Contractor shall be responsible for determining and conforming to the requirements of the Ontario Ministry of the Environment (MOE), the Ontario Ministry of Natural Resources, the City of Ottawa, applicable Conservation Authorities and any other Governmental Regulatory Agencies (collectively "Regulatory Agencies") having jurisdiction in the Working Area or over any potentially affected watercourses.

Erosion and Sediment Control Plan

Before commencing the Work, the Contractor shall submit to the Contract Administrator six copies of a detailed Erosion and Sediment Control Plan. The ESC Plan will consist of a written description and detailed drawings indicating the on-site activities and measures to be used to control erosion and sediment movement for each step of the Work. The written description shall be signed by, and the drawings shall bear the stamp and signature of a qualified Professional Engineer licensed in Ontario, herein designated as the Engineer of Record (EOR).

The Contractor acknowledges that the scheduling of the implementation of erosion and sediment controls is the key component for successful sediment control. Accordingly, the ESC Plan will contain a detailed schedule which identifies the following:

- Phasing of the steps for the installation of all control measures.
- Inspection, monitoring and maintenance of all control measures during construction.

EROSION AND SEDIMENT CONTROL PLAN, MONITORING, AND MEASURES

- Phasing of the removal and disposal of the control measures.

The Contractor acknowledges that no one measure is likely to be 100% effective for erosion protection and controlling sediment runoff and water discharges from the site. Therefore, where necessary the ESC Plan will implement sequential measures arranged in such a manner so as to mitigate sediment release from construction operations and achieve specific maximum permitted criteria where applicable. Suggested on-site measures may include, but shall not be limited to, the following methods: sediment ponds, filter bags, pump filters, settling tanks, silt fences, straw bales, filter cloths, check dams and/or berms, or other recognized technologies and methods available at the time of construction. Specific measures shall be installed in accordance with the requirements of OPSS 805 where appropriate, or in accordance with manufacturer's recommendations.

Inspection and Monitoring of Mitigation Measures

The Contractor shall be solely responsible for inspecting, monitoring and maintaining the effectiveness of the ESC Plan upon implementation. The Contractor shall submit to the Contract Administrator weekly inspection reports demonstrating the performance of the installed measures, identifying deficiencies and indentifying required maintenance issues. These reports shall be prepared, signed by the EOR and provided to the Contract Administrator within 48 hours of the inspection.

- Maintenance issues are defined as any measure which is not functioning to the satisfaction of the EOR and in the opinion of the EOR may be repaired by the contractor with subsequent re-inspection at the next scheduled EOR site inspection.
- Deficiencies are defined as any measure or lack of measure which has potential to cause an adverse environmental impact at the site given the current/forecasted conditions and schedule of the work.

Maintenance issues which have previously been identified but not adequately corrected shall be considered deficiencies.

Deficiencies shall be immediately corrected. Corrective actions shall be re-inspected and documented by the EOR. Re-inspection reports shall be specific to the deficiency observed and may be written field reports.

EOR monitoring reports submitted shall include:

- The date and time of the inspection and monitoring.
- General description of the mitigating measures being utilized at the site.
- Confirmation as to the effectiveness of the measures inspected.

EROSION AND SEDIMENT CONTROL PLAN, MONITORING, AND MEASURES

- Description of any maintenance issue which requires minor repair, improvement or maintenance.
- Description of any deficiency observed including timeline for correction and re-inspection.
- Deficiency re-inspection reports outstanding for the site.

The Contractor shall notify the Contract Administrator in all situations where a regulatory agency has identified deficiencies in erosion/sediment control measures, quality of runoff or quality of water quality discharged from dewatering operation.

Where in the opinion of the Contract Administrator either the proof of performance submitted is or the measures implemented are considered inadequate, the Contractor shall have the EOR review measures in the presence of the Contract Administrator within 24 hours of being notified in writing.

The Contractor shall monitor all weather forecasts and schedule the Work in order to minimize the risk of sediment-laden water from entering any watercourse or sewer system. The ESC Plan shall contain a Contingency Plan to include the provision of additional labour, equipment or materials to install additional control measures, and detail an emergency response plan in case of an accidental event. As such, the Contractor shall have additional control materials on site at all times which are easily accessible and may be implemented at a moment's notice.

Contractor's Responsibilities

The Contractor shall ensure that all workers, including sub-contractors, in the Working Area are aware of the importance of the erosion and sediment control measures and informed of the consequences of the failure to comply with the requirements of all Regulatory Agencies and the specifications detailed herein.

The Contractor shall periodically, and when requested by the Contract Administrator or EOR, clean out accumulated sediment deposits as required at the sediment control devices, including those deposits that may originate from outside the construction area. Accumulated sediment shall be removed in such a manner that prevents the deposition of this material into any sewer or watercourse and avoids damage to the control measure. The sediment shall be removed from the site at the Contractor's expense and managed in compliance with the requirements for excess earth material, as specified elsewhere in the Contract.

The Contractor shall immediately report to applicable regulatory agencies and the Contract Administrator any accidental discharges of sediment material into either the watercourse or the storm sewer system. Failure to report will be constitute a breach of this specification and the Contractor may also be subject to the penalties imposed by any

EROSION AND SEDIMENT CONTROL PLAN, MONITORING, AND MEASURES

applicable Regulatory Agency. Appropriate response measures, including any repairs to existing control measures or the implementation of additional control measures, shall be carried out by the Contractor without delay.

The sediment control measures shall be removed when, in the opinion of the EOR, the measure(s) is no longer required. No control measure may be permanently removed without prior written authorization from the EOR. All sediment and erosion control measures shall be removed in a manner that avoids the entry of sediment or debris into any sewer or watercourse within or downstream of the Working Area. All accumulated sediment shall be removed from the Working Area at the Contractor's expense and managed in compliance with the requirements for excess earth material, as specified elsewhere in the Contract. Any seeding and mulching, temporary cover, sodding or original turf cover that is disturbed by the removal of the control measures and accumulated sediment, shall be brought to final grade and restored. Payment for the supply and placing of ground cover at these locations shall be made under the applicable items listed elsewhere in the Contract.

Where, in the opinion of either the Contract Administrator or a Regulatory Agency, any of the terms specified herein have either not been complied with or not performed in a suitable manner, the Contract Administrator or Regulatory Agency has the right to immediately withdraw its permission to continue the work but may renew its permission upon being satisfied that the defaults and/or deficiencies in the performance of this specification by the Contractor have been remedied. No compensation will be made to the Contractor for the withdrawal of permission to do the work resulting from non-compliance with the requirements of this specification and the Regulatory Agencies.

In addition to any other remedy and/or penalty provided by law, where there has been default or non-compliance with any of the terms specified herein and the Contractor refuses to perform or rectify same within forty-eight (48) hours of the receipt of the written demand of the Contract Administrator to do so, the Owner is hereby entitled to enter upon the Working Area and either complete the work in conformity with the Contract or have the work done that it considers necessary to complete the Work to its intended condition, whichever, in the Owner's sole opinion, is the most reasonable course of action. The Contractor and the Owner further agree that the costs incurred for any such work shall be retained by the Owner from monies otherwise due to the Contractor.

Monitoring of Water Quality Impacts and Point Source Discharges

The Contractor shall monitor runoff quality and quantity of water discharged from dewatering operations. The work shall include turbidity monitoring of impacts to watercourses (upstream vs downstream conditions), total suspended solids (TSS) monitoring of point sources such as those from dewatering operations. Discharge shall be in accordance with site specific constraints, regulatory requirements and sewer use bylaw

EROSION AND SEDIMENT CONTROL PLAN, MONITORING, AND MEASURES

requirements. Where no specific criteria has otherwise been identified, the contractor shall meet the following discharge objective.

Source	Objective	Monitoring Frequency (min)
Watercourse Impacts	Downstream turbidity not to exceed upstream levels by greater than 25%	Minimum of daily for first three days of operation Minimum of twice weekly on an ongoing basis Daily for situations where the work is being conducted within 20 metres of a watercourse.
Discharge from Dewatering Operations	TSS maximum level of 25 mg/L	Minimum of daily for first three days of operation Minimum of twice weekly on an ongoing basis

Monitoring frequency to increase where scheduled construction operations have potential to impair water quality.

Mitigation and Action by Contractor Where Monitoring Indicates Water Impacts or Discharges Over Criteria or Objectives

Where site specific criteria or objectives are not attained, the Contractor and/or EOR shall immediately notify applicable regulatory agency of the monitoring results and possible impacts to sewers and watercourses. The Contractor shall implement an Action/Mitigation Plan acceptable to the EOR and applicable regulatory agency prior to continuing or resuming construction activities.

Measurement and Basis of Payment

Item – Erosion and Sediment Control Plan and Monitoring

Payment at the Contract price for the item "Erosion and Sediment Control Plan and Monitoring" shall be full compensation for the preparation and monitoring of the Erosion and Sediment Control Plan.

Payment shall be based upon the following schedule:

a) 25% upon satisfactory submission and implementation of the ESC Plan; and,
b) 75% pro-rated into equal payments over the term of the contract.

EROSION AND SEDIMENT CONTROL PLAN, MONITORING, AND MEASURES

This payment schedule may only be modified as agreed upon in writing between the Contractor and the Contract Administrator.

Item – Erosion and Sediment Control Measures

Payment at the Contract price for the item "Erosion and Sediment Control Measures" shall be full compensation for the implementation and maintenance of erosion and sediment control measures required for the site, and shall include all labour, equipment and materials to supply, construct, monitor and maintain all erosion and sediment control measures detailed therein.

Payment shall be based upon the following schedule:

a) 20% upon satisfactory installation of the control measures;
b) 70% pro-rated into equal payments over the term of the contract; and,
c) 10% upon successful completion and removal of the ESC Plan protection measures.

This payment schedule may only be modified as agreed upon in writing between the Contractor and the Contract Administrator.

Warrant: For work which is conducted in close proximity to watercourses or environmentally sensitive areas.