

RICHCRAFT GROUP OF COMPANIES

RICHCRAFT TERRACE FLATS, CRT LANDS (BLOCK 344) STORMWATER MANAGEMENT REPORT

OCTOBER 15, 2021

COPY





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COPY

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WSP

201-1224 GARDINERS ROAD

KINGSTON, ON

CANADA K7P 0G2

T: +1 613 634-7373

F: +1 613 634-3523

WSP.COM

SIGNATURES

PREPARED BY



Daniel Searle, P.Eng.
Municipal Engineer



REVIEWED BY



Steve Davidson, P.Eng., OLS (Ret.), MBA
Manager, Municipal Engineering – Kingston & Cornwall



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1 INTRODUCTION

1.1 SCOPE

WSP has been retained to provide civil engineering consulting services to support the Site Plan Approval application for greenfield development at 620 Bobolink Ridge, also known as Block 344 of the Phase 1 CRT Lands. This stormwater management (SWM) report examines the potential water quality and quantity impacts of the proposed development and details SWM measures to be provided to address these impacts in accordance with the City of Ottawa Sewer Design Guidelines (2012) and associated Technical Bulletins, Pre-application consultation meeting minutes, and the City of Ottawa Servicing Study Guidelines for Development Applications (2009). Refer to Servicing Report – Appendix B for completed City Servicing Report Checklist.

1.2 SITE LOCATION

The site of the proposed development is located within the City of Ottawa, within the Stittsville Ward, as shown in Figure 1. The site is approximately 1.6 ha and is bounded by Bobolink Ridge (to the north), Embankment Street (to the west), Robert Grant Avenue (to the east), and Cope Drive (to the south).



Figure 1: Project Location (Image Source: GeoOttawa)

1.3 OBJECTIVES

The objectives of this SWM plan are noted below:

- Determine the site-specific stormwater management requirements for the proposed development, as indicated by associated Provincial, Municipal, and Conservation Authority regulations and guidelines, pre-consultation with the City of Ottawa, and IBI Group’s (IBI) report titled “ Design Brief - CRT Lands Phase 1 - Fernbank Community” dated July 2017 (referred herein as CRT Phase 1 Servicing Report). Refer to Servicing Report – Appendix G for a copy of the CRT Phase 1 Servicing Report.
- In collaboration with the design team and the Developer, develop a strategy to address the SWM criteria on-site. Complete calculations and analyses necessary to determine the required size of the SWM features and demonstrate compliance with the design criteria.
- Prepare a SWM report documenting the above tasks in a manner suitable for review by the City’s development review department.
- Address review comments by the City to refine and finalize the SWM report.

1.4 DESIGN CRITERIA

Based on applicable design guidelines and standards, pre-application consultation with the City (Servicing Report - Appendix B), and the CRT Phase 1 Servicing Report, the SWM design criteria for the development have been summarized below:

- Stormwater runoff from all storm events up to and including the 5-year storm (i.e. minor storm) will be captured and conveyed to the Embankment Street storm sewer system; where it ultimately outlet to the CRT Lands Phase 1 – Pond 5.
- Stormwater runoff in excess of the 5-year event and up to the 100-year storm (i.e. major storms), will be attenuated on-site with no overland flow to Embankment Street. During major storm attenuation, stormwater discharge to the Embankment Street storm sewer system shall be restricted to the site’s post-development 5-year runoff flow rate. Additionally, up to 39 l/s of major storm flow (corresponding to a 3-hour 100-year Chicago storm event) is permitted to shed onto the Robert Grant Ave./ Cope Dr. Right-of-Ways, as prescribed in the CRT Phase 1 Servicing Report.
- Ponding shall not occur in parking lots under the 2-year design storm event.
- 100-year ponding depths in parking lots and laneways shall not exceed 0.35m.
- All stormwater storage provided on-site must be above the Hydraulic Grade Line (HGL) of the receiving storm sewer.
- Maintain 300mm of freeboard between the underside of footing elevations and the 100-year HGL.
- The HGL in the storm sewer must remain below the underside of building footing during the stress test event (100-year + 20%).
- Ponding under the 100 -year + 20% event shall not reach any building envelop, nor breach the lowest building opening.
- Maintain at least 15 cm of vertical clearance between the spill elevation on the street and the ground elevation at the building envelope that is in the proximity of the flow route or ponding area.
- Quality control for stormwater is not required if the site’s post-development imperviousness is equal or less than 86% (or runoff coefficient of 0.8), assumed by IBI’s the sizing of the subdivision’s SWM system. Otherwise, quality control on-site will be required.

2 PRE-DEVELOPMENT CONDITIONS

2.1 EXISTING LAND-USE AND DRAINAGE PATTERNS

The project site is approximately 1.6 ha in area and is currently greenfield. Once water sheet flows off the site it is captured via surface inlets and routed eastward along Cope Drive via storm sewers (600-2400 mm diameter) to Pond 6 of the Fernbank Crossing Development. Refer to Figure 2 for geographic depiction of pre-development drainage patterns.



Figure 2: Pre-Development Stormwater Drainage Pattern (Image Source: GeoOttawa)

Using PCSWMM 2D hydrologic and hydraulic modelling software (PCSWMM), the 5-year and 100-year pre-development runoff flow rates are estimated to be 130 l/s and 280 l/s, respectively. These flows are based on 3-hour Chicago storm distribution (10-minute timestep) using City rainfall Intensity-Duration-Frequency curves (IDF) and the following site -specific parameter:

- Imperviousness = 5% (C-Factor = 0.15)
- Flow Path Length = 300 m

– Catchment slope = 1.2%

Refer to Appendix A for pre-development catchment map, as well as Appendix C for schematic model map and associated scenario model outputs.

2.2 APPROVED OUTLET & ALLOWABLE DISCHARGE RATES

As the subject property is within the boundary of the CRT Lands – Phase 1 development (designed by IBI Group inc.), a portion of the subdivision’s stormwater management/collection system has been allocated to the site. As such, allowable runoff release rates for the site are not derived by a comparison to pre-development flows, but rather complying with the requirements specified in IBI’s report.

As documented in CRT Phase 1 Servicing Report, the minor storm sewer system was first sized using the rational method where a runoff coefficient of 0.80 (or 86% imperviousness) was assumed for the subject site, resulting in a 5-year site discharge of 306.1 l/s. Following this sizing exercise, the DDSWMM hydrologic modelling was carried out to estimate single event runoff flows and hydraulic performance of the subdivision’s dual-drainage system. The single event design storms used in this analysis for the minor and major system were the 5-year and 100-year 3-hour Chicago storm (10 -minute time step).

The DDSWMM modeling, in conjunction with the introduction of inlet flow control devices (IDCs), set the threshold for permissible stormwater flows entering the subdivision’s system (including from the subject site) such that hydraulic grade line (HGL) elevations within the subdivision’s minor system do not flood developments. From this exercise, 318 l/s of 5-year stormwater discharge (outletting to the Embankment Street storm sewer) was allocated to the subject site. Under the 100-year event (major design storm event), IBI assumed all flow in excess of 318 l/s (to Embankment Street) and 39 l/s (to Robert Grant Ave./Cope Dr.) was to be attenuated on-site. No major storm flow was assumed to enter the CRT Lands – Phase 1 major storm system (i.e. Embankment Street R.O.W.). The allowance for the release of up to 39 l/s to Robert Grant Ave./Cope Dr. was established jointly between the designers of CRT Lands Phase 1 subdivision (IBI) and the designers of Robert Grant Avenue (Novatech) and published in the aforementioned IBI subdivision servicing report.

Refer to Table 1 for a summary of allowable release rates for the site by outlet, as well as Figure 3 for geographic location of dedicated outlets.

Table 1: Allowable Post-Development Runoff Release Rates (by Outlet and Design Storm Event).

Outlet	5-year*	100-year*
Embankment Street (Minor System)	318 l/s	318 l/s
Embankment Street (Major System)	-	-
Robert Grant Ave. / Cope Dr. (Minor System)	-	-
Robert Grant Ave. / Cope Dr. (Major System)	-	39 l/s

***3-hour Chicago Storms (10 min time steps) generated using City of Ottawa IDF curves.**

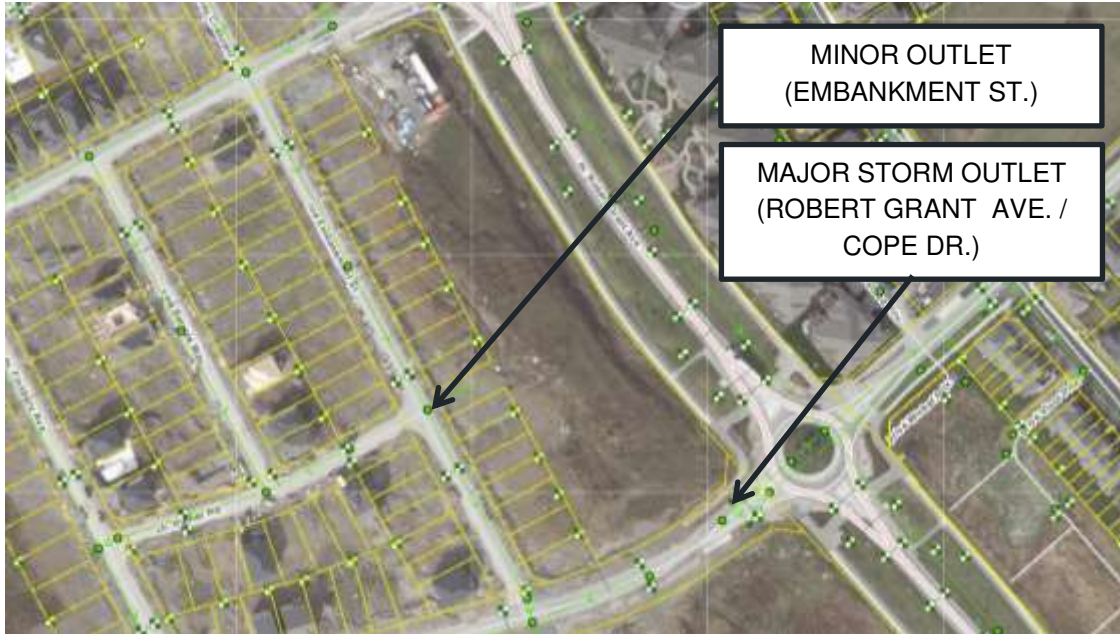


Figure 3: Post-Development Stormwater Outlets.

3 POST-DEVELOPMENT CONDITIONS

The proposed development includes seven (7) new 12-unit townhouses, each with a building area of 412 m². In addition, an accessory building with a building area of 154 m² will be included for storage and garbage. The site will include both private and communal amenity areas. At-grade features also include access laneways, vehicle parking, and asphalt sidewalks. The resulting imperviousness of the site was calculated to be 64% (Runoff Coefficient = 0.68).

3.1 PROPOSED MINOR STORM SYSTEM

The proposed minor system constitutes a gravity system comprised of swales, storm sewers, manholes, and catch basins. Stormwater which falls on the site will sheet flow towards parking lots and laneway areas, where it is directed to catch basins. Catchbasin leads direct the flow to the gravity storm sewer system which routes the flow to the site's minor storm system outlet (located along the southern site access corridor). The outlet is a 750mm storm sewer which drains to the existing 975mm storm sewer within Embankment Street, which ultimately drains to the CRT lands Phase 1 Stormwater Management Facility (Pond 5).

The storm sewers (i.e. minor system) were sized using the Rationale method (to establish design flows) and the Manning's equation (for hydraulics), based on the following criteria:

- Design Storm 1:5 years Return Period (Ottawa IDF Curves)
- Runoff coefficients (C-Factor):
 - Landscaped areas (i.e. Grass) = 0.25
 - Pavement and Concrete Areas = 0.90
 - Roofed Areas = 0.95
- Initial Inlet Time of Concentration = 10 mins.
- Pipe Velocities = 0.80 m/s to 6.0 m/s
- Minimum Pipe Size (Diameter) 250 mm (Sewers) & 200mm (CB Leads)

Refer to Appendix A for post-development catchment map and Appendix B storm sewer sizing calculation sheet.

3.2 STORMWATER MANAGEMENT

Following the design and sizing of the minor system, hydrodynamic modelling was carried out using PCSWMM software to estimate single event runoff flows and the hydraulic performance of the site's overall stormwater system; including stormwater attenuation complete with the onsite storage areas, and an estimate of the peak hydraulic grade line elevation throughout the entire system.

In addition, the following supplementary checks were completed in order to comply with the City of Ottawa design guidelines and associated technical bulletins:

- 2-year Ponding Checks (Refer to Section 3.2.6)
- 100-year HGL to ensure gravity drainage for foundations (Refer to Sections 3.2.4 and 3.2.5)
- 100-year + 20% Stress Test (Refer to Section 3.2.7)

In order to remain consistent with the design of the downstream subdivision system, the single event design storms used in this analysis for the 2-year, 5-year (minor event), 100-year (major event), and 100-year + 20% (stress testing event) were simulated using the 3-hour Chicago storm (10-minute time step) distribution.

3.2.1 BOUNDARY CONDITIONS

Boundary conditions for the stormwater collections were obtained from the CRT Phase 1 Servicing Report. The receiving storm sewer system within Embankment Street is designed for free flow conditions under the 5-year storm event. As such, free flowing condition was assumed within the Embankment Street storm sewer for the purpose of sizing of the minor system within the site and performance assessment simulation of the 5-year Chicago event.

However, under the 100-year and stress testing events, IBI noted receiving storm sewer HGL elevations of 105.31m and 105.41m, respectively at MH189 on Embankment Street. To account for this, our modelling specified corresponding fixed tailwater elevations for the associated design storm scenarios.

3.2.2 QUANTITY CONTROL & ATTENUATION

As it relates to the minor storm event (5-year), no quantity control is required prior to discharging from the site to the storm sewer system on Embankment Street. Post-development 5-year flows (including both the rational and single event modelling methods) yielded peak flows lower than what was specified by IBI to be released from the subject site in the design of the subdivision's stormwater system. Refer to Table 2 for comparison of IBI's specified site post-development flows and WSP's calculated proposed peak flow rates.

Table 2: 5-year Flows (Previously Assumed vs. Proposed)

Outlet	5-year (Rational Method)	5-year (3-hour Chicago)
IBI Design Flows	306 l/s	318 l/s
WSP Modelled Flows	263 l/s	257 l/s

As discussed in Section 1.4 and 2.2, runoff peak flow in excess of the 5 year event (and up to the 100-year event) must be controlled on-site to the release rates defined in Table 1. In order to achieve this, our site design allows for storage within the parking lots, swales and pond storage to achieve the quantity control requirements for the site. Ponding within parking lots has been limited to 350mm in accordance with City of Ottawa Sewer Design Guidelines. In order to control ponding in storage areas, inlet control devices (ICDs) of varying sizes are proposed in dedicated stormwater inlet structures to throttle the flow prior to discharging into the sewer main. Refer to Table 3 for an overview of system quantity control performance as it relates to peak discharge to dedicated outlets, as well as total storage utilized in the system. Refer to Table 4 and Table 5 for summaries of individual storage cell performance under the 5-year and 100-year storm events, respectively.

It should be noted that discharge from the dry pond (located at the southeast corner of the site) to Robert Grant Ave / Cope Dr. major system will be controlled through a dedicated outlet structure. A broadcrested weir - with the following characteristics - has been selected as the proposed control structure to ensure proper hydraulic operation and release from the storage facility (refer to Drawing C1.7 located in the Servicing Report - Appendix A for further details):

- Invert Elevation: 105.97m
- Both Width: 0.5m
- Side Slopes: 3H:1V
- Depth (Parallel to Flow Direction): 300mm

Refer to Servicing Report – Appendix A for detailed design drawings (including proposed grading plan) and Appendix C of this report for a model map figure for the purpose of providing geographical context.

Table 3: Proposed Conditions (Controlled) Peak Flows and Total Volume Utilized

Storm Event	Peak Flow Embankment St. Minor System (L/s)	Peak Flow Robert Grant Ave / Cope Dr. Major System (L/s)	Total Storage Utilized (m ³)
5-year	257	-	27
100-year	312	33	164

Table 4: Individual Storage Cell Performance Summary (5-year)

Storage Cell (By Outlet Structure)	Peak Modelled Storage (m3)	Max. Depth of Ponding(m)*	Highest Ponding Elevation (m)	Outlet Structure Top of Grate Elevation (m)
CB03	1	0.06	108.11	108.05
CB04	1	-	107.76	108.00
CB06 & CB07	0	-	107.05	108.15
CB08	4	0.14	107.84	107.70
CB10	1	-	107.22	107.85
CB11	2	0.07	108.07	108.00
CB12	1	-	107.24	108.01
CBMH13	2	0.8	108.03	107.95
CB14 & CB15	1	-	107.79	107.95
CB16	1	-	107.29	107.71
DCB17	1	-	105.63	106.38
Pond	12	0.13	105.63	105.50

* For parking lot storage zones, maximum depth of ponding is relative to top of grate of primary surface outlet.

Table 5: Individual Storage Cell Performance Summary (100-year)

Storage Cell (By Outlet Structure)	Peak Modelled Storage (m3)	Max. Depth of Ponding(m)*	Highest Ponding Elevation (m)	Outlet Structure Top of Grate Elevation (m)
CB03	12	0.17	108.22	108.05
CB04	6	0.15	108.15	108.00
CB06 & CB07	3	0.08	108.23	108.15
CB08	27	0.29	107.99	107.70
CB10	6	0.18	108.03	107.85
CB11	13	0.16	108.16	108.00
CB12	3	0.09	108.10	108.01
CB13	14	0.2	108.15	107.95
CB14 & CB15	10	0.14	108.09	107.95
CB16	3	0.15	107.86	107.71
DCB17	1	-	106.13	106.38
Pond	66	0.54	106.04	105.50

* For parking lot storage zones, maximum depth of ponding is relative to top of grate of primary surface outlet.

3.2.3 INLET CONTROLS

In order to limit flows into the minor system such that peak flows leaving the site are within allowable limits, ICDs (either stainless steel orifice plates with varying inlet diameters, or a manufactured inlet device such as a Tempest) are proposed throughout the site. ICDs are sized and positioned vertically within PCSWMM model such that maximum ponding depths and release rate to the minor system were optimized. Refer to Table 6 for an inventory of ICDs by host structure, along with peak release and acting head depths for the 2-year and 100-year event. Several ICDs require diameters less than 100mm, as such prefabricated low-flow ICDs (such as a Tempest ICD) with similar drawdown performance will be required to avoid clogging.

Table 6: Inlet Control Device Summary

ICD (By Host Structure)	Diameter* (mm)	Invert Elevation (m)	Peak Cell Release Rate (l/s)*		Acting Head (m)	
			2-Year	100-Year	2-Year	100-Year
CB03	75	105.85	15	19	1.38	2.37
CB04	60	105.80	8	12	1.05	2.35
CB06	43**	105.95	3	6	0.58	2.28
CB07	43**	105.95	3	6	0.58	2.28
CB08	76	105.50	18	20	1.88	2.49
CB10	60	105.65	7	12	0.80	2.38
CB11	80	105.80	17	22	1.49	2.36
CB12	60	105.81	7	12	0.80	2.29
CBMH13	75	105.01	18	21	1.98	3.14
CB14	53**	105.75	6.5	9.5	1.04	2.34
CB15	53**	105.75	6.5	9.5	1.04	2.34
CB16	50	105.51	5	9	0.92	2.35
MH409	190	104.81	49	64	0.76	1.24
RYCB02	75	106.05	4	13	0.13	1.06
RYCB07	60	105.85	4	12	0.32	2.35
RYCB09	60	105.69	8	12	0.89	2.37
RYCB18	120	105.39	14	34	0.23	1.17

* Where ICD diameters are less than 75mm (required minimum per MECP), manufactured low-flow ICDs will be required with equal discharge performance noted active head.

** Modelled as single orifice to account for joint CB’s drawdown from single storage zone. Actual orifices (specified in design drawings) for each CB was solved for such that the combined opening areas of these orifices matches the single modelled orifice. For example:

CB06/07:

- Modelled Orifice @ 60mm diameter -> Open Area = 0.002827 m²
- Actual Orifices x2 @ 43m diameter -> Combined Open Area = 0.002827

3.2.4 HGL ANALYSIS & FOUNDATION DRAINAGE (BLOCKS 1 - 4 AND AUXILIARY BUILDING)

In order to ensure gravity drainage for the proposed development’s foundation drainage system, minimum underside of footing elevations (MUSF) elevations and proposed underside of footing (USF) elevations for each block are required to be at least 300mm above the 100-year HGL line at the proposed connection location. Refer to Table 7 for a summary of 100-year HGL elevations and foundation drainage details for Blocks 1, 2,3, 4, and the auxiliary building as produced in the PCSWMM hydrodynamic model. As shown, a minimum freeboard of 300mm is present for all buildings for both the MUSF and USF.

Table 7:100-year HGL Analysis & Foundation Drainage Summary (Blocks 1- 4 and Auxiliary Building)

Block	100-yr HGL Elevation (m)	Minimum USF Elevation (m)	Proposed USF Elevation (m)	Freeboard (m) - MUSF *	Freeboard (m) - USF **
1	105.80	106.10	107.26	0.3	1.46
2	106.05	106.35	106.37		0.32
3	105.80	106.10	106.24		0.44
4	105.42	105.72	106.23		0.81
Auxiliary Bldg.	105.66	105.96	106.68***		1.02

* Freeboard between 100-yr HGL and Proposed MUSF elevation.

* Freeboard between 100-yr HGL and Proposed USF elevation.

**Auxiliary building assumed to possess strip footing foundations at 1.8m below finished ground elevation.

Note that foundation drainage for Blocks 5, 6, and 7 are not proposed to drain to the site’s stormwater connection system, but instead be piped to an alternate existing outlet along Cope Drive with a lower invert and HGL. Refer to the following section for further details.

3.2.5 FOUNDATION DRAINAGE (BLOCKS 5 - 7)

Early in the design process we encountered design challenges while trying to ensure gravity drainage of the foundation systems, in conjunction with the layout and grading of the surrounding lands, all while trying to maintain barrier free connectivity to adjacent streets without the requirement for retaining walls, ramps, etc. In order to maintain barrier free connectivity and comply with the site’s design criteria, the units within the southeasterly Blocks 5,6 and 7 would require sump pump systems, which was not desirable or accepted by the developer.

After the initial grading and drainage review, WSP discovered the potential existence of a storm sewer stub located at the southeast corner of the site (northwest corner of the Cope Drive/Robert Grant Avenue turning circle). The storm stub constitutes part of the Fernbank Crossing develop storm water system, ultimately discharging to Fernbank Development Pond 6 (via Cope Drive). In April 2021, WSP and Richcraft Group of Companies (Richcraft) consulted with Eric Surprenant (City of Ottawa liaison) to confirm the City’s willingness to allow for Blocks 5,6, and 7 to drain their foundations to the subject storm sewer stub (via third-pipe system) such that gravity drainage could be provide in combination with the preferred grading strategy for barrier free connectivity to adjacent streets..

The City did not appose the proposed use of new stormwater outlet in this manner; however, the City did indicate that two (2) elements must be confirmed prior to approving the connection, which were:

- 1 Confirmation that the 100-year HGL (in the receiving system) is at least 300mm below the MUSF and proposed USF elevations for Blocks 5, 6, and 7;
- 2 Confirmation that the storm sewer stubs exists.

In order to satisfy the first condition, we completed an analysis to infer the 100-year HGL at the subject connection point based on the 100-year HGL boundary condition used for the design of Phase 3 of the Fernbank Crossing Development (prepared by IBI), as well as as-built storm sewer plan and profile drawings prepared by Novatech. Using the provided 100-year HGL elevation for the intersection of Shiny and Cope Drive, and the cumulative fall of upstream sewers up to the connection point, the 100-year HGL was estimated to be 102.71m. Refer to Table 8 for comparison of the 100-year HGL elevations and proposed foundation details from Blocks 5, 6,and 7. As shown, freeboard in excess of 300mm is present for all buildings for both the MUSF and USF.

Table 8: HGL Analysis & Foundation Drainage Summary (Blocks 5, 6, and 7)

Block	100-yr HGL Elevation (m)	Minimum USF Elevation (m)	Proposed USF Elevation (m)	Freeboard (m) - MUSF *	Freeboard (m) - USF **
5 (W)	102.71	105.41	105.89	2.70	3.18
5 (E)		104.50	105.29	1.79	2.58
6		104.58	104.58	1.87	1.87
7 (E)		104.55	104.64	1.84	1.93
7 (W)		104.55	104.94	1.84	2.23

* Freeboard between 100-yr HGL and Proposed MUSF elevation.

** Freeboard between 100-yr HGL and Proposed USF elevation.

To satisfy the third condition, Richcraft retained a CCTV contractor (Clean Water Works Inc.) to inspect the downstream storm sewer (along Cope Drive). During the inspection – which took place on June 2nd, 2021 - a tee connection to the Cope Drive storm sewer was identified which proves the subject storm stub exists.

Refer to Appendix D for correspondence between the City of Ottawa and WSP, as well as the CCTV inspection report and HGL analysis for the downstream system (Cope Drive sewer). Refer to Appendix E for the Fernbank Crossing (Phase 3) Servicing Report.

3.2.6 2-YEAR PONDING CHECKS

In accordance with City of Ottawa Sewer Design Guidelines (2012) (Technical Bulletin PIEDTB-2016-01), no ponding is permitted in parking lots and laneways during the 2-year design storm event. To complete this check, a 2-year 3-hour Chicago storm event was simulated. Results of this analysis determined that there is no ponding within the parking lot storage cells during the 2-year storm event. This was evident based on the maximum HGL elevations reported in the storage nodes remaining below the proposed top of grate elevations. Refer to Appendix C for the model output for the associated scenario.

3.2.7 100-YEAR + 20% STRESS TEST CHECKS & EMERGENCY SPILLWAYS

In accordance with City of Ottawa Sewer Design Guidelines (2012) - Technical Bulletin PIEDTB-2016-01, the stormwater management shall be stress tested under a 100-year + 20% storm event. The following are the two (2) mandatory checks carried out relative to the stress testing event:

- Stress test ponding water surface elevation (WSEL) remains below the lowest building opening
- HGL in the minor system remains below the USF Elevation

Refer to Servicing Report – Appendix A for detailed grading plan which communicates lowest building elevations and stress test ponding water surface elevations. Under no circumstances did the stress test ponding reach any building’s lowest opening. Refer to Table 9 for a comparison of stress test event HGL elevations (within the minor system) versus the MUSF and USF elevations for Blocks 1-4 and the auxiliary building. As shown, positive freeboard is present for all buildings.

Table 9: Stress Test HGL Analysis & Foundation Drainage Summary (Blocks 1, 2, 3, 4, and Aux.)

Block	Stress Test HGL Elevation (m)	Minimum USF Elevation (m)	Proposed USF Elevation (m)	Freeboard (m) - MUSF *	Freeboard (m) - USF **
1	105.93	106.10	107.26	0.17	1.33
2	106.06	106.35	106.37	0.29	0.31
3	105.93	106.10	106.24	0.17	0.31
4	105.53	105.72	106.23	0.19	0.70
Auxiliary Bldg.	105.78	105.96	106.68***	0.18	0.90

* Freeboard between Stress Test HGL and Proposed MUSF elevation.

* Freeboard between Stress Test HGL and Proposed USF elevation.

**Auxiliary building assumed to possess strip footing foundations at 1.8m below finished ground elevation.

As previously stated in Section 3.2.5, foundation drains from Blocks 5, 6, and 7 are not connected to the site’s minor system but to a secondary storm outlet at the northwest corner of Cope Drive and Robert Grant Ave. To verify compliance as it relates to stress test event HGL in the receiving sewer and MUSF/USF elevations for Block 5-7, WSP first completed a review to estimate the stress test event HGL in the receiving sewer. Given location-specific stress test HGL information was not available, WSP reviewed the maximum differential elevation between the 100-year and stress test event HGLs simulated within the proposed development site. This differential would then be added to the receiving sewer’s 100-year HGL elevation to estimate the stress test HGL elevation. The greatest HGL differential was observed at MH410 with a depth of 0.24m. Adding this to the receiving sewer’s 100-year HGL elevation resulted in a stress test HGL of 102.95m. Refer to Table 10 for a comparison of stress test event HGL elevations (within the Cope Drive sewer) versus the MUSF/USF elevations for Blocks 5-7. As shown, positive freeboard is present for all buildings.

Table 10: Stress Test HGL Analysis & Foundation Drainage Summary (Blocks 5-7)

Block	Stress Test HGL Elevation (m)	Minimum USF Elevation (m)	Proposed USF Elevation (m)	Freeboard (m) - MUSF *	Freeboard (m) - USF **
5 (W)	102.95	105.41	105.89	2.46	2.94
5 (E)		104.50	105.29	1.55	2.34
6		104.58	104.58	1.63	1.63
7 (E)		104.55	104.64	1.60	1.69
7 (W)		104.55	104.94	1.60	1.99

* Freeboard between 100-yr HGL and Proposed MUSF elevation.

** Freeboard between 100-yr HGL and Proposed USF elevation.

In addition to the checks carried out relative to the 100-year + 20% stress testing event, WSP has included provisions for emergency spillways. This was achieved through grading where 150mm vertical clearances between ground elevations (at building envelopes) and the site’s spill elevation to municipal Right-of-Ways were provided.

3.3 QUALITY CONTROL

As noted in Section 1.4, Quality control for the site’s stormwater is not required if the site’s post-development imperviousness is equal or less than 86% (or runoff coefficient of 0.8), as specified by IBI’s sizing of the subdivision’s SWM system. Stormwater from the site will be treated in Pond 5 downstream of the development. The post-development site imperviousness was calculated to be 64% (Runoff coefficient = 0.63); therefore, no on-site quality control is required.

3.4 DIVERSION OF DRAINAGE CATCHMENT AREAS

A diversion of a drainage catchment (when comparing pre-development to post-development) is currently proposed; however, the allocation of stormwater flow to the designated outlets is in accordance with the overall Subdivision design criteria as specified in the CRT Phase 1 Servicing Report.

3.5 WATERCOURSES, MUNICIPAL DRAINS, AND FLOODPLAINS

Stormwater from the proposed development will not be directly discharged to a watercourse. As such, no significant negative impacts are anticipated to downstream receiving watercourses due to proposed quantity and quality control measures. All stormwater from the site will ultimately be routed to one the two following stormwater management facilities:

- Pond 6 of the CRT Lands – Phase1 development (up to 39 l/s of major overland flow); and
- Pond 5 of the Fernbank Crossing development.

As such, no significant negative impacts are anticipated to downstream receiving watercourses due to proposed quantity and quality control measures.

There are no municipal drains on the site or associated with the drainage from the site.

There are no designated floodplains on the site of this development.

3.6 SETBACKS FROM SIGNIFICANT FEATURES

There are no private sewage disposal systems, watercourses, and/or hazard lands in the vicinity of the subject site. As such, there are no associated set-backs requirements to adhere to.

3.7 FILL CONSTRAINT

There are no known fill constraints applicable to this site related to any floodplain. No fill constraints related to soil conditions are anticipated, as confirmed in the geotechnical report.

4 SEDIMENT AND EROSION CONTROL

4.1 5.1 GENERAL

During construction, existing storm sewer system can be exposed to sediment loadings. A number of construction techniques designed to reduce unnecessary construction sediment loadings will be used, including:

- Filter cloths, which will remain on open surface structures such as manholes and catch basins until these structures are commissioned and put into use;
- Installation of silt fence, where applicable, around the perimeter of the proposed work area;
- The installation of straw bales within existing drainage features surround the site; and
- Bulkhead barriers will be installed in the outlet pipes.

During construction of the services, any trench dewatering using pumps will be fitted with a “filter sock.” Thus, any pumped groundwater will be filtered prior to release to the existing surface runoff. The contractor will inspect and maintain the filter sock as needed including sediment removal and disposal.

All catch basins, and to a lesser degree, manholes, convey surface water to sewers. Consequently, until the surrounding surface has been completed, these structures will be covered to prevent sediment from entering the minor storm sewer system. These measures will stay in place and be maintained during construction and build-out until it is appropriate to remove them.

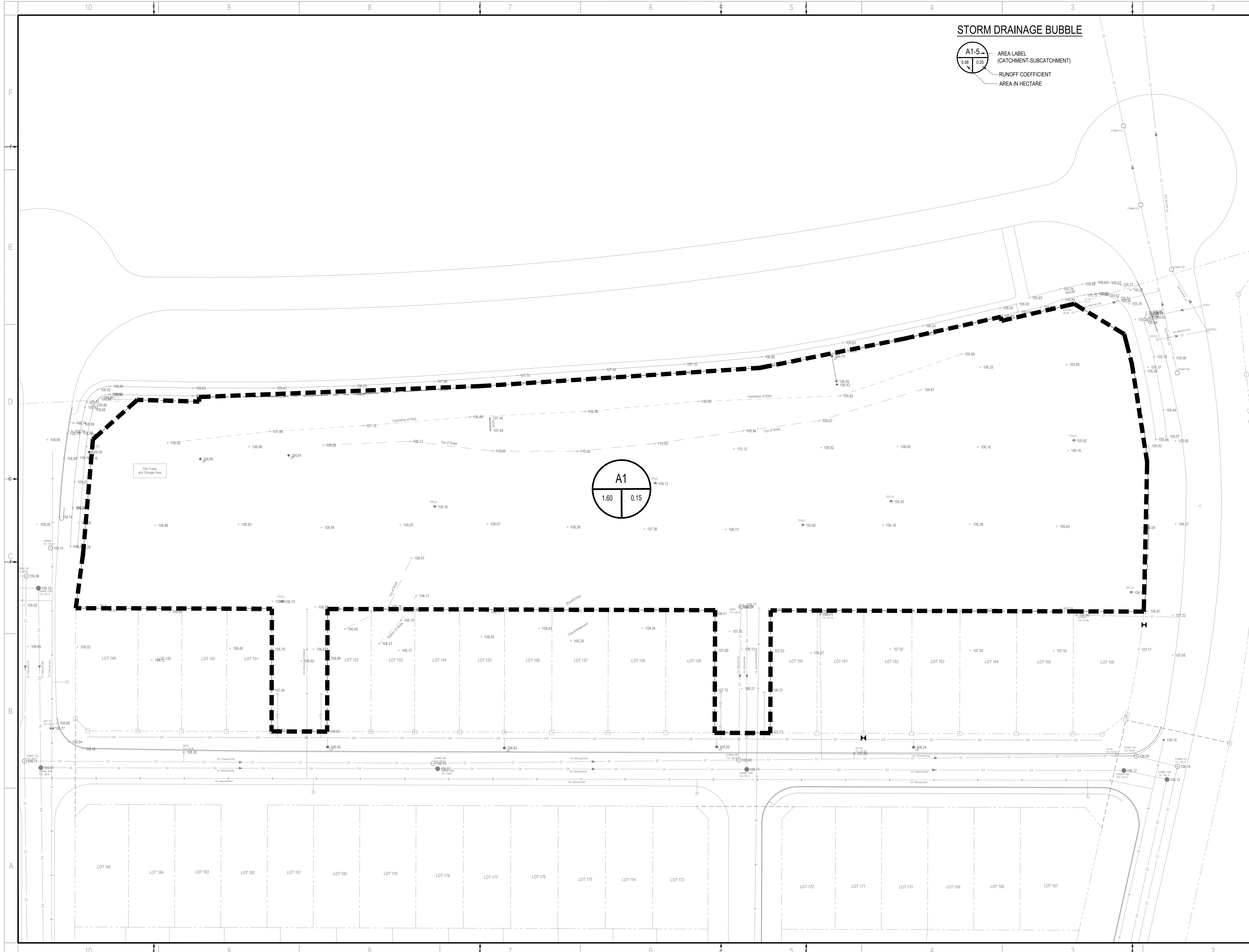
During construction of any development both imported and native soils are placed in stockpiles. Mitigative measures and proper management to prevent these materials entering the sewer system are needed. During construction of the deeper water mains and sewers, imported granular bedding materials are temporarily stockpiled on site. These materials are however quickly used up and generally placed before any catch basins are installed. Refer to the Sediment and Erosion Control Plan (drawing C1.8) provided in Servicing Report - Appendix A.

5 CONCLUSIONS

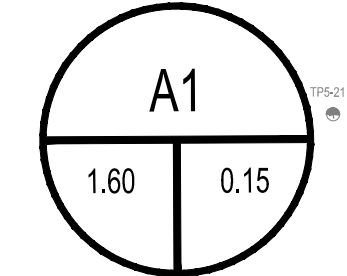
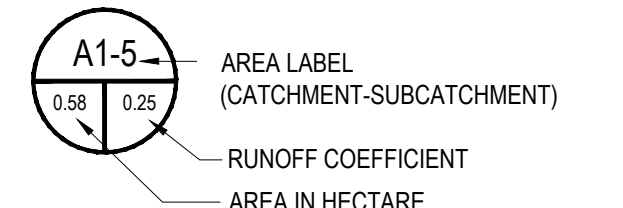
WSP has completed this stormwater management analysis, calculations, and reporting in support of the Site Plan Application for the proposed development at 620 Bobolink Ridge (Block 344). Stormwater management requirements for the site have been determined and associated on-site quantity control infrastructure has been sized. A total of 165 m³ of storage will be provided (through a combination of parking lot storage, pipe storage, and pond storage) to restrict flow into the minor system during major storm events. Said storage will limit peak flow to dedicated outlets to within allowable limits in accordance with the CRT Lands Phase 1 Servicing Report, as well as comply with all City's SWM criteria.

APPENDIX A – CATCHMENT FIGURES





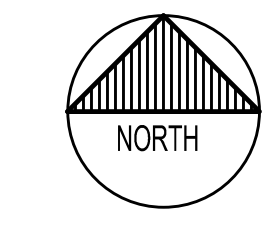
STORM DRAINAGE BUBBLE



124 GARDINERS ROAD, SUITE 201
KINGSTON, ONTARIO
CANADA K7P 0G2
PHONE: 613-634-7373
WWW.WSP.COM

CONSULTANT:

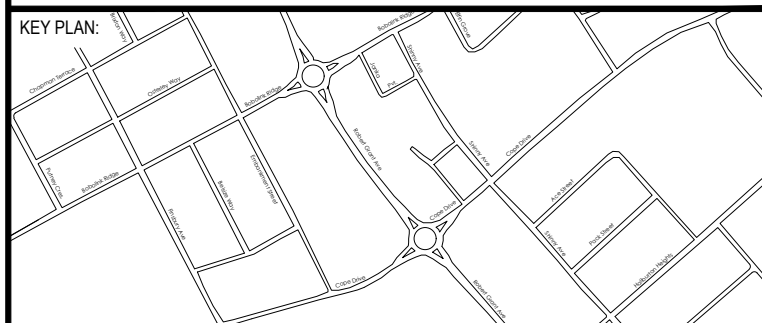
**M. David Blakely
Architect Inc.**
2203 Prince of Wales Dr., Suite 101
Ottawa, Ontario, K2E 6Z9
Phone: (613) 226-8811 Fax: (613) 226-7942



CLIENT:

**RICHCRAFT
Group Of Companies**

CLIENT REF. #
PROJECT:
TERRACE FLATS



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ISSUED FOR REVISION

NO.	DATE	DESCRIPTION
1	2021/06/16	ISSUED FOR CLIENT REVIEW

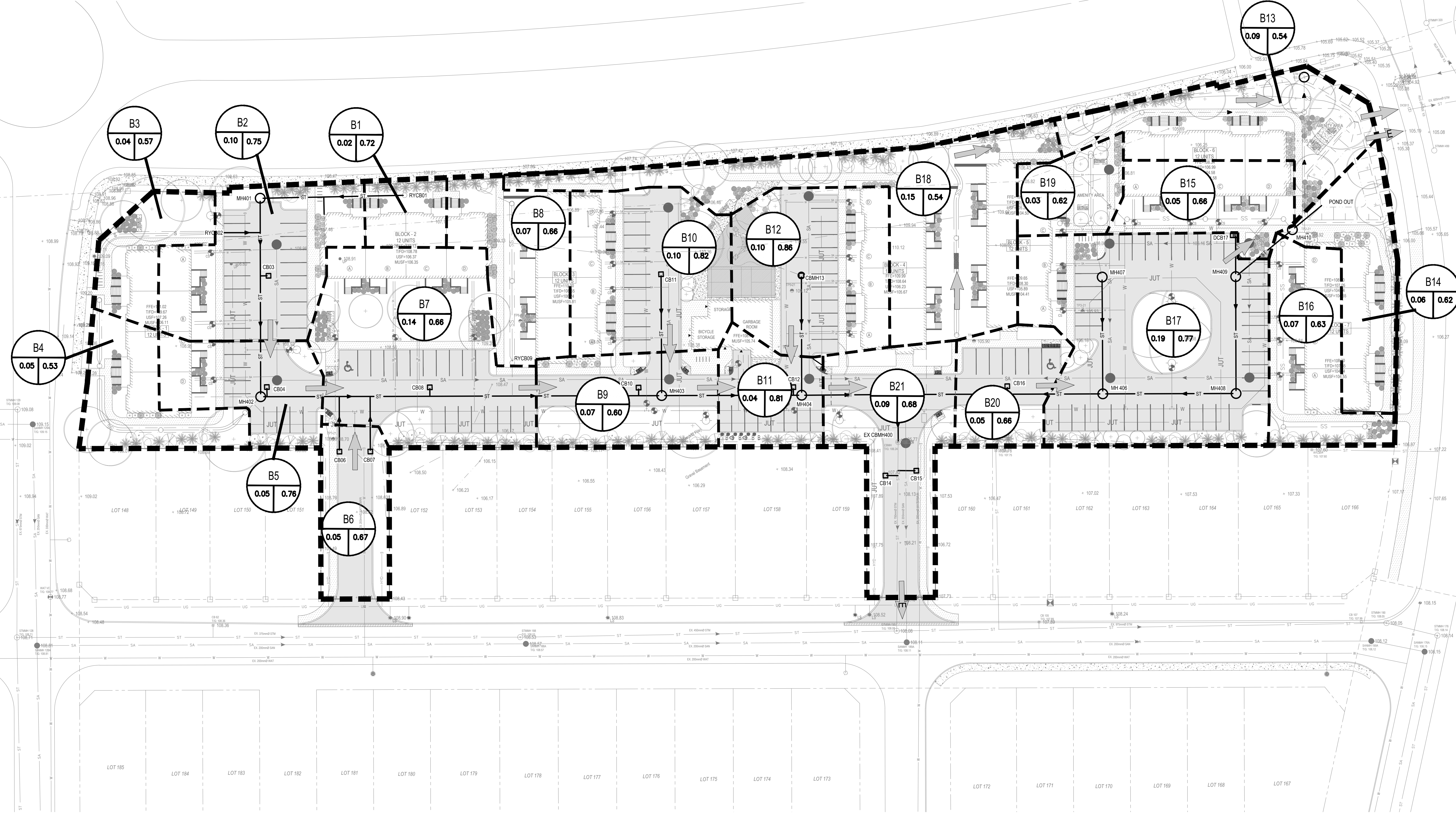
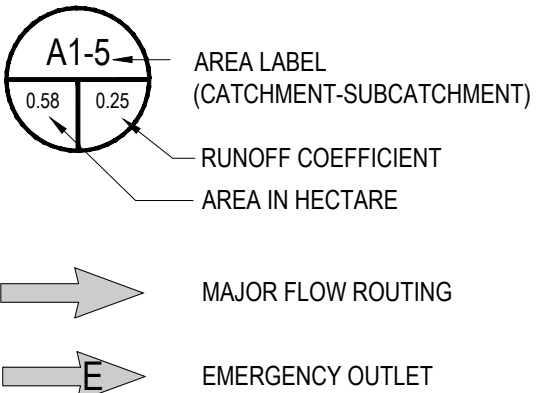
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ORIGINAL SCALE: 1:500	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.
DESIGNED BY: DS	
DRAWN BY: MH	
CHECKED BY: SD	

DISCIPLINE:	CIVIL
TITLE:	PRE-DEVELOPMENT CATCHMENT MAP
SHEET NUMBER:	SWM-SK1-1
SHEET #:	1 OF 2
ISSUE:	ISSUED FOR DISTRIBUTION
DATE OF:	2020/06/11
REV #:	0

N:\2021\211-01221-00 - Richcraft Terrace Flats Site Plan\Drawings\01_Catchment_FCS-SWS02_Schedule211-01221-00_SWM-SK1-1_PlotArea.dwg Jun 18, 2021 10:30am BY:daniel.wasko

CATCHMENT ID (B#)	CATCHMENT CHARACTERISTICS				TOTAL AREAS (ha)	WEIGHTED C-FACTOR	IMPERVIOUS (%)
	GRASSED @ C-FACTOR BELOW	GRAVEL @ C-FACTOR BELOW	ASPH/CONC @ C-FACTOR BELOW	ROOFED @ C-FACTOR BELOW			
	0.25	0.65	0.90	0.95			
1	0.0071	0.0000	0.0020	0.0128	0.0219	0.72	0.68
2	0.0233	0.0000	0.0538	0.0189	0.0960	0.75	0.76
3	0.0199	0.0000	0.0065	0.0114	0.0378	0.57	0.47
4	0.0301	0.0000	0.0060	0.0149	0.0510	0.53	0.41
5	0.0125	0.0000	0.0315	0.0105	0.0545	0.76	0.77
6	0.0164	0.0000	0.0299	0.0000	0.0463	0.67	0.65
7	0.0543	0.0000	0.0683	0.0213	0.1439	0.66	0.62
8	0.0274	0.0000	0.0071	0.0322	0.0667	0.66	0.59
9	0.0306	0.0000	0.0346	0.0016	0.0668	0.60	0.54
10	0.0140	0.0000	0.0550	0.0310	0.1000	0.82	0.86
11	0.0061	0.0000	0.0303	0.0420	0.0096	0.81	0.85
12	0.0083	0.0000	0.0615	0.0285	0.0983	0.86	0.92
13	0.0518	0.0000	0.0150	0.0229	0.0897	0.54	0.42
14	0.0290	0.0000	0.0100	0.0240	0.0630	0.62	0.54
15	0.0216	0.0000	0.0070	0.0250	0.0536	0.66	0.60
16	0.0293	0.0000	0.0100	0.0257	0.0650	0.63	0.55
17	0.0397	0.0000	0.0140	0.0140	0.1890	0.77	0.79
18	0.0885	0.0000	0.0140	0.0490	0.1515	0.54	0.42
19	0.0154	0.0000	0.0065	0.0113	0.0332	0.62	0.54
20	0.0165	0.0000	0.0277	0.0011	0.0453	0.66	0.64
21	0.0309	0.0000	0.0596	0.0018	0.0923	0.68	0.67
TOTAL	0.5727	0.0000	0.6716	0.3635	1.6078	0.68	0.64

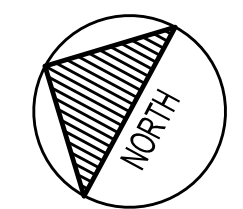
STORM DRAINAGE BUBBLE



124 GARDINERS ROAD, SUITE 201
KINGSTON, ONTARIO
CANADA K7P 0G2
PHONE: 613-634-7373
WWW.WSP.COM

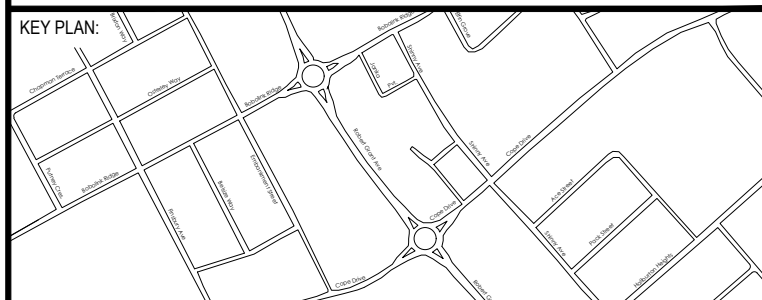


2020 Prince of Wales Dr., Suite 101
Ottawa, Ontario K2E 6Z9
Phone (613) 226-8811 Fax (613) 226-7942



CLIENT REF. #
PROJECT:

TERRACE FLATS



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ISSUED FOR - REVISION	DATE	DESCRIPTION
2	2021/10/14	ISSUED FOR SPA (REV 1)
1	2021/06/18	ISSUED FOR CLIENT REVIEW

PROJECT NO:	211-01221-00	DATE:	MARCH 2021
ORIGINAL SCALE:	1:400	IF THIS BAR IS NOT 25mm LONG, ADJUST YOUR PLOTTING SCALE.	
DESIGNED BY:	DS		
DRAWN BY:	MH		
CHECKED BY:	SD		

DISCIPLINE:	CIVIL
TITLE:	POST-DEVELOPMENT CATCHMENT MAP MINOR STORM SYSTEM
SHEET NUMBER:	SWM-SK1-2
SHEET #:	2 OF 2
ISSUE:	ISSUED FOR SPA (REV 1)
DATE OF:	2021/10/14
REV #:	0

M:\2021\211-01221-00 - Richcraft Terrace Flats Site Plan Drawings\01_Civil\03_FGS-SK1-2 (PostDev) dwg, Oct 05, 2021 2:50pm BY: (detail user)

APPENDIX B – MINOR SYSTEM SIZING CALCULATIONS



STORM SEWER CAPACITY CALCULATIONS - RICHCRAFT TERRACE FLATS

DATE: OCT 2021
PROJECT NO. 211-01221-00

PREPARED BY: Daniel Searle, P.Eng.
CHECKED BY: Steve Davidson, P.Eng., OLS (Ret.), MBA

1:5 YR STORM EVENT

REF. FIGURE: SWM - SK1-2

DRAINAGE AREA			RUNOFF DATA							PIPE DATA					
FROM No.	TO No.	AREA DESCRIPTION	AREA (ha)	RUNOFF COEFFICIENT	AC	Σ AC	Tc (min)	I (mm/hour)	PEAK RUNOFF, Q (L/s)	SIZE (mm)	SLOPE (%)	CAPACITY (L/sec)	Q/Q _{full}	VELOCITY (m/sec)	LENGTH (m)
RYCB01	MH401	B1	0.02	0.72	0.02	0.02	10.00	104.2	4.6	450	0.50%	201.6	0.02	1.27	29.0
MH401	MH402	B2-3	0.13	0.70	0.09	0.11	10.61	101.1	30.7	450	0.50%	201.6	0.15	1.27	39.0
MH402	MH403	B4-9	0.43	0.65	0.28	0.39	11.44	97.2	104.8	450	0.50%	201.6	0.52	1.27	80.0
CB11	MH403	B10	0.10	0.82	0.08	0.08	10.00	104.2	23.8	450	0.50%	201.6	0.12	1.27	29.0
MH403	MH404	B11	0.04	0.81	0.03	0.50	13.13	90.1	126.3	450	0.50%	201.6	0.63	1.27	28.0
CBMH13	MH404	B12	0.10	0.86	0.08	0.08	10.00	104.2	24.5	450	0.50%	201.6	0.12	1.27	24.0
MH404	MH405	-	0.00	0.00	0.00	0.59	13.72	87.9	143.9	450	0.50%	201.6	0.71	1.27	19.0
POND OUTLET	MH410	B13-14	0.15	0.57	0.09	0.09	10.00	104.2	25.3	300	3.90%	191.0	0.13	2.70	8.0
MH410	MH409	B15-16	0.12	0.64	0.08	0.16	10.36	102.3	46.6	600	0.15%	237.8	0.20	0.84	14.6
MH409	MH408	B17	0.19	0.77	0.15	0.31	10.56	101.3	87.1	600	0.15%	237.8	0.37	0.84	23.2
MH408	MH406	-	0.00	0.00	0.00	0.31	10.89	99.7	85.8	600	0.15%	237.8	0.36	0.84	26.4
MH407	MH406	B18-19	0.18	0.55	0.10	0.10	10.00	104.2	29.7	450	0.25%	142.6	0.21	0.90	23.2
MH406	MH405	B20	0.05	0.66	0.03	0.44	11.26	98.0	120.3	600	0.15%	237.8	0.51	0.84	41.0
MH405	STUB	B21	0.09	0.68	0.06	1.09	14.12	86.5	262.8	750	0.12%	385.7	0.68	0.87	9.5

NOTES:

- PIPE MANNING'S COEFFICIENT IS "0.013"
- RAINFALL INTENSITY IN ACCORDANCE WITH CITY OF OTTAWA SEWER DESIGN GUIDELINES.

APPENDIX C – PCSWMM MODEL MAPS AND OUTPUTS



PRE-DEV MODEL MAP



PRE-DEV - 5YR - CHICAGO - 3HR

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

Element Count

Number of rain gages 1
Number of subcatchments ... 1
Number of nodes 1
Number of links 0
Number of pollutants 0
Number of land uses 0

Raingage Summary

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_5yr_10min	INTENSITY	10 min.

Subcatchment Summary

Name	Area	Width	%Imperv	%Slope	Rain Gage
1	1.60	53.48	5.00	1.2000	Richcraft

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
2	OUTFALL	0.00	0.00	0.0	

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 CMS

Process Models:

Rainfall/Runoff YES
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing NO
 Water Quality NO
 Infiltration Method HORTON
 Surcharge Method EXTRAN
 Starting Date 04/21/2021 00:00:00
 Ending Date 04/21/2021 12:00:00
 Antecedent Dry Days 0.0
 Report Time Step 00:01:00
 Wet Time Step 00:05:00
 Dry Time Step 00:05:00

	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
Total Precipitation	0.068	42.498
Evaporation Loss	0.000	0.000
Infiltration Loss	0.008	5.054
Surface Runoff	0.060	37.507
Final Storage	0.000	0.002
Continuity Error (%)	-0.154	

	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.060	0.602
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.060	0.602
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

 Subcatchment Runoff Summary

Perv	Total	Total	Total	Total	Total	Total	Imperv
Runoff	Runoff	Total	Peak	Total	Evap	Infil	Runoff
mm	mm	Runoff	Runoff	Runoff	mm	mm	mm
		10^6 ltr	mm	mm	mm	mm	
			CMS				

1		42.50	0.00	0.00	5.05	2.13
35.38	37.51	0.60	0.13	0.883		

Analysis begun on: Thu Jun 17 23:03:26 2021

Analysis ended on: Thu Jun 17 23:03:26 2021

Total elapsed time: < 1 sec

PRE-DEV - 100YR - CHICAGO - 3HR

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

Element Count

Number of rain gages 1
Number of subcatchments ... 1
Number of nodes 1
Number of links 0
Number of pollutants 0
Number of land uses 0

Raingage Summary

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_100yr_10min	INTENSITY	10 min.

Subcatchment Summary

Name	Area	Width	%Imperv	%Slope	Rain Gage
1	1.60	53.48	5.00	1.2000	Richcraft

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
2	OUTFALL	0.00	0.00	0.0	

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 CMS
Process Models:

Rainfall/Runoff YES
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing NO
 Water Quality NO
 Infiltration Method HORTON
 Surcharge Method EXTRAN
 Starting Date 04/21/2021 00:00:00
 Ending Date 04/21/2021 12:00:00
 Antecedent Dry Days 0.0
 Report Time Step 00:01:00
 Wet Time Step 00:05:00
 Dry Time Step 00:05:00

	Volume hectare-m	Depth mm

Runoff Quantity Continuity	-----	-----

Total Precipitation	0.114	71.277
Evaporation Loss	0.000	0.000
Infiltration Loss	0.008	5.212
Surface Runoff	0.106	66.205
Final Storage	0.000	0.002
Continuity Error (%)	-0.199	

	Volume hectare-m	Volume 10^6 ltr

Flow Routing Continuity	-----	-----

Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.106	1.062
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.106	1.062
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

 Subcatchment Runoff Summary

Perv	Total	Total	Total	Total	Total	Total	Imperv
Runoff	Runoff	Total	Peak	Runoff	Evap	Infil	Runoff
mm	mm	Runoff	Runoff	Coeff	mm	mm	mm
		10^6 ltr	mm	mm	mm	mm	
			CMS				

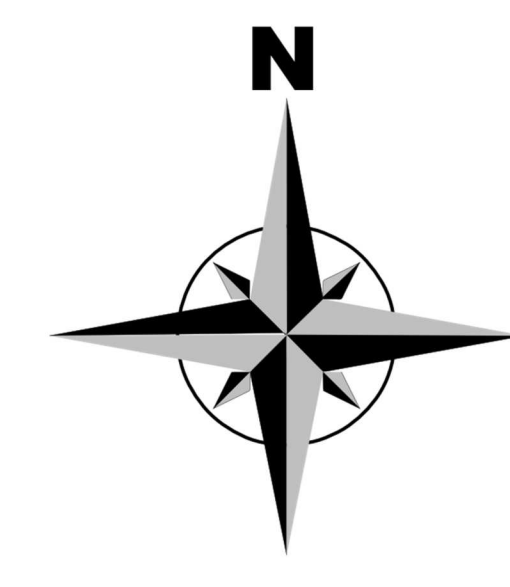
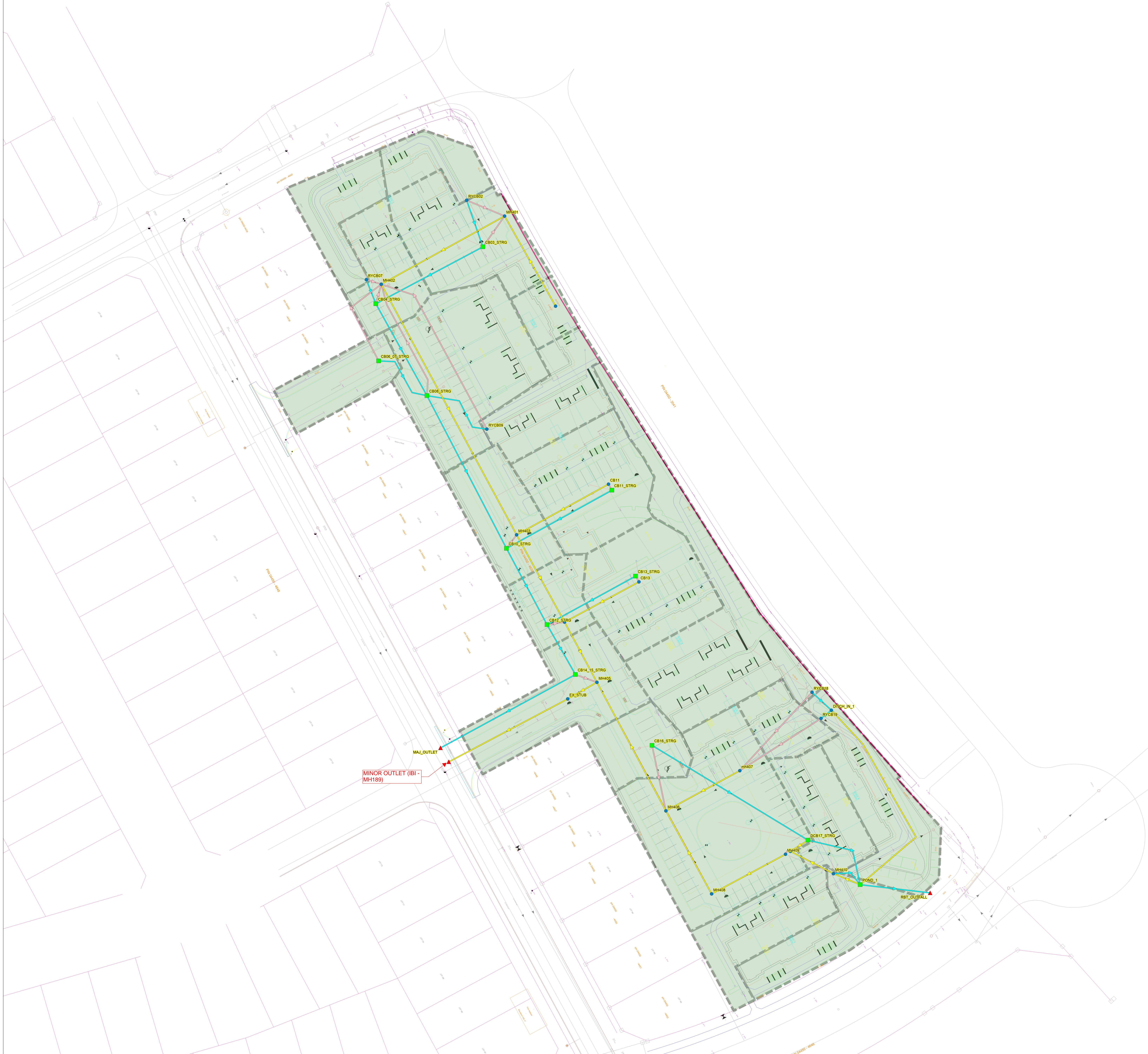
1		71.28	0.00	0.00	5.21	3.57
62.64	66.21	1.06	0.28	0.929		

Analysis begun on: Tue Jun 29 08:53:42 2021
Analysis ended on: Tue Jun 29 08:53:42 2021
Total elapsed time: < 1 sec

POST-DEV MODEL MAP

Legend

- Junctions
- ▲ Outfalls
- Storages
- Conduits
- Orifices
- Weirs
- Subcatchments
- ACAD-XR-211-01221-00 BASE_2021.06.17
- ACAD-XR-211-01221-00 NEW_2021.10.08
- PostDev_Subcatch_2021.10.05



50 m

POST-DEV - 2YR - CHICAGO - 3HR

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

WARNING 02: maximum depth increased for Node MH410
WARNING 02: maximum depth increased for Node RYCB02
WARNING 02: maximum depth increased for Node RYCB07
WARNING 02: maximum depth increased for Node RYCB09
WARNING 02: maximum depth increased for Node RYCB18
WARNING 02: maximum depth increased for Node RYCB19

Element Count

Number of rain gages 1
Number of subcatchments ... 21
Number of nodes 36
Number of links 51
Number of pollutants 0
Number of land uses 0

Raingage Summary

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_2yr_10min	INTENSITY	10 min.

Subcatchment Summary

Name	Area	Width	%Imperv	%Slope	Rain Gage
Outlet					
B1	0.02	14.60	68.00	2.0000	Richcraft
RYCB01					
B10	0.10	43.26	86.00	2.0000	Richcraft
CB11_STRG					
B11	0.04	23.11	85.00	2.0000	Richcraft
CB12_STRG					
B12	0.10	48.95	92.00	2.0000	Richcraft
CB13_STRG					
B13	0.09	16.24	42.00	2.0000	Richcraft
DITCH_IN_1					
B14	0.06	9.62	54.00	2.0000	Richcraft
POND_1					
B15	0.05	16.30	60.00	2.0000	Richcraft
MH410					
B16	0.06	18.23	55.00	2.0000	Richcraft
MH410					
B17	0.19	34.34	79.00	3.0000	Richcraft
DCB17_STRG					
B18	0.15	24.05	42.00	1.0000	Richcraft
RYCB18					

B19	0.03	16.75	54.00	2.0000	Richcraft
RYCB19					
B2	0.10	48.20	76.00	1.0000	Richcraft
CB03_STRG					
B20	0.05	30.33	64.00	2.0000	Richcraft
CB16_STRG					
B21	0.09	30.93	67.00	2.0000	Richcraft
CB14_15_STRG					
B3	0.04	12.53	47.00	2.0000	Richcraft
RYCB02					
B4	0.05	11.44	41.00	2.0000	Richcraft
RYCB07					
B5	0.05	36.60	77.00	2.0000	Richcraft
CB04_STRG					
B6	0.05	15.50	65.00	1.0000	Richcraft
CB06_07_STRG					
B7	0.14	48.07	62.00	2.0000	Richcraft
CB08_STRG					
B8	0.07	16.63	59.00	1.0000	Richcraft
RYCB09					
B9	0.07	29.04	54.00	1.0000	Richcraft
CB10_STRG					

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB11	JUNCTION	105.20	2.89	0.0	
CB13	JUNCTION	105.01	3.02	0.0	
DITCH_IN_1	JUNCTION	106.18	0.67	0.0	
EX_STUB	JUNCTION	104.30	3.65	0.0	
MH401	JUNCTION	105.68	2.97	0.0	
MH402	JUNCTION	105.34	2.68	0.0	
MH403	JUNCTION	104.91	3.12	0.0	
MH404	JUNCTION	104.74	3.30	0.0	
MH405	JUNCTION	104.34	3.66	0.0	
MH406	JUNCTION	104.54	3.43	0.0	
mh407	JUNCTION	104.75	2.60	0.0	
MH408	JUNCTION	104.60	2.53	0.0	
MH409	JUNCTION	104.81	1.79	0.0	
MH409_null	JUNCTION	104.81	1.79	0.0	
MH410	JUNCTION	104.90	1.62	0.0	
RYCB01	JUNCTION	105.98	2.08	0.0	
RYCB02	JUNCTION	106.05	2.50	0.0	
RYCB07	JUNCTION	105.85	2.50	0.0	
RYCB09	JUNCTION	105.69	2.51	0.0	
RYCB18	JUNCTION	105.39	1.31	0.0	
RYCB19	JUNCTION	104.80	1.80	0.0	
14	OUTFALL	104.25	0.75	0.0	
2	OUTFALL	105.38	0.00	0.0	
5	OUTFALL	108.07	0.00	0.0	
CB03_STRG	STORAGE	105.85	4.15	0.0	
CB04_STRG	STORAGE	105.80	4.20	0.0	
CB06_07_STRG	STORAGE	105.95	3.05	0.0	
CB08_STRG	STORAGE	105.50	4.50	0.0	

CB10_STRG	STORAGE	105.65	4.35	0.0
CB11_STRG	STORAGE	105.80	4.20	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.01	4.99	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	105.51	2.74	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

Link Summary

Name	From Node	To Node	Type	Length	%

11	POND_1	MH410	CONDUIT	8.0	
3.8581	0.0130				
13	MH402	MH403	CONDUIT	79.4	
0.5036	0.0130				
14	RYCB01	MH401	CONDUIT	28.9	
0.5193	0.0130				
15	mh407	MH406	CONDUIT	23.5	
0.2557	0.0130				
16	CB11	MH403	CONDUIT	29.2	
0.4790	0.0130				
17	MH403	MH404	CONDUIT	27.8	
0.5042	0.0130				
18	MH404	MH405	CONDUIT	19.1	
0.5246	0.0130				
2	MH401	MH402	CONDUIT	39.3	
0.4835	0.0130				
2_3	MH408	MH406	CONDUIT	26.4	
0.1515	0.0130				
3	MH410	MH409_null	CONDUIT	13.6	
0.2949	0.0130				
39	CB13	MH404	CONDUIT	23.6	
0.5095	0.0130				
4	MH409	MH408	CONDUIT	23.4	
0.1709	0.0130				
44	DITCH_IN_1	POND_1	CONDUIT	55.0	
0.5091	0.0350				
54	DCB17_STRG	MH409_null	CONDUIT	5.8	
1.0259	0.0130				
7	MH406	MH405	CONDUIT	40.7	
0.1474	0.0130				
8	MH405	EX_STUB	CONDUIT	9.4	
0.1065	0.0130				
9	EX_STUB	14	CONDUIT	37.5	
0.1334	0.0130				
10	CB14_15_STRG	MH405	ORIFICE		
19	RYCB02	MH401	ORIFICE		
21	CB03_STRG	MH401	ORIFICE		
22	RYCB07	MH402	ORIFICE		
24	CB04_STRG	MH402	ORIFICE		
25	CB06_07_STRG	MH402	ORIFICE		
27	RYCB19	mh407	ORIFICE		
28	RYCB18	mh407	ORIFICE		

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB07	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

Cross Section Summary

Full Conduit Flow	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels
11	CIRCULAR	0.30	0.07	0.07	0.30	1
0.19						
13	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
14	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
15	CIRCULAR	0.45	0.16	0.11	0.45	1
0.14						
16	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
17	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
18	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
2	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.33						
39	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						

4	CIRCULAR	0.60	0.28	0.15	0.60	1
0.25						
44	TRAPEZOIDAL	0.30	0.36	0.16	2.10	1
0.22						
54	CIRCULAR	0.30	0.07	0.07	0.30	1
0.10						
7	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
8	CIRCULAR	0.75	0.44	0.19	0.75	1
0.36						
9	CIRCULAR	0.75	0.44	0.19	0.75	1
0.41						

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 CMS

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
Surcharge Method EXTRAN
Starting Date 04/21/2021 00:00:00
Ending Date 04/21/2021 12:00:00
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 0.50 sec
Variable Time Step YES
Maximum Trials 8
Number of Threads 4
Head Tolerance 0.001500 m

Runoff Quantity Continuity	Volume hectare-m	Depth mm
Total Precipitation	0.051	31.776
Evaporation Loss	0.000	0.000
Infiltration Loss	0.018	11.264
Surface Runoff	0.033	20.644
Final Storage	0.000	0.001

Continuity Error (%) -0.416

```
*****
Flow Routing Continuity          Volume      Volume
                                hectare-m   10^6 ltr
*****
Dry Weather Inflow .....      0.000      0.000
Wet Weather Inflow .....      0.033      0.332
Groundwater Inflow .....      0.000      0.000
RDII Inflow .....              0.000      0.000
External Inflow .....           0.000      0.000
External Outflow .....          0.033      0.329
Flooding Loss .....             0.000      0.000
Evaporation Loss .....           0.000      0.000
Exfiltration Loss .....          0.000      0.000
Initial Stored Volume ....       0.000      0.000
Final Stored Volume .....        0.000      0.001
Continuity Error (%) .....      0.530
```

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

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

```
*****
Routing Time Step Summary
*****
Minimum Time Step      :      0.50 sec
Average Time Step      :      0.50 sec
Maximum Time Step      :      0.50 sec
Percent in Steady State :      0.00
Average Iterations per Step :      2.00
Percent Not Converging :      0.00
Time Step Frequencies :
  0.500 - 0.500 sec    :    100.00 %
  0.500 - 0.500 sec    :      0.00 %
  0.500 - 0.500 sec    :      0.00 %
  0.500 - 0.500 sec    :      0.00 %
  0.500 - 0.500 sec    :      0.00 %
```

```
*****
Subcatchment Runoff Summary
*****
```

```
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-----
Perv      Total      Total      Total      Total      Total      Imperv
          Total      Peak      Runoff
```

Runoff	Runoff	Precip	Runon	Evap	Infil	Runoff	
Subcatchment	mm	Runoff	Runoff	Coeff	mm	mm	
mm	mm	10 ⁶ ltr	mm	mm	mm	mm	
			CMS				
B1			31.78	0.00	0.00	10.12	21.66
0.10	21.76	0.00	0.00	0.685			
B10			31.78	0.00	0.00	4.42	27.46
0.06	27.52	0.03	0.02	0.866			
B11			31.78	0.00	0.00	4.69	27.11
0.27	27.38	0.01	0.01	0.862			
B12			31.78	0.00	0.00	2.52	29.36
0.06	29.43	0.03	0.02	0.926			
B13			31.78	0.00	0.00	18.41	13.42
0.03	13.45	0.01	0.01	0.423			
B14			31.78	0.00	0.00	14.60	17.28
0.03	17.30	0.01	0.01	0.544			
B15			31.78	0.00	0.00	12.68	19.16
0.05	19.20	0.01	0.01	0.604			
B16			31.78	0.00	0.00	14.27	17.56
0.05	17.60	0.01	0.01	0.554			
B17			31.78	0.00	0.00	6.65	25.28
0.04	25.31	0.05	0.03	0.797			
B18			31.78	0.00	0.00	18.42	13.44
0.02	13.46	0.02	0.01	0.424			
B19			31.78	0.00	0.00	14.58	17.20
0.08	17.28	0.01	0.00	0.544			
B2			31.78	0.00	0.00	7.60	24.27
0.05	24.33	0.02	0.02	0.766			
B20			31.78	0.00	0.00	11.39	20.38
0.10	20.48	0.01	0.01	0.645			
B21			31.78	0.00	0.00	10.46	21.39
0.05	21.44	0.02	0.01	0.675			
B3			31.78	0.00	0.00	16.81	14.99
0.05	15.04	0.01	0.00	0.473			
B4			31.78	0.00	0.00	18.73	13.09
0.04	13.12	0.01	0.00	0.413			
B5			31.78	0.00	0.00	7.26	24.53
0.10	24.63	0.01	0.01	0.775			
B6			31.78	0.00	0.00	11.10	20.78
0.04	20.82	0.01	0.01	0.655			
B7			31.78	0.00	0.00	12.05	19.79
0.05	19.84	0.03	0.02	0.624			
B8			31.78	0.00	0.00	13.01	18.87
0.03	18.90	0.01	0.01	0.595			
B9			31.78	0.00	0.00	14.59	17.23
0.05	17.28	0.01	0.01	0.544			

Node Depth Summary

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
------	------	----------------------------	----------------------------	--------------------------	--	---------------------------------

CB11	JUNCTION	0.01	0.10	105.30	0	01:10	0.10
CB13	JUNCTION	0.01	0.09	105.10	0	01:10	0.09
DITCH_IN_1	JUNCTION	0.01	0.08	106.26	0	01:10	0.08
EX_STUB	JUNCTION	0.04	0.38	104.68	0	01:12	0.38
MH401	JUNCTION	0.01	0.11	105.79	0	01:10	0.11
MH402	JUNCTION	0.02	0.18	105.52	0	01:10	0.18
MH403	JUNCTION	0.02	0.25	105.16	0	01:11	0.25
MH404	JUNCTION	0.02	0.31	105.05	0	01:11	0.31
MH405	JUNCTION	0.04	0.40	104.74	0	01:12	0.40
MH406	JUNCTION	0.04	0.27	104.81	0	01:11	0.27
mh407	JUNCTION	0.02	0.13	104.88	0	01:09	0.13
MH408	JUNCTION	0.04	0.25	104.85	0	01:11	0.25
MH409	JUNCTION	0.02	0.20	105.01	0	01:11	0.20
MH409_null	JUNCTION	0.03	0.63	105.44	0	01:10	0.63
MH410	JUNCTION	0.02	0.54	105.44	0	01:10	0.54
RYCB01	JUNCTION	0.00	0.04	106.02	0	01:10	0.04
RYCB02	JUNCTION	0.01	0.13	106.18	0	01:10	0.13
RYCB07	JUNCTION	0.01	0.32	106.17	0	01:10	0.32
RYCB09	JUNCTION	0.02	0.89	106.58	0	01:10	0.89
RYCB18	JUNCTION	0.01	0.23	105.62	0	01:10	0.23
RYCB19	JUNCTION	1.44	1.57	106.37	0	01:10	1.57
14	OUTFALL	0.02	0.27	104.52	0	01:12	0.27
2	OUTFALL	0.00	0.00	105.38	0	00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0	00:00	0.00
CB03_STRG	STORAGE	0.03	1.38	107.23	0	01:10	1.37
CB04_STRG	STORAGE	0.02	1.05	106.85	0	01:10	1.05
CB06_07_STRG	STORAGE	0.02	0.58	106.53	0	01:10	0.58
CB08_STRG	STORAGE	0.04	1.88	107.38	0	01:10	1.87
CB10_STRG	STORAGE	0.02	0.80	106.45	0	01:10	0.79
CB11_STRG	STORAGE	0.03	1.49	107.29	0	01:10	1.48
CB12_STRG	STORAGE	0.02	0.80	106.61	0	01:10	0.80
CB13_STRG	STORAGE	0.05	2.02	107.03	0	01:10	2.02
CB14_15_STRG	STORAGE	0.02	1.04	106.79	0	01:10	1.03
CB16_STRG	STORAGE	0.02	0.92	106.43	0	01:11	0.92
DCB17_STRG	STORAGE	0.60	0.88	105.45	0	01:10	0.88
POND_1	STORAGE	0.01	0.05	105.55	0	01:12	0.05

Node Inflow Summary

Total Flow		Maximum Lateral Inflow	Maximum Total Inflow	Time of Max Occurrence	Lateral Inflow Volume
Node	Error Percent	Type	CMS	days hr:min	10^6 ltr
CB11	0.0274	JUNCTION	0.000	0 01:10	0
CB13	0.0288	JUNCTION	0.000	0 01:10	0

DITCH_IN_1	JUNCTION	0.008	0.008	0	01:10	0.012
0.012		0.005				
EX_STUB	JUNCTION	0.000	0.200	0	01:11	0
0.329		0.015				
MH401	JUNCTION	0.000	0.022	0	01:10	0
0.0339		-0.003				
MH402	JUNCTION	0.000	0.066	0	01:10	0
0.105		0.041				
MH403	JUNCTION	0.000	0.090	0	01:11	0
0.144		-0.133				
MH404	JUNCTION	0.000	0.114	0	01:11	0
0.184		-0.043				
MH405	JUNCTION	0.000	0.200	0	01:11	0
0.329		-0.001				
MH406	JUNCTION	0.000	0.075	0	01:10	0
0.125		-0.316				
mh407	JUNCTION	0.000	0.017	0	01:10	0
0.0244		0.844				
MH408	JUNCTION	0.000	0.054	0	01:11	0
0.0915		0.018				
MH409	JUNCTION	0.000	0.054	0	01:10	0
0.0914		-0.033				
MH409_null	JUNCTION	0.000	0.055	0	01:10	0
0.0914		-0.040				
MH410	JUNCTION	0.015	0.026	0	01:10	0.0216
0.0443		0.025				
RYCB01	JUNCTION	0.003	0.003	0	01:10	0.00476
0.00476		0.003				
RYCB02	JUNCTION	0.004	0.004	0	01:10	0.00565
0.00565		0.001				
RYCB07	JUNCTION	0.005	0.005	0	01:10	0.00676
0.00676		0.001				
RYCB09	JUNCTION	0.008	0.008	0	01:10	0.0126
0.0126		0.000				
RYCB18	JUNCTION	0.014	0.014	0	01:10	0.0204
0.0204		0.000				
RYCB19	JUNCTION	0.004	0.004	0	01:10	0.00579
0.00579		45.469				
14	OUTFALL	0.000	0.200	0	01:12	0
0.329		0.000				
2	OUTFALL	0.000	0.000	0	00:00	0
0		0.000 ltr				
5	OUTFALL	0.000	0.000	0	00:00	0
0		0.000 ltr				
CB03_STRG	STORAGE	0.016	0.016	0	01:10	0.0235
0.0235		0.000				
CB04_STRG	STORAGE	0.009	0.009	0	01:10	0.0135
0.0135		0.000				
CB06_07_STRG	STORAGE	0.006	0.006	0	01:10	0.00968
0.00968		0.000				
CB08_STRG	STORAGE	0.019	0.019	0	01:10	0.0286
0.0286		0.000				
CB10_STRG	STORAGE	0.008	0.008	0	01:10	0.0115
0.0115		0.000				
CB11_STRG	STORAGE	0.018	0.018	0	01:10	0.0274
0.0274		0.000				
CB12_STRG	STORAGE	0.008	0.008	0	01:10	0.0114
0.0114		0.000				
CB13_STRG	STORAGE	0.019	0.019	0	01:10	0.0288
0.0288		0.001				

CB14_15_STRG	STORAGE	0.013	0.013	0	01:10	0.0199
0.0199	0.000					
CB16_STRG	STORAGE	0.006	0.006	0	01:10	0.00932
0.00932	0.000					
DCB17_STRG	STORAGE	0.032	0.032	0	01:10	0.0478
0.0478	0.550					
POND_1	STORAGE	0.007	0.014	0	01:10	0.0108
0.0228	-0.037					

Node Surcharge Summary

No nodes were surcharged.

Node Flooding Summary

No nodes were flooded.

Storage Volume Summary

of Max Occurrence		Maximum Outflow	Average Volume	Avg Full	Evap Loss	Exfil Loss	Maximum Volume	Max Full	Time days
hr:min	Storage Unit	CMS	1000 m3	Full	Loss	Loss	1000 m3	Full	
01:10	CB03_STRG	0.015	0.000	0	0	0	0.000	0	0
01:10	CB04_STRG	0.008	0.000	0	0	0	0.000	0	0
01:10	CB06_07_STRG	0.006	0.000	0	0	0	0.000	0	0
01:10	CB08_STRG	0.018	0.000	0	0	0	0.001	0	0
01:10	CB10_STRG	0.007	0.000	0	0	0	0.000	0	0
01:10	CB11_STRG	0.017	0.000	0	0	0	0.001	0	0
01:10	CB12_STRG	0.007	0.000	0	0	0	0.000	0	0
01:10	CB13_STRG	0.018	0.000	0	0	0	0.001	0	0
01:10	CB14_15_STRG	0.013	0.000	0	0	0	0.000	1	0
01:11	CB16_STRG	0.005	0.000	0	0	0	0.000	1	0
01:11	DCB17_STRG	0.005	0.000	5	0	0	0.001	7	0

POND_1 0.001 0 0 0 0.004 4 0
 01:12 0.012

 Outfall Loading Summary

Outfall Node	Flow Freq Pcmt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
14	54.77	0.014	0.200	0.329
2	0.00	0.000	0.000	0.000
5	0.00	0.000	0.000	0.000
System	18.26	0.014	0.200	0.329

 Link Flow Summary

Link	Type	Maximum Flow CMS	Time of Max Occurrence days hr:min	Maximum Veloc m/sec	Max/ Full Flow	Max/ Full Depth
11	CONDUIT	0.012	0 01:12	1.34	0.06	0.50
13	CONDUIT	0.066	0 01:11	0.99	0.33	0.44
14	CONDUIT	0.003	0 01:10	0.48	0.02	0.09
15	CONDUIT	0.018	0 01:10	0.63	0.12	0.25
16	CONDUIT	0.017	0 01:10	0.73	0.09	0.21
17	CONDUIT	0.089	0 01:11	0.93	0.44	0.58
18	CONDUIT	0.114	0 01:12	1.13	0.55	0.60
2	CONDUIT	0.022	0 01:10	0.80	0.11	0.23
2_3	CONDUIT	0.053	0 01:11	0.53	0.22	0.38
3	CONDUIT	0.025	0 01:11	0.36	0.08	0.94
39	CONDUIT	0.018	0 01:10	0.68	0.09	0.27
4	CONDUIT	0.054	0 01:11	0.79	0.21	0.29
44	CONDUIT	0.007	0 01:10	0.26	0.03	0.19
54	CONDUIT	0.031	0 01:10	1.17	0.32	0.96
7	CONDUIT	0.074	0 01:11	0.67	0.31	0.43
8	CONDUIT	0.200	0 01:11	0.90	0.55	0.50
9	CONDUIT	0.200	0 01:12	1.09	0.49	0.43
10	ORIFICE	0.013	0 01:10			1.00
19	ORIFICE	0.004	0 01:10			1.00
21	ORIFICE	0.015	0 01:10			1.00
22	ORIFICE	0.004	0 01:10			1.00
24	ORIFICE	0.008	0 01:10			1.00
25	ORIFICE	0.006	0 01:10			1.00
27	ORIFICE	0.004	0 01:10			1.00
28	ORIFICE	0.014	0 01:10			1.00
30	ORIFICE	0.007	0 01:10			1.00
31	ORIFICE	0.017	0 01:10			1.00
34	ORIFICE	0.007	0 01:10			1.00

39	1.00	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.01
0.00									
4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
0.00									
44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
0.00									
54	1.00	0.03	0.00	0.00	0.01	0.00	0.00	0.96	0.00
0.00									
7	1.00	0.01	0.00	0.00	0.02	0.00	0.00	0.97	0.00
0.00									
8	1.00	0.00	0.00	0.00	0.23	0.00	0.00	0.77	0.00
0.00									
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
0.00									

 Conduit Surcharge Summary

Conduit	Hours Full			Hours	
	Both Ends	Upstream	Dnstream	Above Full Normal Flow	Capacity Limited
54	0.01	0.01	0.04	0.01	0.01

Analysis begun on: Thu Oct 7 09:58:50 2021
 Analysis ended on: Thu Oct 7 09:59:04 2021
 Total elapsed time: 00:00:14

POST-DEV - 5YR - 3HR -10MIN - CHIGACO

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

 WARNING 02: maximum depth increased for Node MH410
 WARNING 02: maximum depth increased for Node RYCB02
 WARNING 02: maximum depth increased for Node RYCB07
 WARNING 02: maximum depth increased for Node RYCB09
 WARNING 02: maximum depth increased for Node RYCB18
 WARNING 02: maximum depth increased for Node RYCB19

 Element Count

Number of rain gages 1
 Number of subcatchments ... 21
 Number of nodes 36
 Number of links 51
 Number of pollutants 0
 Number of land uses 0

 Raingage Summary

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_5yr_10min	INTENSITY	10 min.

 Subcatchment Summary

Outlet	Name	Area	Width	%Imperv	%Slope	Rain Gage
	B1	0.02	14.60	68.00	2.0000	Richcraft
	RYCB01					
	B10	0.10	43.26	86.00	2.0000	Richcraft
	CB11_STRG					
	B11	0.04	23.11	85.00	2.0000	Richcraft
	CB12_STRG					
	B12	0.10	48.95	92.00	2.0000	Richcraft
	CB13_STRG					
	B13	0.09	16.24	42.00	2.0000	Richcraft
	DITCH_IN_1					
	B14	0.06	9.62	54.00	2.0000	Richcraft
	POND_1					
	B15	0.05	16.30	60.00	2.0000	Richcraft
	MH410					
	B16	0.06	18.23	55.00	2.0000	Richcraft
	MH410					
	B17	0.19	34.34	79.00	3.0000	Richcraft
	DCB17_STRG					
	B18	0.15	24.05	42.00	1.0000	Richcraft
	RYCB18					

B19	0.03	16.75	54.00	2.0000	Richcraft
RYCB19					
B2	0.10	48.20	76.00	1.0000	Richcraft
CB03_STRG					
B20	0.05	30.33	64.00	2.0000	Richcraft
CB16_STRG					
B21	0.09	30.93	67.00	2.0000	Richcraft
CB14_15_STRG					
B3	0.04	12.53	47.00	2.0000	Richcraft
RYCB02					
B4	0.05	11.44	41.00	2.0000	Richcraft
RYCB07					
B5	0.05	36.60	77.00	2.0000	Richcraft
CB04_STRG					
B6	0.05	15.50	65.00	1.0000	Richcraft
CB06_07_STRG					
B7	0.14	48.07	62.00	2.0000	Richcraft
CB08_STRG					
B8	0.07	16.63	59.00	1.0000	Richcraft
RYCB09					
B9	0.07	29.04	54.00	1.0000	Richcraft
CB10_STRG					

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB11	JUNCTION	105.20	2.89	0.0	
CB13	JUNCTION	105.01	3.02	0.0	
DITCH_IN_1	JUNCTION	106.18	0.67	0.0	
EX_STUB	JUNCTION	104.30	3.65	0.0	
MH401	JUNCTION	105.68	2.97	0.0	
MH402	JUNCTION	105.34	2.68	0.0	
MH403	JUNCTION	104.91	3.12	0.0	
MH404	JUNCTION	104.74	3.30	0.0	
MH405	JUNCTION	104.34	3.66	0.0	
MH406	JUNCTION	104.54	3.43	0.0	
mh407	JUNCTION	104.75	2.60	0.0	
MH408	JUNCTION	104.60	2.53	0.0	
MH409	JUNCTION	104.81	1.79	0.0	
MH409_null	JUNCTION	104.81	1.79	0.0	
MH410	JUNCTION	104.90	1.62	0.0	
RYCB01	JUNCTION	105.98	2.08	0.0	
RYCB02	JUNCTION	106.05	2.50	0.0	
RYCB07	JUNCTION	105.85	2.50	0.0	
RYCB09	JUNCTION	105.69	2.51	0.0	
RYCB18	JUNCTION	105.39	1.31	0.0	
RYCB19	JUNCTION	104.80	1.80	0.0	
14	OUTFALL	104.25	0.75	0.0	
2	OUTFALL	105.38	0.00	0.0	
5	OUTFALL	108.07	0.00	0.0	
CB03_STRG	STORAGE	105.85	4.15	0.0	
CB04_STRG	STORAGE	105.80	4.20	0.0	
CB06_07_STRG	STORAGE	105.95	3.05	0.0	
CB08_STRG	STORAGE	105.50	4.50	0.0	

CB10_STRG	STORAGE	105.65	4.35	0.0
CB11_STRG	STORAGE	105.80	4.20	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.01	4.99	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	105.51	2.74	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

Link Summary

Name	From Node	To Node	Type	Length	%

11	POND_1	MH410	CONDUIT	8.0	
3.8581	0.0130				
13	MH402	MH403	CONDUIT	79.4	
0.5036	0.0130				
14	RYCB01	MH401	CONDUIT	28.9	
0.5193	0.0130				
15	mh407	MH406	CONDUIT	23.5	
0.2557	0.0130				
16	CB11	MH403	CONDUIT	29.2	
0.4790	0.0130				
17	MH403	MH404	CONDUIT	27.8	
0.5042	0.0130				
18	MH404	MH405	CONDUIT	19.1	
0.5246	0.0130				
2	MH401	MH402	CONDUIT	39.3	
0.4835	0.0130				
2_3	MH408	MH406	CONDUIT	26.4	
0.1515	0.0130				
3	MH410	MH409_null	CONDUIT	13.6	
0.2949	0.0130				
39	CB13	MH404	CONDUIT	23.6	
0.5095	0.0130				
4	MH409	MH408	CONDUIT	23.4	
0.1709	0.0130				
44	DITCH_IN_1	POND_1	CONDUIT	55.0	
0.5091	0.0350				
54	DCB17_STRG	MH409_null	CONDUIT	5.8	
1.0259	0.0130				
7	MH406	MH405	CONDUIT	40.7	
0.1474	0.0130				
8	MH405	EX_STUB	CONDUIT	9.4	
0.1065	0.0130				
9	EX_STUB	14	CONDUIT	37.5	
0.1334	0.0130				
10	CB14_15_STRG	MH405	ORIFICE		
19	RYCB02	MH401	ORIFICE		
21	CB03_STRG	MH401	ORIFICE		
22	RYCB07	MH402	ORIFICE		
24	CB04_STRG	MH402	ORIFICE		
25	CB06_07_STRG	MH402	ORIFICE		
27	RYCB19	mh407	ORIFICE		
28	RYCB18	mh407	ORIFICE		

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB07	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

Cross Section Summary

Full Conduit Flow	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels

11	CIRCULAR	0.30	0.07	0.07	0.30	1
0.19						
13	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
14	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
15	CIRCULAR	0.45	0.16	0.11	0.45	1
0.14						
16	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
17	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
18	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
2	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.33						
39	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						

4	CIRCULAR	0.60	0.28	0.15	0.60	1
0.25						
44	TRAPEZOIDAL	0.30	0.36	0.16	2.10	1
0.22						
54	CIRCULAR	0.30	0.07	0.07	0.30	1
0.10						
7	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
8	CIRCULAR	0.75	0.44	0.19	0.75	1
0.36						
9	CIRCULAR	0.75	0.44	0.19	0.75	1
0.41						

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 CMS

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
Surcharge Method EXTRAN
Starting Date 04/21/2021 00:00:00
Ending Date 04/21/2021 12:00:00
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 0.50 sec
Variable Time Step YES
Maximum Trials 8
Number of Threads 4
Head Tolerance 0.001500 m

Runoff Quantity Continuity	Volume hectare-m	Depth mm
*****	-----	-----
Total Precipitation	0.068	42.498
Evaporation Loss	0.000	0.000
Infiltration Loss	0.022	13.461
Surface Runoff	0.047	29.253
Final Storage	0.000	0.001

Continuity Error (%) -0.512

	Volume hectare-m	Volume 10 ⁶ ltr
Flow Routing Continuity		
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.047	0.470
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.047	0.468
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.001
Continuity Error (%)	0.409	

Time-Step Critical Elements
None

Highest Flow Instability Indexes
All links are stable.

Routing Time Step Summary

Minimum Time Step	:	0.50 sec
Average Time Step	:	0.50 sec
Maximum Time Step	:	0.50 sec
Percent in Steady State	:	0.00
Average Iterations per Step	:	2.00
Percent Not Converging	:	0.00
Time Step Frequencies	:	
0.500 - 0.500 sec	:	100.00 %
0.500 - 0.500 sec	:	0.00 %
0.500 - 0.500 sec	:	0.00 %
0.500 - 0.500 sec	:	0.00 %
0.500 - 0.500 sec	:	0.00 %

Subcatchment Runoff Summary

Perv	Total	Total	Total Peak	Total Runoff	Total	Total	Imperv
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Runoff	Runoff	Precip	Runon	Evap	Infil	Runoff	
Subcatchment	mm	Runoff	Runoff	Coeff	mm	mm	
mm	mm	10^6 ltr	mm	mm	mm	mm	
			CMS				
B1			42.50	0.00	0.00	11.70	28.95
2.08	31.03	0.01	0.01	0.730			
B10			42.50	0.00	0.00	5.08	36.69
0.95	37.65	0.04	0.03	0.886			
B11			42.50	0.00	0.00	5.37	36.23
1.13	37.36	0.02	0.01	0.879			
B12			42.50	0.00	0.00	2.88	39.24
0.57	39.81	0.04	0.03	0.937			
B13			42.50	0.00	0.00	22.48	17.93
2.24	20.17	0.02	0.01	0.475			
B14			42.50	0.00	0.00	17.79	23.09
1.83	24.92	0.02	0.01	0.586			
B15			42.50	0.00	0.00	15.01	25.60
2.10	27.70	0.01	0.01	0.652			
B16			42.50	0.00	0.00	17.00	23.46
2.24	25.71	0.02	0.01	0.605			
B17			42.50	0.00	0.00	7.80	33.79
1.20	34.99	0.07	0.05	0.823			
B18			42.50	0.00	0.00	22.91	17.97
1.79	19.76	0.03	0.02	0.465			
B19			42.50	0.00	0.00	17.08	23.00
2.64	25.63	0.01	0.01	0.603			
B2			42.50	0.00	0.00	8.84	32.44
1.47	33.90	0.03	0.02	0.798			
B20			42.50	0.00	0.00	13.20	27.25
2.29	29.54	0.01	0.01	0.695			
B21			42.50	0.00	0.00	12.28	28.59
1.86	30.45	0.03	0.02	0.716			
B3			42.50	0.00	0.00	20.02	20.03
2.63	22.66	0.01	0.01	0.533			
B4			42.50	0.00	0.00	22.71	17.49
2.46	19.94	0.01	0.01	0.469			
B5			42.50	0.00	0.00	8.36	32.79
1.55	34.35	0.02	0.01	0.808			
B6			42.50	0.00	0.00	13.19	27.77
1.77	29.55	0.01	0.01	0.695			
B7			42.50	0.00	0.00	14.20	26.45
2.07	28.52	0.04	0.03	0.671			
B8			42.50	0.00	0.00	15.70	25.23
1.80	27.02	0.02	0.01	0.636			
B9			42.50	0.00	0.00	17.34	23.03
2.33	25.36	0.02	0.01	0.597			

Node Depth Summary

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
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CB11	JUNCTION	0.01	0.11	105.31	0	01:07	0.10
CB13	JUNCTION	0.01	0.11	105.12	0	01:13	0.11
DITCH_IN_1	JUNCTION	0.01	0.10	106.28	0	01:11	0.10
EX_STUB	JUNCTION	0.05	0.44	104.74	0	01:12	0.44
MH401	JUNCTION	0.01	0.13	105.81	0	01:10	0.13
MH402	JUNCTION	0.02	0.20	105.54	0	01:11	0.20
MH403	JUNCTION	0.02	0.30	105.21	0	01:12	0.30
MH404	JUNCTION	0.03	0.37	105.11	0	01:12	0.37
MH405	JUNCTION	0.04	0.46	104.80	0	01:12	0.46
MH406	JUNCTION	0.04	0.32	104.86	0	01:11	0.32
mh407	JUNCTION	0.02	0.16	104.91	0	01:10	0.16
MH408	JUNCTION	0.05	0.29	104.89	0	01:12	0.29
MH409	JUNCTION	0.03	0.22	105.03	0	01:12	0.22
MH409_null	JUNCTION	0.05	0.81	105.62	0	01:12	0.81
MH410	JUNCTION	0.03	0.72	105.62	0	01:12	0.72
RYCB01	JUNCTION	0.00	0.05	106.03	0	01:10	0.05
RYCB02	JUNCTION	0.01	0.26	106.31	0	01:10	0.26
RYCB07	JUNCTION	0.02	0.66	106.51	0	01:10	0.66
RYCB09	JUNCTION	0.04	1.65	107.34	0	01:11	1.64
RYCB18	JUNCTION	0.02	0.44	105.83	0	01:10	0.44
RYCB19	JUNCTION	1.45	1.58	106.38	0	01:10	1.58
14	OUTFALL	0.03	0.31	104.56	0	01:12	0.31
2	OUTFALL	0.00	0.00	105.38	0	00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0	00:00	0.00
CB03_STRG	STORAGE	0.05	2.26	108.11	0	01:11	2.26
CB04_STRG	STORAGE	0.04	1.96	107.76	0	01:11	1.95
CB06_07_STRG	STORAGE	0.03	1.10	107.05	0	01:11	1.09
CB08_STRG	STORAGE	0.07	2.34	107.84	0	01:12	2.34
CB10_STRG	STORAGE	0.04	1.57	107.22	0	01:11	1.56
CB11_STRG	STORAGE	0.06	2.27	108.07	0	01:11	2.27
CB12_STRG	STORAGE	0.03	1.43	107.24	0	01:11	1.43
CB13_STRG	STORAGE	0.07	3.02	108.03	0	01:11	3.02
CB14_15_STRG	STORAGE	0.04	2.04	107.79	0	01:10	2.04
CB16_STRG	STORAGE	0.04	1.78	107.29	0	01:12	1.78
DCB17_STRG	STORAGE	0.61	1.06	105.63	0	01:11	1.06
POND_1	STORAGE	0.01	0.13	105.63	0	01:12	0.13

Node Inflow Summary

Total Flow		Maximum Lateral Inflow	Maximum Total Inflow	Time of Max Occurrence	Lateral Inflow Volume
Node	Error Percent	Type	CMS	days hr:min	10^6 ltr
CB11	0.0375	JUNCTION	0.000	0 01:11	0
CB13	0.039	JUNCTION	0.000	0 01:10	0

DITCH_IN_1	JUNCTION	0.013	0.013	0	01:10	0.018
0.018						
EX_STUB	JUNCTION	0.000	0.257	0	01:12	0
0.468						
MH401	JUNCTION	0.000	0.030	0	01:10	0
0.048						
MH402	JUNCTION	0.000	0.086	0	01:11	0
0.15						
MH403	JUNCTION	0.000	0.118	0	01:11	0
0.204						
MH404	JUNCTION	0.000	0.147	0	01:12	0
0.259						
MH405	JUNCTION	0.000	0.257	0	01:12	0
0.468						
MH406	JUNCTION	0.000	0.095	0	01:10	0
0.18						
mh407	JUNCTION	0.000	0.027	0	01:10	0
0.0367						
MH408	JUNCTION	0.000	0.063	0	01:12	0
0.13						
MH409	JUNCTION	0.000	0.063	0	01:12	0
0.13						
MH409_null	JUNCTION	0.000	0.063	0	01:12	0
0.13						
MH410	JUNCTION	0.023	0.045	0	01:15	0.0313
0.0662						
RYCB01	JUNCTION	0.005	0.005	0	01:10	0.0068
0.0068						
RYCB02	JUNCTION	0.006	0.006	0	01:10	0.00852
0.00852						
RYCB07	JUNCTION	0.007	0.007	0	01:10	0.0103
0.0103						
RYCB09	JUNCTION	0.013	0.013	0	01:10	0.018
0.018						
RYCB18	JUNCTION	0.020	0.020	0	01:10	0.0299
0.0299						
RYCB19	JUNCTION	0.007	0.007	0	01:10	0.00859
0.00859						
14	OUTFALL	0.000	0.257	0	01:12	0
0.468						
2	OUTFALL	0.000	0.000	0	00:00	0
0						
5	OUTFALL	0.000	0.000	0	00:00	0
0						
CB03_STRG	STORAGE	0.024	0.024	0	01:10	0.0327
0.0327						
CB04_STRG	STORAGE	0.014	0.014	0	01:10	0.0189
0.0189						
CB06_07_STRG	STORAGE	0.010	0.010	0	01:10	0.0137
0.0137						
CB08_STRG	STORAGE	0.030	0.030	0	01:10	0.0411
0.0411						
CB10_STRG	STORAGE	0.012	0.012	0	01:10	0.0169
0.0169						
CB11_STRG	STORAGE	0.027	0.027	0	01:10	0.0375
0.0375						
CB12_STRG	STORAGE	0.011	0.011	0	01:10	0.0155
0.0155						
CB13_STRG	STORAGE	0.028	0.028	0	01:10	0.039
0.039						

CB14_15_STRG	STORAGE	0.021	0.021	0	01:10	0.0283
0.0283	0.000					
CB16_STRG	STORAGE	0.010	0.010	0	01:10	0.0134
0.0134	0.000					
DCB17_STRG	STORAGE	0.047	0.047	0	01:10	0.0661
0.0661	0.409					
POND_1	STORAGE	0.011	0.028	0	01:10	0.0156
0.0349	-0.027					

Node Surcharge Summary

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
MH409_null	JUNCTION	0.20	0.163	0.977

Node Flooding Summary

No nodes were flooded.

Storage Volume Summary

of Max Occurrence	Maximum Outflow Storage Unit	Average Volume	Avg Full	Evap Loss	Exfil Loss	Maximum Volume	Max Full	Time days
hr:min	CMS	1000 m3	Full	Loss	Loss	1000 m3	Full	days
CB03_STRG		0.000	0	0	0	0.001	0	0
01:11	0.019							
CB04_STRG		0.000	0	0	0	0.001	0	0
01:11	0.011							
CB06_07_STRG		0.000	0	0	0	0.000	0	0
01:11	0.008							
CB08_STRG		0.000	0	0	0	0.004	0	0
01:12	0.020							
CB10_STRG		0.000	0	0	0	0.001	0	0
01:11	0.010							
CB11_STRG		0.000	0	0	0	0.002	0	0
01:11	0.022							
CB12_STRG		0.000	0	0	0	0.001	0	0
01:11	0.010							

CB13_STRG	0.000	0	0	0	0.002	0	0
01:11 0.022							
CB14_15_STRG	0.000	0	0	0	0.001	1	0
01:10 0.018							
CB16_STRG	0.000	0	0	0	0.001	1	0
01:12 0.007							
DCB17_STRG	0.000	5	0	0	0.001	9	0
01:11 0.046							
POND_1	0.001	1	0	0	0.012	11	0
01:12 0.037							

 Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
14	55.22	0.020	0.257	0.468
2	0.00	0.000	0.000	0.000
5	0.00	0.000	0.000	0.000
System	18.41	0.020	0.257	0.468

 Link Flow Summary

Link	Type	Maximum Flow CMS	Time of Max Occurrence days hr:min	Maximum Veloc m/sec	Max/ Full Flow	Max/ Full Depth
11	CONDUIT	0.037	0 01:15	1.41	0.20	0.71
13	CONDUIT	0.086	0 01:11	1.03	0.43	0.53
14	CONDUIT	0.005	0 01:10	0.55	0.03	0.11
15	CONDUIT	0.027	0 01:10	0.67	0.18	0.34
16	CONDUIT	0.022	0 01:09	0.74	0.11	0.28
17	CONDUIT	0.117	0 01:12	0.95	0.58	0.72
18	CONDUIT	0.147	0 01:12	1.21	0.71	0.71
2	CONDUIT	0.030	0 01:10	0.87	0.15	0.27
2_3	CONDUIT	0.063	0 01:13	0.55	0.27	0.46
3	CONDUIT	0.046	0 01:15	0.36	0.14	1.00
39	CONDUIT	0.022	0 01:14	0.69	0.11	0.38
4	CONDUIT	0.063	0 01:12	0.83	0.25	0.31
44	CONDUIT	0.011	0 01:11	0.29	0.05	0.24
54	CONDUIT	0.046	0 01:10	1.20	0.47	1.00
7	CONDUIT	0.094	0 01:11	0.70	0.40	0.52
8	CONDUIT	0.257	0 01:12	0.97	0.71	0.58
9	CONDUIT	0.257	0 01:12	1.17	0.63	0.50
10	ORIFICE	0.018	0 01:10			1.00
19	ORIFICE	0.006	0 01:10			1.00
21	ORIFICE	0.019	0 01:11			1.00

22	ORIFICE	0.006	0	01:10	1.00
24	ORIFICE	0.011	0	01:11	1.00
25	ORIFICE	0.008	0	01:11	1.00
27	ORIFICE	0.007	0	01:10	
28	ORIFICE	0.020	0	01:10	1.00
30	ORIFICE	0.010	0	01:11	1.00
31	ORIFICE	0.022	0	01:11	1.00
34	ORIFICE	0.010	0	01:11	1.00
35	ORIFICE	0.022	0	01:10	1.00
41	ORIFICE	0.007	0	01:12	1.00
51	ORIFICE	0.010	0	01:11	1.00
52	ORIFICE	0.020	0	01:13	1.00
53	ORIFICE	0.063	0	01:12	1.00
1	WEIR	0.000	0	00:00	0.00
12	WEIR	0.000	0	00:00	0.00
20	WEIR	0.000	0	00:00	0.00
23	WEIR	0.000	0	00:00	0.00
26	WEIR	0.000	0	00:00	0.00
29	WEIR	0.000	0	00:00	0.00
32	WEIR	0.000	0	00:00	0.00
33	WEIR	0.000	0	00:00	0.00
36	WEIR	0.000	0	00:00	0.00
37	WEIR	0.000	0	00:00	0.00
38	WEIR	0.000	0	00:00	0.00
40	WEIR	0.000	0	00:00	0.00
42	WEIR	0.000	0	00:00	0.00
43	WEIR	0.000	0	00:00	0.00
45	WEIR	0.000	0	00:00	0.00
46	WEIR	0.000	0	00:00	0.00
5	WEIR	0.000	0	00:00	0.00
50	WEIR	0.000	0	00:00	0.00

Flow Classification Summary

```

-----
-----
---
Adjusted      ----- Fraction of Time in Flow Class -----
---
/Actual          Up   Down  Sub   Sup   Up   Down  Norm
Inlet
Conduit         Length  Dry  Dry   Dry   Crit Crit  Crit  Crit  Ltd
Ctrl
-----
-----
11              1.00   0.00 0.00 0.00 0.02 0.00 0.00 0.97 0.01
0.00
13              1.00   0.00 0.00 0.00 0.04 0.00 0.00 0.96 0.01
0.00
14              1.00   0.00 0.00 0.00 0.00 0.00 0.00 1.00 0.00
0.00
15              1.00   0.01 0.00 0.00 0.03 0.00 0.00 0.97 0.00
0.00
16              1.00   0.00 0.00 0.00 0.02 0.00 0.00 0.98 0.01
0.00
17              1.00   0.00 0.00 0.00 0.05 0.00 0.00 0.95 0.00
0.00

```

18	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
0.00									
2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
0.00									
2_3	1.00	0.02	0.00	0.00	0.22	0.00	0.00	0.76	0.00
0.00									
3	1.00	0.00	0.00	0.00	0.14	0.00	0.00	0.86	0.03
0.00									
39	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.01
0.00									
4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
0.00									
44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
0.00									
54	1.00	0.02	0.00	0.00	0.03	0.00	0.00	0.95	0.00
0.00									
7	1.00	0.01	0.00	0.00	0.03	0.00	0.00	0.96	0.00
0.00									
8	1.00	0.00	0.00	0.00	0.24	0.00	0.00	0.76	0.00
0.00									
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
0.00									

 Conduit Surcharge Summary

Conduit	Hours Full			Hours	
	Both Ends	Upstream	Dnstream	Above Full Normal Flow	Capacity Limited
11	0.01	0.01	0.20	0.01	0.01
3	0.19	0.19	0.20	0.01	0.01
54	0.20	0.20	0.22	0.01	0.01

Analysis begun on: Thu Oct 7 09:58:50 2021
 Analysis ended on: Thu Oct 7 09:59:04 2021
 Total elapsed time: 00:00:14

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

 WARNING 02: maximum depth increased for Node MH410
 WARNING 02: maximum depth increased for Node RYCB02
 WARNING 02: maximum depth increased for Node RYCB07
 WARNING 02: maximum depth increased for Node RYCB09
 WARNING 02: maximum depth increased for Node RYCB18
 WARNING 02: maximum depth increased for Node RYCB19

Element Count

Number of rain gages 1
 Number of subcatchments ... 21
 Number of nodes 36
 Number of links 51
 Number of pollutants 0
 Number of land uses 0

Raingage Summary

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_100yr_10min	INTENSITY	10 min.

Subcatchment Summary

Name	Area	Width	%Imperv	%Slope	Rain Gage
Outlet					
B1	0.02	14.60	68.00	2.0000	Richcraft
RYCB01					
B10	0.10	43.26	86.00	2.0000	Richcraft
CB11_STRG					
B11	0.04	23.11	85.00	2.0000	Richcraft
CB12_STRG					
B12	0.10	48.95	92.00	2.0000	Richcraft
CB13_STRG					
B13	0.09	16.24	42.00	2.0000	Richcraft
DITCH_IN_1					
B14	0.06	9.62	54.00	2.0000	Richcraft
POND_1					
B15	0.05	16.30	60.00	2.0000	Richcraft
MH410					
B16	0.06	18.23	55.00	2.0000	Richcraft
MH410					
B17	0.19	34.34	79.00	3.0000	Richcraft
DCB17_STRG					
B18	0.15	24.05	42.00	1.0000	Richcraft
RYCB18					

B19	0.03	16.75	54.00	2.0000	Richcraft
RYCB19					
B2	0.10	48.20	76.00	1.0000	Richcraft
CB03_STRG					
B20	0.05	30.33	64.00	2.0000	Richcraft
CB16_STRG					
B21	0.09	30.93	67.00	2.0000	Richcraft
CB14_15_STRG					
B3	0.04	12.53	47.00	2.0000	Richcraft
RYCB02					
B4	0.05	11.44	41.00	2.0000	Richcraft
RYCB07					
B5	0.05	36.60	77.00	2.0000	Richcraft
CB04_STRG					
B6	0.05	15.50	65.00	1.0000	Richcraft
CB06_07_STRG					
B7	0.14	48.07	62.00	2.0000	Richcraft
CB08_STRG					
B8	0.07	16.63	59.00	1.0000	Richcraft
RYCB09					
B9	0.07	29.04	54.00	1.0000	Richcraft
CB10_STRG					

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB11	JUNCTION	105.20	2.89	0.0	
CB13	JUNCTION	105.01	3.02	0.0	
DITCH_IN_1	JUNCTION	106.18	0.67	0.0	
EX_STUB	JUNCTION	104.30	3.65	0.0	
MH401	JUNCTION	105.68	2.97	0.0	
MH402	JUNCTION	105.34	2.68	0.0	
MH403	JUNCTION	104.91	3.12	0.0	
MH404	JUNCTION	104.74	3.30	0.0	
MH405	JUNCTION	104.34	3.66	0.0	
MH406	JUNCTION	104.54	3.43	0.0	
mh407	JUNCTION	104.75	2.60	0.0	
MH408	JUNCTION	104.60	2.53	0.0	
MH409	JUNCTION	104.81	1.79	0.0	
MH409_null	JUNCTION	104.81	1.79	0.0	
MH410	JUNCTION	104.90	1.62	0.0	
RYCB01	JUNCTION	105.98	2.08	0.0	
RYCB02	JUNCTION	106.05	2.50	0.0	
RYCB07	JUNCTION	105.85	2.50	0.0	
RYCB09	JUNCTION	105.69	2.51	0.0	
RYCB18	JUNCTION	105.39	1.31	0.0	
RYCB19	JUNCTION	104.80	1.80	0.0	
14	OUTFALL	104.25	0.75	0.0	
2	OUTFALL	105.38	0.00	0.0	
5	OUTFALL	108.07	0.00	0.0	
CB03_STRG	STORAGE	105.85	4.15	0.0	
CB04_STRG	STORAGE	105.80	4.20	0.0	
CB06_07_STRG	STORAGE	105.95	3.05	0.0	
CB08_STRG	STORAGE	105.50	4.50	0.0	

CB10_STRG	STORAGE	105.65	4.35	0.0
CB11_STRG	STORAGE	105.80	4.20	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.01	4.99	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	105.51	2.74	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

Link Summary

Name	From Node	To Node	Type	Length	%

11	POND_1	MH410	CONDUIT	8.0	
3.8581	0.0130				
13	MH402	MH403	CONDUIT	79.4	
0.5036	0.0130				
14	RYCB01	MH401	CONDUIT	28.9	
0.5193	0.0130				
15	mh407	MH406	CONDUIT	23.5	
0.2557	0.0130				
16	CB11	MH403	CONDUIT	29.2	
0.4790	0.0130				
17	MH403	MH404	CONDUIT	27.8	
0.5042	0.0130				
18	MH404	MH405	CONDUIT	19.1	
0.5246	0.0130				
2	MH401	MH402	CONDUIT	39.3	
0.4835	0.0130				
2_3	MH408	MH406	CONDUIT	26.4	
0.1515	0.0130				
3	MH410	MH409_null	CONDUIT	13.6	
0.2949	0.0130				
39	CB13	MH404	CONDUIT	23.6	
0.5095	0.0130				
4	MH409	MH408	CONDUIT	23.4	
0.1709	0.0130				
44	DITCH_IN_1	POND_1	CONDUIT	55.0	
0.5091	0.0350				
54	DCB17_STRG	MH409_null	CONDUIT	5.8	
1.0259	0.0130				
7	MH406	MH405	CONDUIT	40.7	
0.1474	0.0130				
8	MH405	EX_STUB	CONDUIT	9.4	
0.1065	0.0130				
9	EX_STUB	14	CONDUIT	37.5	
0.1334	0.0130				
10	CB14_15_STRG	MH405	ORIFICE		
19	RYCB02	MH401	ORIFICE		
21	CB03_STRG	MH401	ORIFICE		
22	RYCB07	MH402	ORIFICE		
24	CB04_STRG	MH402	ORIFICE		
25	CB06_07_STRG	MH402	ORIFICE		
27	RYCB19	mh407	ORIFICE		
28	RYCB18	mh407	ORIFICE		

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB07	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

Cross Section Summary

Full Conduit Flow	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels
11	CIRCULAR	0.30	0.07	0.07	0.30	1
0.19						
13	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
14	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
15	CIRCULAR	0.45	0.16	0.11	0.45	1
0.14						
16	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
17	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
18	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
2	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.33						
39	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						

4	CIRCULAR	0.60	0.28	0.15	0.60	1
0.25						
44	TRAPEZOIDAL	0.30	0.36	0.16	2.10	1
0.22						
54	CIRCULAR	0.30	0.07	0.07	0.30	1
0.10						
7	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
8	CIRCULAR	0.75	0.44	0.19	0.75	1
0.36						
9	CIRCULAR	0.75	0.44	0.19	0.75	1
0.41						

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 CMS
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
Surcharge Method EXTRAN
Starting Date 04/21/2021 00:00:00
Ending Date 04/21/2021 12:00:00
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 0.50 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
*****	-----	-----
Total Precipitation	0.115	71.277
Evaporation Loss	0.000	0.000
Infiltration Loss	0.026	16.166
Surface Runoff	0.090	55.731
Final Storage	0.000	0.001

Continuity Error (%) -0.871

	Volume hectare-m	Volume 10 ⁶ ltr
	-----	-----

Flow Routing Continuity		

Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.090	0.896
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.083	0.826
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.001	0.008
Final Stored Volume	0.007	0.071
Continuity Error (%)	0.774	

Highest Continuity Errors

Node DITCH_IN_1 (4.68%)
Node MH406 (3.53%)
Node MH408 (3.05%)
Node mh407 (2.65%)
Node CB13 (2.24%)

Time-Step Critical Elements

None

Highest Flow Instability Indexes

Link 53 (15)
Link 35 (5)

Routing Time Step Summary

Minimum Time Step : 0.50 sec
Average Time Step : 0.50 sec
Maximum Time Step : 0.50 sec
Percent in Steady State : 0.00
Average Iterations per Step : 2.00
Percent Not Converging : 0.00
Time Step Frequencies :
 0.500 - 0.500 sec : 100.00 %
 0.500 - 0.500 sec : 0.00 %
 0.500 - 0.500 sec : 0.00 %
 0.500 - 0.500 sec : 0.00 %

0.500 - 0.500 sec : 0.00 %

 Subcatchment Runoff Summary

Perv		Total	Total	Total	Total	Total	Imperv
Runoff	Runoff	Runoff	Peak	Runoff	Evap	Infil	Runoff
Subcatchment	Runoff	Precip	Runoff	Runoff	mm	mm	mm
mm	mm	10 ⁶ ltr	mm	Coeff	mm	mm	mm
			CMS				
B1			71.28	0.00	0.00	14.10	48.53
9.53	58.06	0.01	0.01	0.815			
B10			71.28	0.00	0.00	6.15	61.47
4.28	65.75	0.07	0.05	0.922			
B11			71.28	0.00	0.00	6.54	60.71
4.80	65.51	0.03	0.02	0.919			
B12			71.28	0.00	0.00	3.50	65.74
2.53	68.27	0.07	0.05	0.958			
B13			71.28	0.00	0.00	26.96	30.04
14.77	44.80	0.04	0.03	0.629			
B14			71.28	0.00	0.00	21.31	38.69
11.80	50.49	0.03	0.02	0.708			
B15			71.28	0.00	0.00	17.95	42.89
11.09	53.98	0.03	0.02	0.757			
B16			71.28	0.00	0.00	20.30	39.31
12.30	51.61	0.03	0.03	0.724			
B17			71.28	0.00	0.00	9.35	56.60
5.97	62.57	0.12	0.09	0.878			
B18			71.28	0.00	0.00	27.79	30.10
13.81	43.91	0.07	0.04	0.616			
B19			71.28	0.00	0.00	20.47	38.54
13.10	51.65	0.02	0.01	0.725			
B2			71.28	0.00	0.00	10.62	54.34
6.98	61.32	0.06	0.05	0.860			
B20			71.28	0.00	0.00	15.89	45.67
10.64	56.31	0.03	0.02	0.790			
B21			71.28	0.00	0.00	14.71	47.89
9.35	57.24	0.05	0.04	0.803			
B3			71.28	0.00	0.00	23.92	33.56
14.47	48.03	0.02	0.01	0.674			
B4			71.28	0.00	0.00	27.17	29.30
15.34	44.64	0.02	0.02	0.626			
B5			71.28	0.00	0.00	10.10	54.97
7.00	61.96	0.03	0.03	0.869			
B6			71.28	0.00	0.00	15.76	46.52
9.61	56.13	0.03	0.02	0.787			
B7			71.28	0.00	0.00	16.99	44.31
10.66	54.96	0.08	0.06	0.771			
B8			71.28	0.00	0.00	18.77	42.26
10.81	53.07	0.04	0.03	0.745			
B9			71.28	0.00	0.00	20.72	38.58
12.62	51.21	0.03	0.03	0.718			

Node Depth Summary

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
CB11	JUNCTION	0.12	0.47	105.67	0 01:12	0.47
CB13	JUNCTION	0.29	0.54	105.55	0 01:12	0.54
DITCH_IN_1	JUNCTION	0.01	0.16	106.34	0 01:10	0.16
EX_STUB	JUNCTION	0.97	1.07	105.37	0 01:10	1.07
MH401	JUNCTION	0.01	0.14	105.82	0 01:06	0.14
MH402	JUNCTION	0.03	0.46	105.80	0 01:12	0.46
MH403	JUNCTION	0.39	0.75	105.66	0 01:12	0.75
MH404	JUNCTION	0.55	0.81	105.55	0 01:12	0.81
MH405	JUNCTION	0.93	1.05	105.39	0 01:10	1.05
MH406	JUNCTION	0.74	0.88	105.42	0 01:10	0.88
mh407	JUNCTION	0.53	0.69	105.44	0 01:10	0.68
MH408	JUNCTION	0.68	0.83	105.43	0 01:10	0.83
MH409	JUNCTION	0.48	0.62	105.43	0 01:10	0.62
MH409_null	JUNCTION	0.51	1.24	106.05	0 01:11	1.24
MH410	JUNCTION	0.43	1.15	106.05	0 01:11	1.15
RYCB01	JUNCTION	0.01	0.07	106.05	0 01:10	0.07
RYCB02	JUNCTION	0.02	1.06	107.11	0 01:11	1.06
RYCB07	JUNCTION	0.06	2.35	108.20	0 01:10	2.35
RYCB09	JUNCTION	0.09	2.37	108.06	0 01:10	2.37
RYCB18	JUNCTION	0.04	1.17	106.56	0 01:10	1.17
RYCB19	JUNCTION	1.47	1.60	106.40	0 01:10	1.60
14	OUTFALL	1.06	1.06	105.31	0 00:00	1.06
2	OUTFALL	0.00	0.00	105.38	0 00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0 00:00	0.00
CB03_STRG	STORAGE	0.13	2.37	108.22	0 01:14	2.37
CB04_STRG	STORAGE	0.11	2.35	108.15	0 01:13	2.35
CB06_07_STRG	STORAGE	0.07	2.28	108.23	0 01:13	2.28
CB08_STRG	STORAGE	0.20	2.49	107.99	0 01:18	2.49
CB10_STRG	STORAGE	0.11	2.38	108.03	0 01:14	2.38
CB11_STRG	STORAGE	0.12	2.36	108.16	0 01:13	2.36
CB12_STRG	STORAGE	0.08	2.29	108.10	0 01:12	2.29
CB13_STRG	STORAGE	0.43	3.14	108.15	0 01:13	3.14
CB14_15_STRG	STORAGE	0.11	2.34	108.09	0 01:14	2.34
CB16_STRG	STORAGE	0.10	2.35	107.86	0 01:10	2.35
DCB17_STRG	STORAGE	0.77	1.56	106.13	0 01:10	1.56
POND_1	STORAGE	0.03	0.54	106.04	0 01:14	0.54

Node Inflow Summary

Total	Flow	Maximum	Maximum	Lateral
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Inflow Volume Node ltr	Balance Error Percent	Type	Lateral Inflow CMS	Total Inflow CMS	Time of Occurrence days hr:min	Max Inflow Volume 10^6 ltr	10^6
CB11		JUNCTION	0.000	0.022	0 01:13	0	
0.0656	0.901						
CB13		JUNCTION	0.000	0.021	0 01:26	0	
0.0666	2.287						
DITCH_IN_1		JUNCTION	0.029	0.038	0 01:10	0.04	
0.0419	4.910						
EX_STUB		JUNCTION	0.000	0.312	0 01:10	0	
0.822	1.324						
MH401		JUNCTION	0.000	0.042	0 01:10	0	
0.0899	0.241						
MH402		JUNCTION	0.000	0.111	0 01:10	0	
0.287	0.017						
MH403		JUNCTION	0.000	0.142	0 01:13	0	
0.387	2.208						
MH404		JUNCTION	0.000	0.175	0 01:13	0	
0.471	1.284						
MH405		JUNCTION	0.000	0.312	0 01:10	0	
0.84	1.142						
MH406		JUNCTION	0.000	0.122	0 01:10	0	
0.335	3.657						
mh407		JUNCTION	0.000	0.049	0 01:10	0	
0.0804	2.722						
MH408		JUNCTION	0.000	0.064	0 01:14	0	
0.233	3.145						
MH409		JUNCTION	0.000	0.064	0 01:15	0	
0.236	1.779						
MH409_null		JUNCTION	0.000	0.097	0 01:10	0	
0.252	0.935						
MH410		JUNCTION	0.049	0.082	0 01:10	0.062	
0.174	0.907						
RYCB01		JUNCTION	0.010	0.010	0 01:10	0.0127	
0.0127	-0.004						
RYCB02		JUNCTION	0.015	0.015	0 01:10	0.0181	
0.0181	0.000						
RYCB07		JUNCTION	0.017	0.017	0 01:10	0.023	
0.023	0.000						
RYCB09		JUNCTION	0.026	0.026	0 01:10	0.0353	
0.0353	0.000						
RYCB18		JUNCTION	0.044	0.044	0 01:10	0.0665	
0.0665	0.000						
RYCB19		JUNCTION	0.015	0.015	0 01:10	0.0173	
0.0173	11.680						
14		OUTFALL	0.000	0.312	0 01:10	0	
0.811	0.000						
2		OUTFALL	0.000	0.033	0 01:14	0	
0.0143	0.000						
5		OUTFALL	0.000	0.000	0 00:00	0	
0	0.000 ltr						
CB03_STRG		STORAGE	0.045	0.045	0 01:10	0.0591	
0.0591	0.001						
CB04_STRG		STORAGE	0.026	0.026	0 01:10	0.034	
0.0342	-0.000						

CB06_07_STRG	STORAGE	0.020	0.020	0	01:10	0.0261
0.0261	0.001					
CB08_STRG	STORAGE	0.063	0.077	0	01:10	0.0793
0.0839	0.000					
CB10_STRG	STORAGE	0.027	0.027	0	01:10	0.0342
0.0342	0.001					
CB11_STRG	STORAGE	0.048	0.048	0	01:10	0.0654
0.0654	0.000					
CB12_STRG	STORAGE	0.020	0.020	0	01:10	0.0273
0.0273	0.000					
CB13_STRG	STORAGE	0.048	0.048	0	01:10	0.0668
0.0668	0.353					
CB14_15_STRG	STORAGE	0.042	0.042	0	01:10	0.0531
0.0531	0.001					
CB16_STRG	STORAGE	0.021	0.021	0	01:10	0.0256
0.0256	0.001					
DCB17_STRG	STORAGE	0.088	0.098	0	01:10	0.118
0.121	0.284					
POND_1	STORAGE	0.023	0.133	0	01:10	0.0316
0.111	-0.944					

Node Surcharge Summary

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
CB11	JUNCTION	0.10	0.017	2.423
CB13	JUNCTION	0.37	0.092	2.478
EX_STUB	JUNCTION	11.26	0.285	2.585
MH403	JUNCTION	0.41	0.154	2.366
MH404	JUNCTION	0.71	0.210	2.490
MH405	JUNCTION	11.26	0.303	2.607
MH406	JUNCTION	11.20	0.243	2.547
MH408	JUNCTION	0.44	0.059	1.701
MH409	JUNCTION	0.16	0.024	1.166
MH409_null	JUNCTION	0.93	0.589	0.551

Node Flooding Summary

No nodes were flooded.

Storage Volume Summary

of Max	Maximum	Average	Avg	Evap	Exfil	Maximum	Max	Time
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Occurrence Storage Unit hr:min	Outflow Unit CMS	Volume	Pcnt	Pcnt	Pcnt	Volume	Pcnt	days
		1000 m3	Full	Loss	Loss	1000 m3	Full	

CB03_STRG		0.000	0	0	0	0.012	2	0
01:14	0.019							
CB04_STRG		0.000	0	0	0	0.006	1	0
01:13	0.012							
CB06_07_STRG		0.000	0	0	0	0.003	2	0
01:13	0.012							
CB08_STRG		0.001	0	0	0	0.027	2	0
01:18	0.020							
CB10_STRG		0.000	0	0	0	0.006	1	0
01:14	0.012							
CB11_STRG		0.000	0	0	0	0.013	2	0
01:13	0.022							
CB12_STRG		0.000	0	0	0	0.003	1	0
01:12	0.012							
CB13_STRG		0.000	0	0	0	0.014	2	0
01:13	0.021							
CB14_15_STRG		0.000	0	0	0	0.010	18	0
01:14	0.019							
CB16_STRG		0.000	0	0	0	0.003	5	0
01:10	0.020							
DCB17_STRG		0.001	6	0	0	0.001	13	0
01:10	0.097							
POND_1		0.003	3	0	0	0.066	64	0
01:14	0.049							

 Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr

14	40.32	0.047	0.312	0.811
2	2.06	0.016	0.033	0.014
5	0.00	0.000	0.000	0.000

System	14.13	0.063	0.339	0.826

 Link Flow Summary

Link	Type	Maximum Flow CMS	Time of Max Occurrence days hr:min	Maximum Veloc m/sec	Max/ Full Flow	Max/ Full Depth

11	CONDUIT	0.080	0 01:10	1.13	0.42	1.00

13	CONDUIT	0.108	0	01:13	0.68	0.53	1.00
14	CONDUIT	0.010	0	01:10	0.66	0.05	0.15
15	CONDUIT	0.049	0	01:10	0.31	0.34	1.00
16	CONDUIT	0.023	0	01:28	0.48	0.12	1.00
17	CONDUIT	0.142	0	01:13	0.89	0.70	1.00
18	CONDUIT	0.175	0	01:13	1.10	0.85	1.00
2	CONDUIT	0.042	0	01:10	0.90	0.21	0.50
2_3	CONDUIT	0.065	0	01:14	0.32	0.27	1.00
3	CONDUIT	0.047	0	01:25	0.32	0.14	1.00
39	CONDUIT	0.021	0	01:33	0.44	0.10	1.00
4	CONDUIT	0.064	0	01:14	0.40	0.25	1.00
44	CONDUIT	0.036	0	01:11	0.40	0.16	0.43
54	CONDUIT	0.097	0	01:10	1.38	0.99	1.00
7	CONDUIT	0.122	0	01:10	0.43	0.52	1.00
8	CONDUIT	0.312	0	01:10	0.71	0.86	1.00
9	CONDUIT	0.312	0	01:10	0.71	0.77	1.00
10	ORIFICE	0.019	0	01:14			1.00
19	ORIFICE	0.013	0	01:11			1.00
21	ORIFICE	0.019	0	01:14			1.00
22	ORIFICE	0.012	0	01:10			1.00
24	ORIFICE	0.012	0	01:13			1.00
25	ORIFICE	0.012	0	01:13			1.00
27	ORIFICE	0.015	0	01:10			1.00
28	ORIFICE	0.034	0	01:10			1.00
30	ORIFICE	0.012	0	01:14			1.00
31	ORIFICE	0.022	0	01:13			1.00
34	ORIFICE	0.012	0	01:12			1.00
35	ORIFICE	0.021	0	01:26			1.00
41	ORIFICE	0.009	0	01:10			1.00
51	ORIFICE	0.012	0	01:08			1.00
52	ORIFICE	0.020	0	01:32			1.00
53	ORIFICE	0.064	0	01:15			1.00
1	WEIR	0.000	0	00:00			0.00
12	WEIR	0.000	0	00:00			0.00
20	WEIR	0.000	0	00:00			0.00
23	WEIR	0.003	0	01:10			0.03
26	WEIR	0.000	0	00:00			0.00
29	WEIR	0.014	0	01:10			0.08
32	WEIR	0.000	0	00:00			0.00
33	WEIR	0.000	0	00:00			0.00
36	WEIR	0.000	0	00:00			0.00
37	WEIR	0.000	0	00:00			0.00
38	WEIR	0.000	0	00:00			0.00
40	WEIR	0.011	0	01:10			0.07
42	WEIR	0.000	0	00:00			0.00
43	WEIR	0.000	0	00:00			0.00
45	WEIR	0.010	0	01:10			0.06
46	WEIR	0.000	0	00:00			0.00
5	WEIR	0.033	0	01:14			0.24
50	WEIR	0.000	0	00:00			0.00

Flow Classification Summary

Inlet Conduit Ctrl	Adjusted	----- Fraction of Time in Flow Class -----							
	/Actual	Up	Down	Sub	Sup	Up	Down	Norm	
	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd
11	1.00	0.00	0.00	0.00	0.93	0.00	0.00	0.07	0.86
13	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.90
14	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
15	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00
16	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.01
17	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.01
18	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.01
2	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.02
2_3	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.00
3	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00
39	1.00	0.00	0.00	0.00	0.95	0.00	0.00	0.05	0.01
4	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.00
44	1.00	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.02
54	1.00	0.02	0.00	0.00	0.93	0.00	0.00	0.05	0.00
7	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.00
8	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00

 Conduit Surcharge Summary

Conduit	----- Hours Full -----			Hours	Hours
	Both Ends	Upstream	Dnstream	Above Full Normal Flow	Capacity Limited
11	0.52	0.52	0.88	0.01	0.01
13	0.06	0.06	0.57	0.01	0.01
15	11.19	11.19	11.22	0.01	0.01
16	0.10	0.10	0.41	0.01	0.01
17	0.65	0.65	11.18	0.01	0.01
18	11.20	11.20	11.26	0.01	0.36

2_3	11.18	11.18	11.20	0.01	0.01
3	0.87	0.87	0.93	0.01	0.01
39	0.37	0.37	0.71	0.01	0.01
4	0.16	0.16	0.44	0.01	0.01
54	0.92	0.92	1.00	0.01	0.10
7	11.22	11.22	11.26	0.01	0.01
8	11.26	11.26	11.26	0.01	0.52
9	11.29	11.29	12.00	0.01	0.11

Analysis begun on: Thu Oct 7 09:58:50 2021
Analysis ended on: Thu Oct 7 09:59:04 2021
Total elapsed time: 00:00:14

POST-DEV - 100YR+20% (STRESSS TEST) - 3HR -10MIN - CHIGACO

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

 WARNING 02: maximum depth increased for Node MH410
 WARNING 02: maximum depth increased for Node RYCB02
 WARNING 02: maximum depth increased for Node RYCB07
 WARNING 02: maximum depth increased for Node RYCB09
 WARNING 02: maximum depth increased for Node RYCB18
 WARNING 02: maximum depth increased for Node RYCB19

 Element Count

Number of rain gages 1
 Number of subcatchments ... 21
 Number of nodes 36
 Number of links 51
 Number of pollutants 0
 Number of land uses 0

 Raingage Summary

Name	Data Source	Data Type	Recording Interval
Richcraft	Chicago_3h_500yr_10min	INTENSITY	10 min.

 Subcatchment Summary

Name Outlet	Area	Width	%Imperv	%Slope	Rain Gage
B1 RYCB01	0.02	14.60	68.00	2.0000	Richcraft
B10 CB11_STRG	0.10	43.26	86.00	2.0000	Richcraft
B11 CB12_STRG	0.04	23.11	85.00	2.0000	Richcraft
B12 CB13_STRG	0.10	48.95	92.00	2.0000	Richcraft
B13 DITCH_IN_1	0.09	16.24	42.00	2.0000	Richcraft
B14 POND_1	0.06	9.62	54.00	2.0000	Richcraft
B15 MH410	0.05	16.30	60.00	2.0000	Richcraft
B16 MH410	0.06	18.23	55.00	2.0000	Richcraft
B17 DCB17_STRG	0.19	34.34	79.00	3.0000	Richcraft
B18 RYCB18	0.15	24.05	42.00	1.0000	Richcraft

B19	0.03	16.75	54.00	2.0000	Richcraft
RYCB19					
B2	0.10	48.20	76.00	1.0000	Richcraft
CB03_STRG					
B20	0.05	30.33	64.00	2.0000	Richcraft
CB16_STRG					
B21	0.09	30.93	67.00	2.0000	Richcraft
CB14_15_STRG					
B3	0.04	12.53	47.00	2.0000	Richcraft
RYCB02					
B4	0.05	11.44	41.00	2.0000	Richcraft
RYCB07					
B5	0.05	36.60	77.00	2.0000	Richcraft
CB04_STRG					
B6	0.05	15.50	65.00	1.0000	Richcraft
CB06_07_STRG					
B7	0.14	48.07	62.00	2.0000	Richcraft
CB08_STRG					
B8	0.07	16.63	59.00	1.0000	Richcraft
RYCB09					
B9	0.07	29.04	54.00	1.0000	Richcraft
CB10_STRG					

Node Summary

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
CB11	JUNCTION	105.20	2.89	0.0	
CB13	JUNCTION	105.01	3.02	0.0	
DITCH_IN_1	JUNCTION	106.18	0.67	0.0	
EX_STUB	JUNCTION	104.30	3.65	0.0	
MH401	JUNCTION	105.68	2.97	0.0	
MH402	JUNCTION	105.34	2.68	0.0	
MH403	JUNCTION	104.91	3.12	0.0	
MH404	JUNCTION	104.74	3.30	0.0	
MH405	JUNCTION	104.34	3.66	0.0	
MH406	JUNCTION	104.54	3.43	0.0	
mh407	JUNCTION	104.75	2.60	0.0	
MH408	JUNCTION	104.60	2.53	0.0	
MH409	JUNCTION	104.81	1.79	0.0	
MH409_null	JUNCTION	104.81	1.79	0.0	
MH410	JUNCTION	104.90	1.62	0.0	
RYCB01	JUNCTION	105.98	2.08	0.0	
RYCB02	JUNCTION	106.05	2.50	0.0	
RYCB07	JUNCTION	105.85	2.50	0.0	
RYCB09	JUNCTION	105.69	2.51	0.0	
RYCB18	JUNCTION	105.39	1.31	0.0	
RYCB19	JUNCTION	104.80	1.80	0.0	
14	OUTFALL	104.25	0.75	0.0	
2	OUTFALL	105.38	0.00	0.0	
5	OUTFALL	108.07	0.00	0.0	
CB03_STRG	STORAGE	105.85	4.15	0.0	
CB04_STRG	STORAGE	105.80	4.20	0.0	
CB06_07_STRG	STORAGE	105.95	3.05	0.0	
CB08_STRG	STORAGE	105.50	4.50	0.0	

CB10_STRG	STORAGE	105.65	4.35	0.0
CB11_STRG	STORAGE	105.80	4.20	0.0
CB12_STRG	STORAGE	105.81	4.19	0.0
CB13_STRG	STORAGE	105.01	4.99	0.0
CB14_15_STRG	STORAGE	105.75	2.52	0.0
CB16_STRG	STORAGE	105.51	2.74	0.0
DCB17_STRG	STORAGE	104.57	2.11	0.0
POND_1	STORAGE	105.50	0.75	0.0

Link Summary

Name	From Node	To Node	Type	Length	%

11	POND_1	MH410	CONDUIT	8.0	
3.8581	0.0130				
13	MH402	MH403	CONDUIT	79.4	
0.5036	0.0130				
14	RYCB01	MH401	CONDUIT	28.9	
0.5193	0.0130				
15	mh407	MH406	CONDUIT	23.5	
0.2557	0.0130				
16	CB11	MH403	CONDUIT	29.2	
0.4790	0.0130				
17	MH403	MH404	CONDUIT	27.8	
0.5042	0.0130				
18	MH404	MH405	CONDUIT	19.1	
0.5246	0.0130				
2	MH401	MH402	CONDUIT	39.3	
0.4835	0.0130				
2_3	MH408	MH406	CONDUIT	26.4	
0.1515	0.0130				
3	MH410	MH409_null	CONDUIT	13.6	
0.2949	0.0130				
39	CB13	MH404	CONDUIT	23.6	
0.5095	0.0130				
4	MH409	MH408	CONDUIT	23.4	
0.1709	0.0130				
44	DITCH_IN_1	POND_1	CONDUIT	55.0	
0.5091	0.0350				
54	DCB17_STRG	MH409_null	CONDUIT	5.8	
1.0259	0.0130				
7	MH406	MH405	CONDUIT	40.7	
0.1474	0.0130				
8	MH405	EX_STUB	CONDUIT	9.4	
0.1065	0.0130				
9	EX_STUB	14	CONDUIT	37.5	
0.1334	0.0130				
10	CB14_15_STRG	MH405	ORIFICE		
19	RYCB02	MH401	ORIFICE		
21	CB03_STRG	MH401	ORIFICE		
22	RYCB07	MH402	ORIFICE		
24	CB04_STRG	MH402	ORIFICE		
25	CB06_07_STRG	MH402	ORIFICE		
27	RYCB19	mh407	ORIFICE		
28	RYCB18	mh407	ORIFICE		

30	CB10_STRG	MH403	ORIFICE
31	CB11_STRG	CB11	ORIFICE
34	CB12_STRG	MH404	ORIFICE
35	CB13_STRG	CB13	ORIFICE
41	CB16_STRG	MH406	ORIFICE
51	RYCB09	MH402	ORIFICE
52	CB08_STRG	MH402	ORIFICE
53	MH409_null	MH409	ORIFICE
1	CB14_15_STRG	5	WEIR
12	DCB17_STRG	POND_1	WEIR
20	RYCB02	CB03_STRG	WEIR
23	RYCB07	CB04_STRG	WEIR
26	CB06_07_STRG	CB08_STRG	WEIR
29	RYCB09	CB08_STRG	WEIR
32	CB11_STRG	CB10_STRG	WEIR
33	CB08_STRG	CB10_STRG	WEIR
36	CB10_STRG	CB12_STRG	WEIR
37	CB13_STRG	CB12_STRG	WEIR
38	CB12_STRG	CB14_15_STRG	WEIR
40	CB16_STRG	DCB17_STRG	WEIR
42	CB04_STRG	CB08_STRG	WEIR
43	CB03_STRG	CB04_STRG	WEIR
45	RYCB18	DITCH_IN_1	WEIR
46	RYCB19	DITCH_IN_1	WEIR
5	POND_1	2	WEIR
50	MH410	POND_1	WEIR

Cross Section Summary

Full Conduit Flow	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels
11	CIRCULAR	0.30	0.07	0.07	0.30	1
0.19						
13	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
14	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
15	CIRCULAR	0.45	0.16	0.11	0.45	1
0.14						
16	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
17	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
18	CIRCULAR	0.45	0.16	0.11	0.45	1
0.21						
2	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						
2_3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
3	CIRCULAR	0.60	0.28	0.15	0.60	1
0.33						
39	CIRCULAR	0.45	0.16	0.11	0.45	1
0.20						

4	CIRCULAR	0.60	0.28	0.15	0.60	1
0.25						
44	TRAPEZOIDAL	0.30	0.36	0.16	2.10	1
0.22						
54	CIRCULAR	0.30	0.07	0.07	0.30	1
0.10						
7	CIRCULAR	0.60	0.28	0.15	0.60	1
0.24						
8	CIRCULAR	0.75	0.44	0.19	0.75	1
0.36						
9	CIRCULAR	0.75	0.44	0.19	0.75	1
0.41						

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 CMS

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
Surcharge Method EXTRAN
Starting Date 04/21/2021 00:00:00
Ending Date 04/21/2021 12:00:00
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 0.50 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
*****	-----	-----
Total Precipitation	0.137	85.525
Evaporation Loss	0.000	0.000
Infiltration Loss	0.027	16.953
Surface Runoff	0.111	69.283
Final Storage	0.000	0.001

Continuity Error (%) -0.831

	Volume hectare-m	Volume 10 ⁶ ltr
	-----	-----

Flow Routing Continuity		

Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.111	1.113
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.104	1.037
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.001	0.008
Final Stored Volume	0.008	0.076
Continuity Error (%)	0.769	

Highest Continuity Errors

Node DITCH_IN_1 (3.84%)
Node MH406 (3.13%)
Node MH408 (2.96%)
Node mh407 (2.44%)
Node CB13 (2.33%)

Time-Step Critical Elements

None

Highest Flow Instability Indexes

Link 28 (41)
Link 53 (33)
Link 35 (9)

Routing Time Step Summary

Minimum Time Step : 0.50 sec
Average Time Step : 0.50 sec
Maximum Time Step : 0.50 sec
Percent in Steady State : 0.00
Average Iterations per Step : 2.00
Percent Not Converging : 0.00
Time Step Frequencies :
 0.500 - 0.500 sec : 100.00 %
 0.500 - 0.500 sec : 0.00 %
 0.500 - 0.500 sec : 0.00 %

0.500 - 0.500 sec : 0.00 %
 0.500 - 0.500 sec : 0.00 %

 Subcatchment Runoff Summary

Perv	Total	Total	Total	Total	Total	Total	Imperv
Runoff	Runoff	Total	Peak	Runoff	Evap	Infil	Runoff
Subcatchment	Runoff	Runoff	Precip	Runoff	Runoff	Runoff	Runoff
mm	mm	10 ⁶ ltr	mm	mm	mm	mm	mm

B1			85.53	0.00	0.00	14.85	58.23
13.40	71.63	0.02	0.01	0.838			
B10			85.53	0.00	0.00	6.47	73.73
5.92	79.65	0.08	0.06	0.931			
B11			85.52	0.00	0.00	6.90	72.83
6.30	79.13	0.03	0.02	0.925			
B12			85.53	0.00	0.00	3.69	78.86
3.40	82.25	0.08	0.06	0.962			
B13			85.52	0.00	0.00	28.20	36.02
21.93	57.96	0.05	0.04	0.678			
B14			85.53	0.00	0.00	22.29	46.39
17.49	63.88	0.04	0.03	0.747			
B15			85.53	0.00	0.00	18.85	51.44
16.04	67.47	0.04	0.03	0.789			
B16			85.52	0.00	0.00	21.30	47.15
17.86	65.01	0.04	0.03	0.760			
B17			85.53	0.00	0.00	9.83	67.88
8.56	76.44	0.14	0.11	0.894			
B18			85.52	0.00	0.00	29.02	36.09
20.94	57.04	0.09	0.06	0.667			
B19			85.52	0.00	0.00	21.52	46.24
18.78	65.02	0.02	0.02	0.760			
B2			85.52	0.00	0.00	11.18	65.17
9.93	75.10	0.07	0.06	0.878			
B20			85.53	0.00	0.00	16.72	54.80
15.02	69.82	0.03	0.03	0.816			
B21			85.52	0.00	0.00	15.46	57.44
13.42	70.87	0.07	0.05	0.829			
B3			85.53	0.00	0.00	25.09	40.26
21.03	61.29	0.02	0.02	0.717			
B4			85.53	0.00	0.00	28.44	35.14
22.64	57.78	0.03	0.02	0.676			
B5			85.52	0.00	0.00	10.64	65.94
9.72	75.66	0.04	0.03	0.885			
B6			85.52	0.00	0.00	16.54	55.79
13.94	69.73	0.03	0.02	0.815			
B7			85.53	0.00	0.00	17.85	53.14
15.35	68.50	0.10	0.08	0.801			
B8			85.53	0.00	0.00	19.65	50.68
15.88	66.56	0.04	0.03	0.778			
B9			85.53	0.00	0.00	21.74	46.28
18.31	64.59	0.04	0.03	0.755			

Node Depth Summary

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
CB11	JUNCTION	0.22	0.59	105.79	0 01:12	0.59
CB13	JUNCTION	0.39	0.65	105.66	0 01:11	0.65
DITCH_IN_1	JUNCTION	0.01	0.19	106.37	0 01:09	0.19
EX_STUB	JUNCTION	1.07	1.17	105.47	0 01:10	1.17
MH401	JUNCTION	0.02	0.26	105.94	0 01:12	0.26
MH402	JUNCTION	0.09	0.59	105.93	0 01:12	0.59
MH403	JUNCTION	0.49	0.87	105.78	0 01:12	0.87
MH404	JUNCTION	0.65	0.92	105.66	0 01:11	0.92
MH405	JUNCTION	1.03	1.16	105.50	0 01:10	1.16
MH406	JUNCTION	0.84	0.99	105.53	0 01:10	0.99
mh407	JUNCTION	0.63	0.80	105.55	0 01:10	0.80
MH408	JUNCTION	0.78	0.94	105.54	0 01:10	0.94
MH409	JUNCTION	0.57	0.74	105.55	0 01:10	0.74
MH409_null	JUNCTION	0.61	1.49	106.30	0 01:10	1.48
MH410	JUNCTION	0.53	1.40	106.30	0 01:10	1.39
RYCB01	JUNCTION	0.01	0.08	106.06	0 01:08	0.08
RYCB02	JUNCTION	0.03	1.65	107.70	0 01:11	1.65
RYCB07	JUNCTION	0.08	2.36	108.21	0 01:10	2.36
RYCB09	JUNCTION	0.11	2.38	108.07	0 01:10	2.38
RYCB18	JUNCTION	0.06	1.18	106.57	0 01:10	1.18
RYCB19	JUNCTION	1.48	1.61	106.41	0 01:10	1.61
14	OUTFALL	1.16	1.16	105.41	0 00:00	1.16
2	OUTFALL	0.00	0.00	105.38	0 00:00	0.00
5	OUTFALL	0.00	0.00	108.07	0 00:00	0.00
CB03_STRG	STORAGE	0.16	2.40	108.25	0 01:14	2.40
CB04_STRG	STORAGE	0.15	2.39	108.19	0 01:14	2.39
CB06_07_STRG	STORAGE	0.09	2.30	108.25	0 01:10	2.30
CB08_STRG	STORAGE	0.28	2.56	108.06	0 01:20	2.56
CB10_STRG	STORAGE	0.15	2.41	108.06	0 01:13	2.41
CB11_STRG	STORAGE	0.15	2.39	108.19	0 01:13	2.39
CB12_STRG	STORAGE	0.10	2.31	108.12	0 01:12	2.31
CB13_STRG	STORAGE	0.56	3.17	108.18	0 01:14	3.17
CB14_15_STRG	STORAGE	0.15	2.37	108.12	0 01:14	2.37
CB16_STRG	STORAGE	0.11	2.35	107.86	0 01:10	2.35
DCB17_STRG	STORAGE	0.87	1.87	106.44	0 01:10	1.87
POND_1	STORAGE	0.04	0.64	106.14	0 01:12	0.64

Node Inflow Summary

Total	Flow	Maximum	Maximum	Lateral
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Inflow Volume Node ltr	Balance Error Percent	Type	Lateral Inflow CMS	Total Inflow CMS	Time of Occurrence days hr:min	Max Inflow Volume 10^6 ltr	10^6
CB11		JUNCTION	0.000	0.022	0 01:13	0	
0.0786	1.567						
CB13		JUNCTION	0.000	0.020	0 01:33	0	
0.0801	2.388						
DITCH_IN_1		JUNCTION	0.038	0.062	0 01:10	0.0518	
0.0603	3.995						
EX_STUB		JUNCTION	0.000	0.326	0 01:10	0	
0.985	1.105						
MH401		JUNCTION	0.000	0.048	0 01:10	0	
0.111	-0.033						
MH402		JUNCTION	0.000	0.113	0 01:10	0	
0.36	0.319						
MH403		JUNCTION	0.000	0.147	0 01:12	0	
0.48	2.257						
MH404		JUNCTION	0.000	0.179	0 01:12	0	
0.581	1.098						
MH405		JUNCTION	0.000	0.326	0 01:10	0	
1	0.951						
MH406		JUNCTION	0.000	0.131	0 01:10	0	
0.379	3.226						
mh407		JUNCTION	0.000	0.051	0 01:10	0	
0.0985	2.496						
MH408		JUNCTION	0.000	0.071	0 01:10	0	
0.257	3.045						
MH409		JUNCTION	0.000	0.071	0 01:10	0	
0.26	1.751						
MH409_null		JUNCTION	0.000	0.124	0 01:10	0	
0.289	0.980						
MH410		JUNCTION	0.062	0.115	0 01:10	0.0778	
0.204	0.999						
RYCB01		JUNCTION	0.013	0.013	0 01:10	0.0157	
0.0157	0.949						
RYCB02		JUNCTION	0.019	0.019	0 01:10	0.023	
0.023	0.000						
RYCB07		JUNCTION	0.023	0.023	0 01:10	0.0298	
0.0298	0.000						
RYCB09		JUNCTION	0.033	0.033	0 01:10	0.0443	
0.0449	-0.320						
RYCB18		JUNCTION	0.057	0.057	0 01:10	0.0864	
0.0867	0.046						
RYCB19		JUNCTION	0.018	0.018	0 01:10	0.0218	
0.0218	9.060						
14		OUTFALL	0.000	0.326	0 01:10	0	
0.974	0.000						
2		OUTFALL	0.000	0.113	0 01:12	0	
0.0625	0.000						
5		OUTFALL	0.000	0.000	0 00:00	0	
0	0.000 ltr						
CB03_STRG		STORAGE	0.055	0.055	0 01:10	0.0724	
0.0724	0.001						
CB04_STRG		STORAGE	0.032	0.042	0 01:10	0.0415	
0.044	0.001						

CB06_07_STRG	STORAGE	0.025	0.025	0	01:10	0.0324
0.0324	-0.000					
CB08_STRG	STORAGE	0.079	0.108	0	01:10	0.0988
0.113	0.162					
CB10_STRG	STORAGE	0.035	0.035	0	01:10	0.0431
0.0453	-0.083					
CB11_STRG	STORAGE	0.058	0.058	0	01:10	0.0793
0.0793	0.002					
CB12_STRG	STORAGE	0.024	0.024	0	01:10	0.0329
0.0332	0.001					
CB13_STRG	STORAGE	0.058	0.058	0	01:10	0.0805
0.0805	0.396					
CB14_15_STRG	STORAGE	0.052	0.052	0	01:10	0.0658
0.0661	0.002					
CB16_STRG	STORAGE	0.026	0.026	0	01:10	0.0318
0.0318	0.001					
DCB17_STRG	STORAGE	0.108	0.125	0	01:10	0.144
0.15	0.281					
POND_1	STORAGE	0.029	0.213	0	01:10	0.0399
0.16	-1.158					

Node Surcharge Summary

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Meters	Min. Depth Below Rim Meters
CB11	JUNCTION	0.41	0.136	2.304
CB13	JUNCTION	0.77	0.204	2.366
EX_STUB	JUNCTION	11.33	0.390	2.480
MH403	JUNCTION	0.70	0.273	2.247
MH404	JUNCTION	11.20	0.322	2.378
MH405	JUNCTION	11.33	0.411	2.499
MH406	JUNCTION	11.27	0.355	2.435
MH408	JUNCTION	11.20	0.172	1.588
MH409	JUNCTION	6.87	0.139	1.051
MH409_null	JUNCTION	1.27	0.840	0.300

Node Flooding Summary

No nodes were flooded.

Storage Volume Summary

of Max Maximum Average Avg Evap Exfil Maximum Max Time

Occurrence	Outflow	Volume	Pcnt	Pcnt	Pcnt	Volume	Pcnt	
Storage Unit		1000 m3	Full	Loss	Loss	1000 m3	Full	days
hr:min	CMS							

CB03_STRG		0.001	0	0	0	0.019	2	0
01:14	0.020							
CB04_STRG		0.000	0	0	0	0.012	2	0
01:14	0.012							
CB06_07_STRG		0.000	0	0	0	0.004	2	0
01:10	0.023							
CB08_STRG		0.003	0	0	0	0.048	3	0
01:20	0.027							
CB10_STRG		0.000	0	0	0	0.009	2	0
01:13	0.025							
CB11_STRG		0.001	0	0	0	0.019	3	0
01:13	0.028							
CB12_STRG		0.000	0	0	0	0.005	1	0
01:12	0.015							
CB13_STRG		0.001	0	0	0	0.021	3	0
01:14	0.021							
CB14_15_STRG		0.001	1	0	0	0.016	30	0
01:14	0.021							
CB16_STRG		0.000	0	0	0	0.004	6	0
01:10	0.026							
DCB17_STRG		0.001	7	0	0	0.001	16	0
01:10	0.124							
POND_1		0.004	4	0	0	0.082	79	0
01:12	0.113							

 Outfall Loading Summary

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
14	41.12	0.055	0.326	0.974
2	3.16	0.046	0.113	0.062
5	0.00	0.000	0.000	0.000
System	14.76	0.101	0.431	1.037

 Link Flow Summary

Link	Type	Maximum Flow CMS	Time of Max Occurrence days hr:min	Maximum Veloc m/sec	Max/ Full Flow	Max/ Full Depth
11	CONDUIT	0.113	0 01:10	1.59	0.59	1.00

13	CONDUIT	0.112	0	01:12	0.71	0.55	1.00
14	CONDUIT	0.013	0	01:09	0.69	0.06	0.20
15	CONDUIT	0.051	0	01:10	0.32	0.35	1.00
16	CONDUIT	0.022	0	01:29	0.46	0.11	1.00
17	CONDUIT	0.147	0	01:12	0.92	0.72	1.00
18	CONDUIT	0.179	0	01:12	1.13	0.87	1.00
2	CONDUIT	0.045	0	01:11	0.83	0.23	0.79
2_3	CONDUIT	0.071	0	01:10	0.33	0.30	1.00
3	CONDUIT	0.053	0	01:09	0.32	0.16	1.00
39	CONDUIT	0.020	0	01:33	0.44	0.10	1.00
4	CONDUIT	0.071	0	01:10	0.41	0.28	1.00
44	CONDUIT	0.071	0	01:10	0.46	0.32	0.65
54	CONDUIT	0.124	0	01:10	1.75	1.26	1.00
7	CONDUIT	0.131	0	01:10	0.46	0.55	1.00
8	CONDUIT	0.326	0	01:10	0.74	0.90	1.00
9	CONDUIT	0.326	0	01:10	0.74	0.80	1.00
10	ORIFICE	0.019	0	01:14			1.00
19	ORIFICE	0.016	0	01:11			1.00
21	ORIFICE	0.020	0	01:17			1.00
22	ORIFICE	0.012	0	01:07			1.00
24	ORIFICE	0.012	0	01:21			1.00
25	ORIFICE	0.012	0	01:10			1.00
27	ORIFICE	0.018	0	01:10			1.00
28	ORIFICE	0.033	0	01:04			1.00
30	ORIFICE	0.013	0	01:26			1.00
31	ORIFICE	0.022	0	01:13			1.00
34	ORIFICE	0.012	0	01:12			1.00
35	ORIFICE	0.020	0	01:33			1.00
41	ORIFICE	0.009	0	01:10			1.00
51	ORIFICE	0.012	0	01:04			1.00
52	ORIFICE	0.021	0	01:45			1.00
53	ORIFICE	0.071	0	01:10			1.00
1	WEIR	0.000	0	00:00			0.00
12	WEIR	0.000	0	00:00			0.00
20	WEIR	0.000	0	00:00			0.00
23	WEIR	0.010	0	01:10			0.07
26	WEIR	0.010	0	01:10			0.07
29	WEIR	0.021	0	01:10			0.11
32	WEIR	0.006	0	01:13			0.05
33	WEIR	0.013	0	01:13			0.08
36	WEIR	0.000	0	00:00			0.00
37	WEIR	0.001	0	01:14			0.02
38	WEIR	0.003	0	01:12			0.03
40	WEIR	0.017	0	01:10			0.09
42	WEIR	0.000	0	00:00			0.00
43	WEIR	0.000	0	00:00			0.00
45	WEIR	0.024	0	01:10			0.12
46	WEIR	0.000	0	00:00			0.00
5	WEIR	0.113	0	01:12			0.55
50	WEIR	0.000	0	00:00			0.00

Flow Classification Summary

Inlet Conduit Ctrl	Adjusted	----- Fraction of Time in Flow Class -----							
	/Actual	Up	Down	Sub	Sup	Up	Down	Norm	
	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd
11	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.84
13	1.00	0.00	0.00	0.00	0.95	0.00	0.00	0.05	0.06
14	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.01
15	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.02	0.00
16	1.00	0.00	0.00	0.00	0.94	0.00	0.00	0.06	0.01
17	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.01
18	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00
2	1.00	0.00	0.00	0.00	0.05	0.00	0.00	0.94	0.02
2_3	1.00	0.01	0.00	0.00	0.98	0.00	0.00	0.01	0.00
3	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.01
39	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.01
4	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00
44	1.00	0.00	0.00	0.00	0.04	0.00	0.00	0.96	0.03
54	1.00	0.01	0.00	0.00	0.94	0.00	0.00	0.05	0.00
7	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.01	0.00
8	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00
9	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00

 Conduit Surcharge Summary

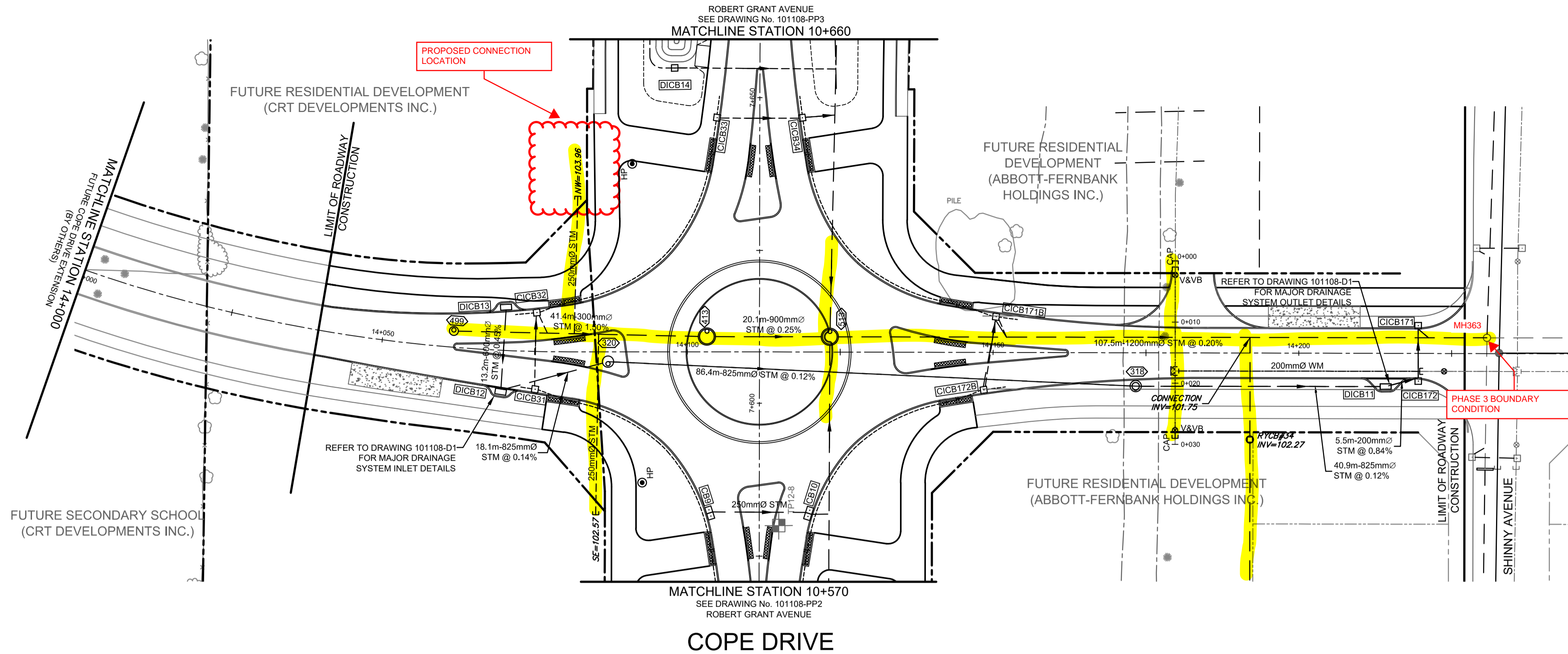
Conduit	----- Hours Full -----			Hours	Hours
	Both Ends	Upstream	Dnstream	Above Full Normal Flow	Capacity Limited
11	0.67	0.67	1.21	0.01	0.01
13	0.33	0.33	11.19	0.01	0.01
15	11.25	11.25	11.28	0.01	0.01
16	0.41	0.41	0.70	0.01	0.01
17	11.20	11.20	11.25	0.01	0.01
18	11.26	11.26	11.33	0.01	0.45

2_3	11.25	11.25	11.27	0.01	0.01
3	1.20	1.20	1.27	0.01	0.01
39	0.76	0.76	11.20	0.01	0.01
4	4.86	4.86	11.20	0.01	0.01
54	1.24	1.24	5.36	0.11	0.15
7	11.28	11.28	11.33	0.01	0.01
8	11.33	11.33	11.33	0.01	0.66
9	11.36	11.36	12.00	0.01	0.17

Analysis begun on: Thu Oct 7 09:58:50 2021
Analysis ended on: Thu Oct 7 09:59:04 2021
Total elapsed time: 00:00:14

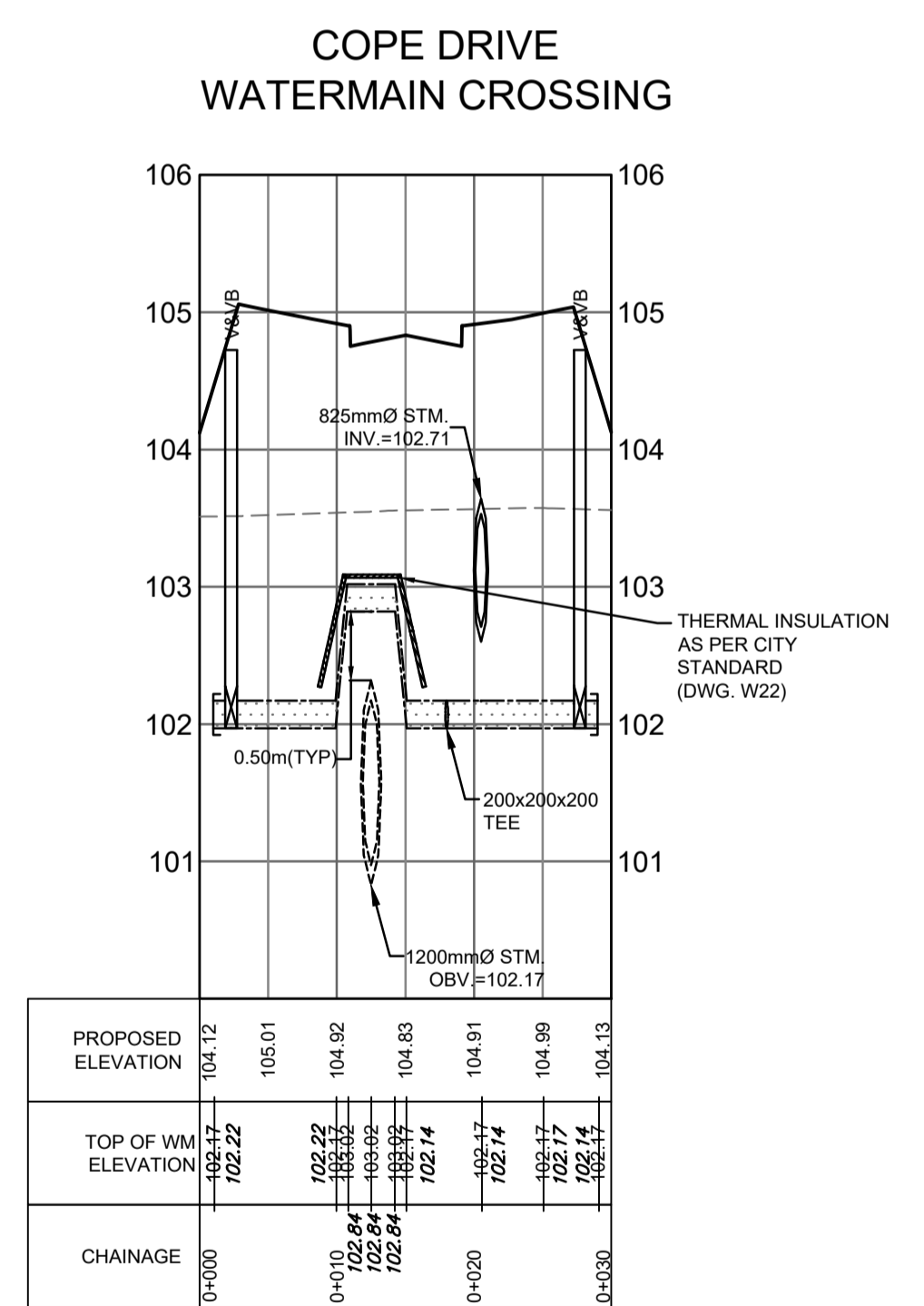
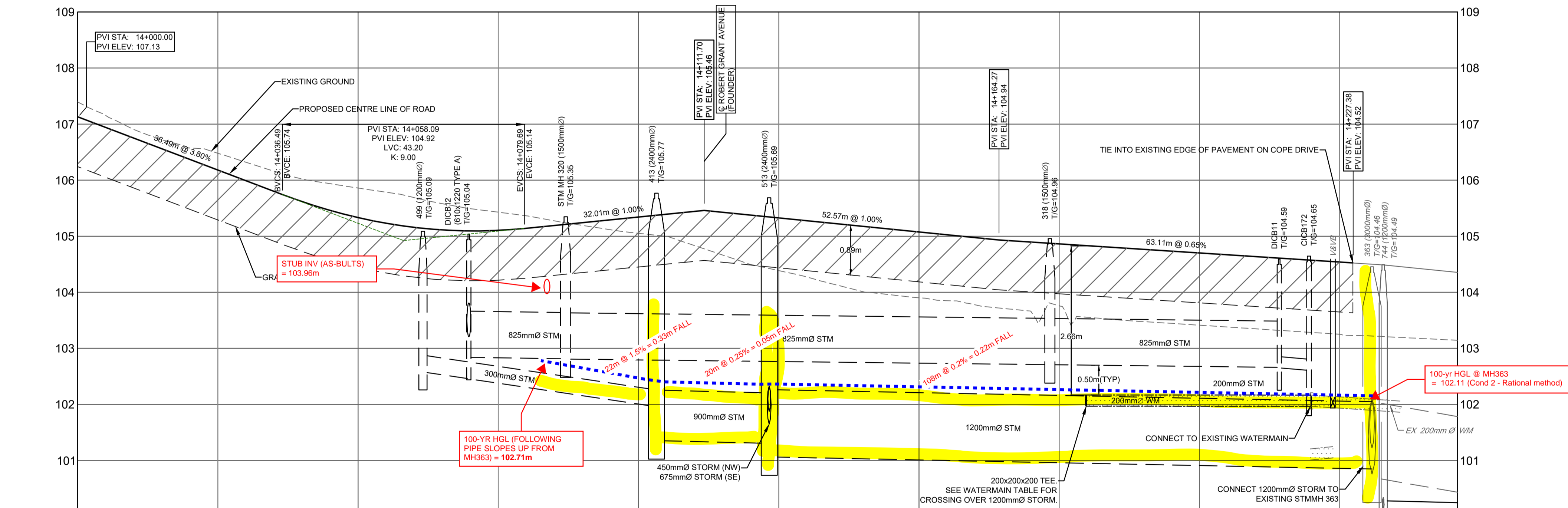
**APPENDIX D –
ROBERT GRANT AVE. / COPE DR. HGL
ANALYSIS**





STATION	SURFACE ELEVATION	T/WM ELEVATION	DESCRIPTION
0+001.00	103.89	102.22	CAP
0+002.30	104.31	102.22	VALVE & VALVE BOX
0+009.90	104.72	102.22	45" V. BEND (INSULATED)
0+010.75	104.74	102.22	45" V. BEND (INSULATED)
0+012.50	104.78	102.22	CROSSING OVER 1200mmØ STORM
0+014.24	104.81	102.22	45" V. BEND (INSULATED)
0+015.09	104.83	102.22	45" V. BEND (INSULATED)
0+017.40	104.78	102.14	CROSSING UNDER 825mmØ STORM
0+020.47	104.93	102.14	200x200x200 TEE
0+027.70	104.33	102.14	VALVE & VALVE BOX
0+029.00	103.68	102.14	CAP

NOTE: BARREL TO BARREL SEPARATION SHALL BE 500mm MINIMUM AS PER CITY OF OTTAWA DETAILS W25, AND W25.2



EXISTING ELEVATION	PROPOSED ELEVATION	TOP OF WM ELEVATION	STORM SYPHON INVERTS	STORM SEWER INVERTS	CHAINAGE	DESCRIPTION
106.48	106.18	102.22			14+000	DESCRIPTION
106.66	105.33	102.22			14+050	DESCRIPTION
105.43	105.11	102.22			14+087.7	DESCRIPTION
105.05	105.34	102.22			14+100	DESCRIPTION
104.39	105.33	102.22			14+173.34	DESCRIPTION
103.90	105.08	102.22			14+179.79	DESCRIPTION
103.76	104.88	102.22			14+219.54	DESCRIPTION
103.41	104.70	102.22			14+237.79	DESCRIPTION
103.25	104.54	102.22			14+246.03	DESCRIPTION
103.45						DESCRIPTION

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

AS-BUILT

No.	REVISION	DATE	BY	No.	REVISION	DATE	BY
14.	ISSUED FOR AS-BUILT	JAN 26/18	ERD	8.	ISSUED WITH MCE APPLICATION	NOV 21/13	ERD
13.	ISSUED FOR CITY OF OTTAWA APPROVAL	OCT 13/15	ERD	7.	ISSUED FOR CITY OF OTTAWA APPROVAL	NOV 8/13	ERD
12.	ISSUED WITH COMMENCE WORK NOTICE	OCT 13/15	ERD	6.	ISSUED TO CONTRACTOR FOR INFORMATION ONLY	NOV 5/13	ERD
11.	RE-ISSUED TO CONTRACTOR FOR INFORMATION ONLY	JUN 12/15	ERD	5.	ISSUED WITH REVISED STORMWATER SERVICING BRIEF	OCT 30/13	ERD
10.	RE-ISSUED FOR FRONT-ENDING AGREEMENT	NOV 4/14	ERD	4.	ISSUED FOR ADDENDUM 3.0	SEPT 5/13	ERD
9.	RE-ISSUED FOR FRONT-ENDING AGREEMENT COMMENTS	MAR 12/14	ERD	3.	ISSUED FOR ADDENDUM 2.0	SEPT 3/13	ERD
8.	RE-ISSUED WITH FRONT-ENDING AGREEMENT	DEC 6/13	ERD	2.	ISSUED FOR TENDER	AUG 16/13	ERD
7.				1.	ISSUED FOR CITY OF OTTAWA REVIEW	AUG 16/13	ERD

SCALE

HORIZONTAL: 1:500

VERTICAL: 1:50

FOR REVIEW ONLY

DESIGN: SML

CHECKED: ERD

DRAWN: JPB

CHECKED: SML

APPROVED: ERD

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6

Telephone: (613) 254-9643
Facsimile: (613) 254-5867
Website: www.novatech-eng.com

CITY OF OTTAWA - FERNBANK COMMUNITY
Robert Grant Avenue (Founder)

**PLAN AND PROFILE
COPE DRIVE
14+000 TO 14+246**

PROJECT No: 101108-07
REV: REV # 14
DRAWING No: 101108-PP6

Ottawa (Head Office)

1800 Bantree Street
Ottawa, Ontario K1B 5L6

☎ 613.745.2444
☎ 613.745.9994

www.cwwcanada.com
1.866.695.0155

Montreal

2700 Sabourin Street
St-Laurent, Quebec H4S 1M2

☎ 514.738.2666
☎ 514.738.9762



INTEGRATED SEWER SOLUTIONS



COPER DR - ROBERT GRANT

Ottawa, Ontario

SEWER CCTV INSPECTION REPORT

Report ID
103980ST1

Sewer Use
Storm

Completion Date
June 02, 2021

Inspected Length
25.6 meters

THE WAY IS CLEAR™

- Watermain Swabbing
- Hydro Vacuum Excavation
- CCTV Inspection of Sewers
- Plumbing & Drain Services
- Structural Rehabilitation of Manholes
- Cured-in-Place-Pipe Lining & Spot Repairs
- Grouting, Test & Seal Joints, Manholes & Services
- Lateral Sewer Inspection & Locates From Main
- Sewer Cleaning, Flushing & Pumping

Table of contents



	Page
1. Index of pipes	2
2. Structural rating	3
3. O&M rating	4
4. Pipe summary and condition details	5
5. Vision Report© Legend	7

1. Index of pipes

1 item

Inspected length : 25.60

Total length : 41.40

Pipe	Start/End	Direction	Road	Date	Inspected	Total	Page
499 413	413 --> 499	Against flow	Cope Dr.	02/06/2021 2:19 PM	25.6	41.4	5

2. Structural rating

1 item

0 - No Defects (1 of 1 items)

Score	Quick	Index	Pipe	Start/End	Direction	Road	Page
0	0000	0	499 413	413 --> 499	Against flow	Cope Dr.	5

3. O&M rating

1 item

3 - Moderate defect grade (1 of 1 items)

Score	Quick	Index	Structural	Pipe	Start/End	Direction	Road	Page
3	3100	3	0	499 413	413 --> 499	Against flow	Cope Dr.	5

4. Pipe summary and condition details

Pipe identification

Pipe: 499 413	Direction of inspection: 413 --> 499
Direction of flow: 499 --> 413	Direction: Against flow

Pipe location

Road: Cope Dr.	<u>UPSTREAM</u>	<u>DOWNSTREAM</u>
Crossroad:	Easting (X):	Easting (X):
Drainage Area:	Northing (Y):	Northing (Y):
City: Ottawa	Elevation (Z):	Elevation (Z):
Location:	GPS Accuracy:	
Owner: Unknown	Coordinate System:	
Road segment:	Vertical Datum:	

Pipe characteristics

Sewer Use: Stormwater	Inspected length: 25.6
Height: 300	Total length: 41.4
Width:	Rim/Inv.:
Shape: Circular	Grade/Inv.:
Material: Polyvinyl Chloride	Rim/Grade:
Lining:	Rim/Inv.:
Joint length: 4	Grade/Inv.:
Year laid:	Rim/Grade:
Year renewed:	Sewer category:

Additional details

Date: 02/06/2021 2:19 PM	Location details:
Project Number:	Surveyed by: Derek Jessup
Customer: Richcraft Homes	Certificate #: U06180703002192
PO number:	Pre-Cleaning: No Pre-Cleaning
Work order:	Date cleaned:
Purpose:	Unit of measurement: Metric
Weather: Dry	Media label:
Flow control: Not Controlled	Sheet #:

Structural rating

O&M rating

Overall rating

Peak: 0	Peak: 3	Peak: 3
Quick rating: 0000	Quick rating: 3100	Quick rating: 3100
Score: 0	Score: 3	Score: 3
Index: 0	Index: 3	Index: 3

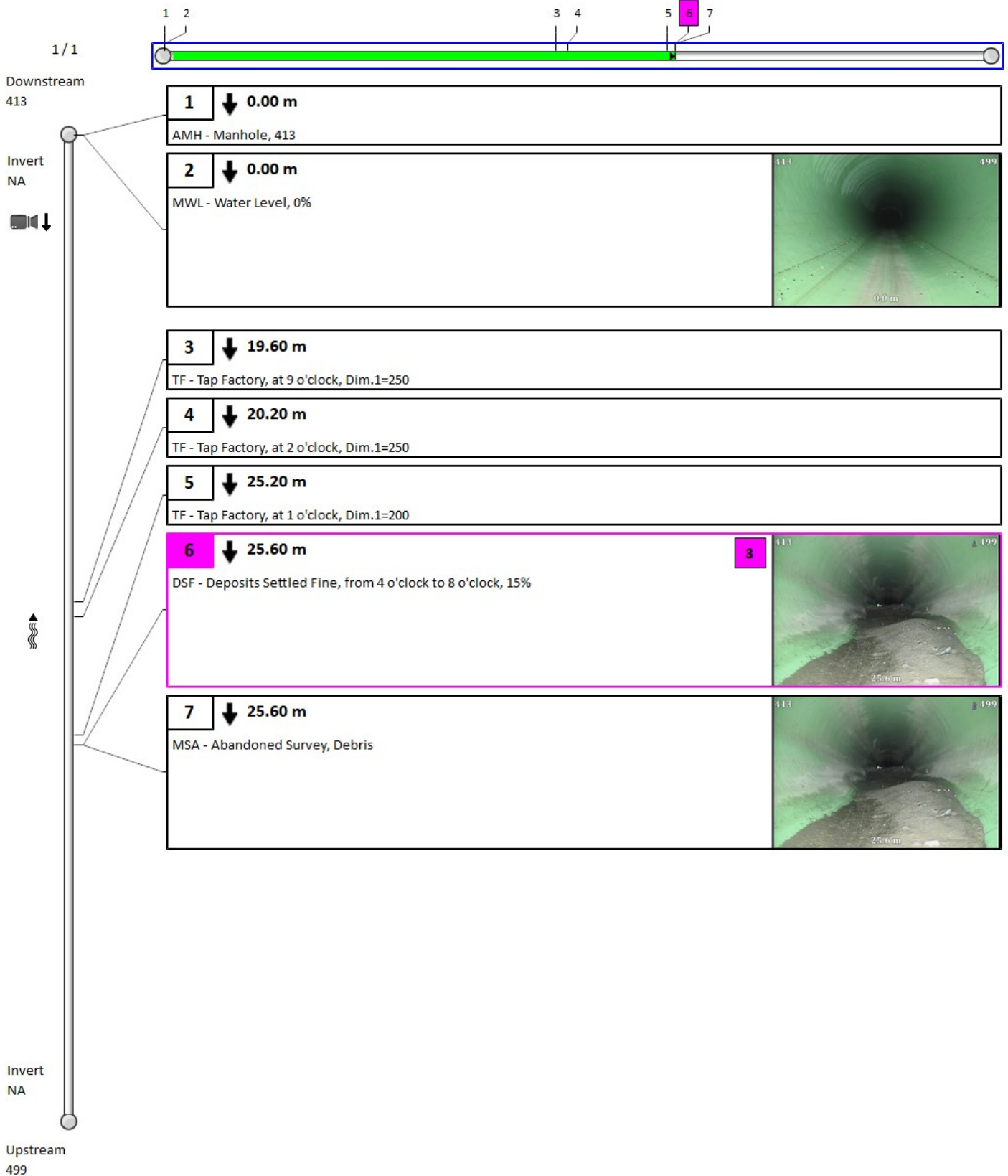
Additional information

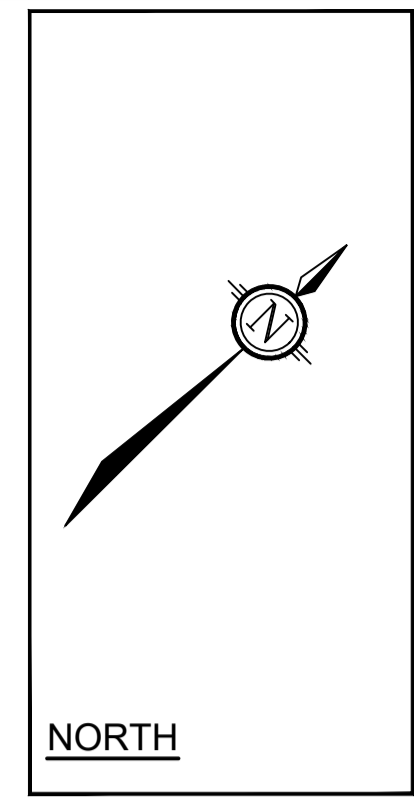
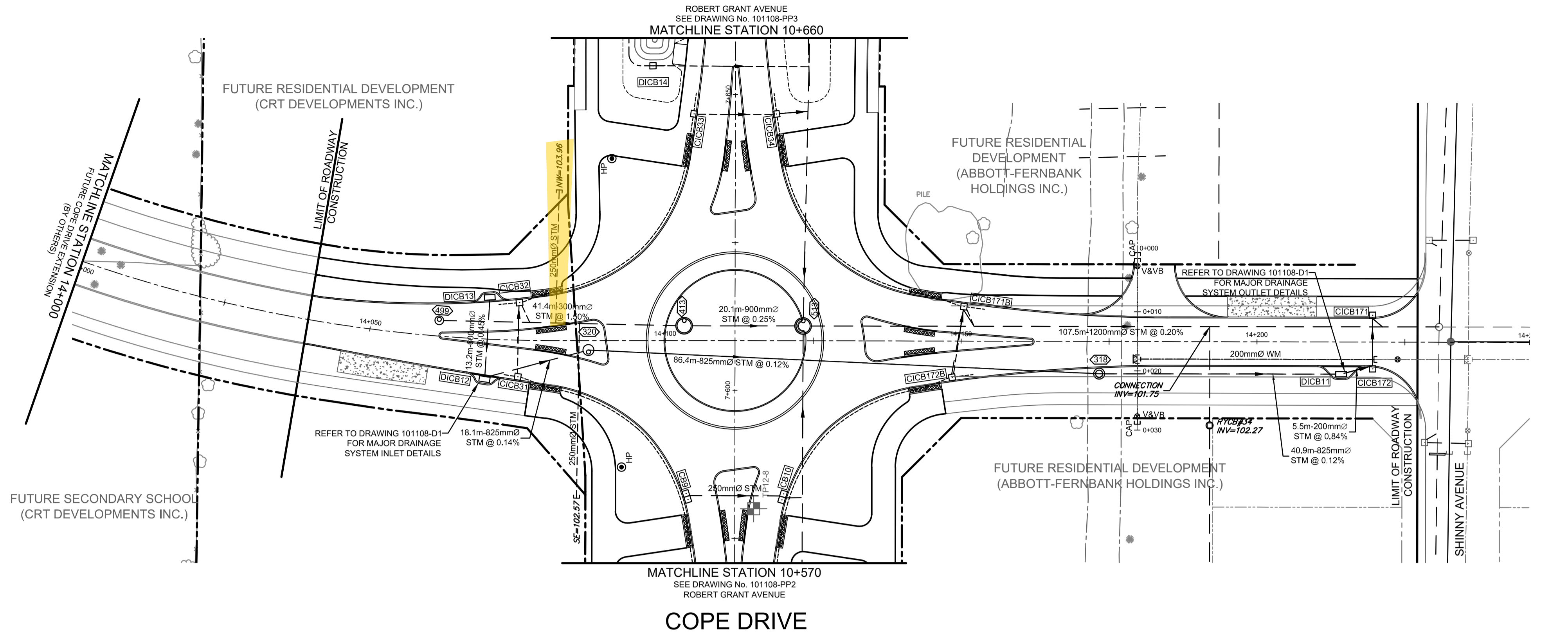
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Other information

REPORT ID: 103980ST1	Information 6:
Information 2:	Information 7:
Information 3:	Information 8:
Information 4:	Information 9:
Information 5:	Information 10:

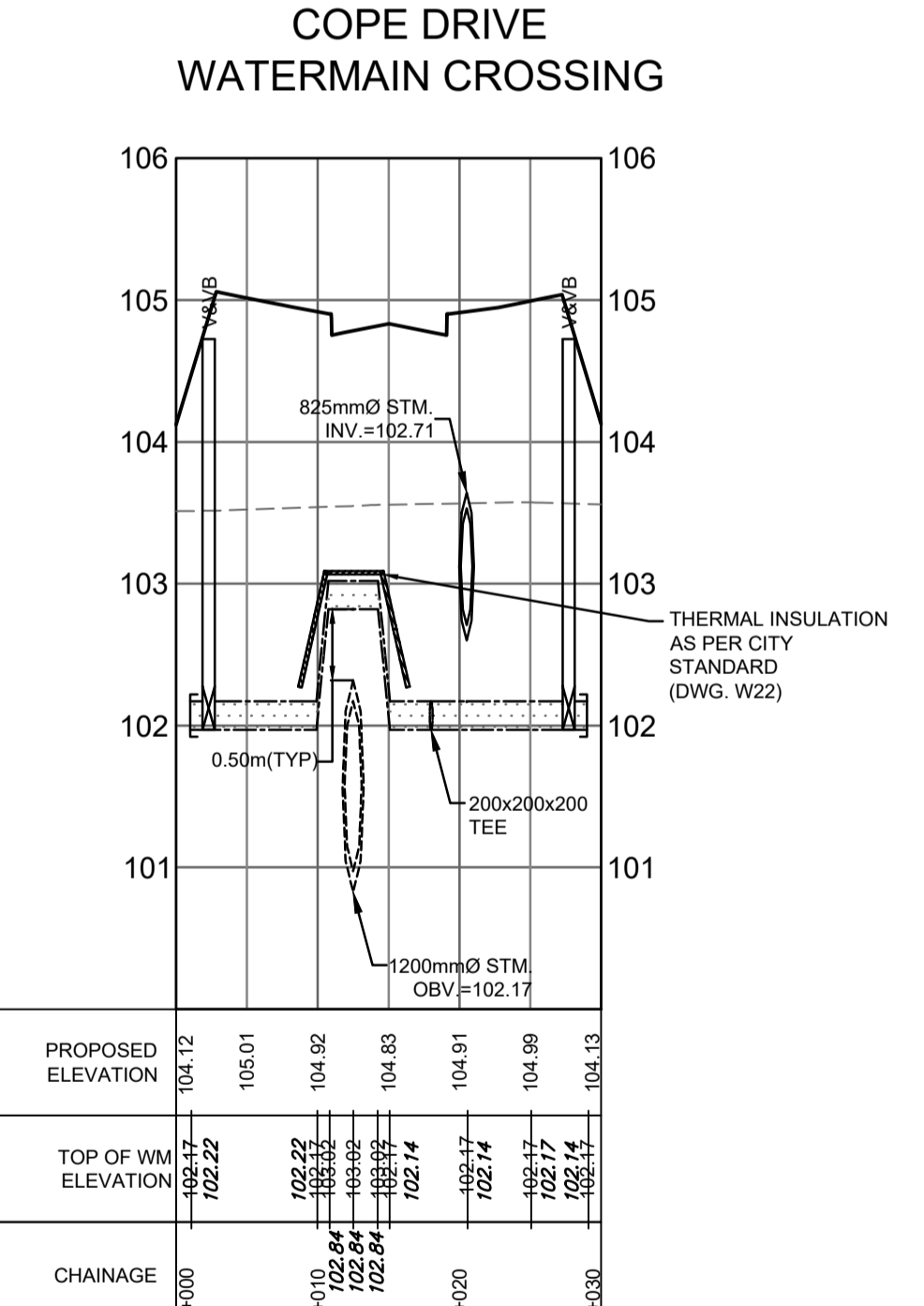
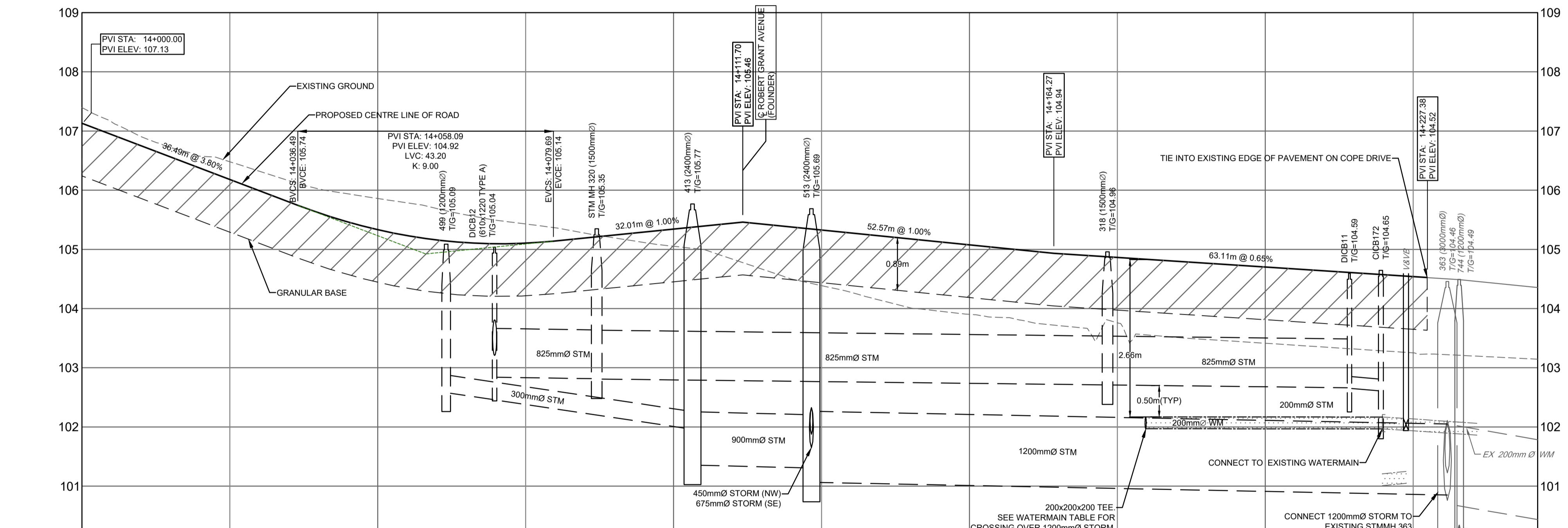
4. Pipe summary and condition details





COPE DRIVE WATERMAIN CROSSING TABLE			
STATION	SURFACE ELEVATION	T/WM ELEVATION	DESCRIPTION
0+001.00	103.89	102.22	CAP
0+002.30	104.31	102.22	VALVE & VALVE BOX
0+009.90	104.72	102.22	45° V. BEND (INSULATED)
0+010.75	104.74	102.22	45° V. BEND (INSULATED)
0+012.50	104.78	102.22	CROSSING OVER 1200mm STM
0+014.24	104.81	102.22	45° V. BEND (INSULATED)
0+015.09	104.83	102.22	45° V. BEND (INSULATED)
0+017.40	104.78	102.22	CROSSING UNDER 825mm STM
0+020.47	104.93	102.22	200x200x200 TEE
0+027.70	104.33	102.22	VALVE & VALVE BOX
0+029.00	103.68	102.22	CAP

NOTE: BARREL TO BARREL SEPARATION SHALL BE 500mm MINIMUM AS PER CITY OF OTTAWA DETAILS W25, AND W25.2

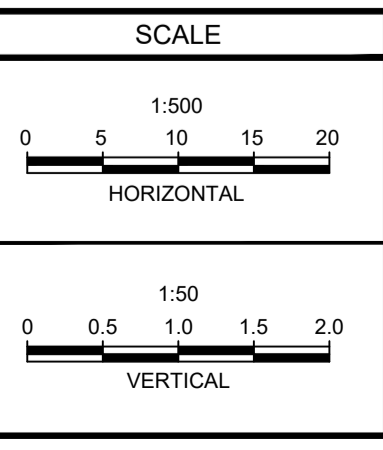


EXISTING ELEVATION	PROPOSED ELEVATION	TOP OF WM ELEVATION	STORM SYPHON INVERTS	STORM SEWER INVERTS	CHAINAGE	DESCRIPTION
103.45	104.13	102.17			14+246.03	DESCRIPTION
102.25	104.54	102.22			14+232.79	DESCRIPTION
103.41	104.70	102.22			14+219.54	DESCRIPTION
103.76	104.88	102.22			14+179.79	DESCRIPTION
103.99	105.08	102.22			14+150	DESCRIPTION
104.39	105.33	102.22			14+100	DESCRIPTION
105.05	105.34	102.22			14+050	DESCRIPTION
105.43	105.11	102.22			14+000	DESCRIPTION
105.66	105.33	102.22				DESCRIPTION
105.48	105.18	102.22				DESCRIPTION

NOTE:
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10.	REVISED AS PER FRONT-ENDING AGREEMENT COMMENTS	MAR 12/14	ERD	4.	ISSUED FOR ADDENDUM 3.0	SEPT 5/13	ERD
9.	ISSUED WITH FRONT-ENDING AGREEMENT	DEC 6/13	ERD	3.	ISSUED FOR ADDENDUM 2.0	SEPT 3/13	ERD
				2.	ISSUED FOR TENDER	AUG 16/13	ERD
				1.	ISSUED FOR CITY OF OTTAWA REVIEW	AUG 16/13	ERD



DESIGN	FOR REVIEW ONLY
CHECKED	
DRAWN	
CHECKED	
APPROVED	

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CITY OF OTTAWA - FERNBANK COMMUNITY
Robert Grant Avenue (Founder)

**PLAN AND PROFILE
COPE DRIVE
14+000 TO 14+246**

PROJECT No. 101108-07
REV 14
DRAWING No. 101108-PP6

M:\2008\108180\NSA\Aerial\CAD\Design\Submittals\As-Built\101108-PP6-06.dwg, Jan 05, 2018 - 8:44am, j.ponnell

Vision Report © Legend

	The numbers sequentially indicate each observation that was picked up throughout the inspection period. This will allow you to sift through the pages and view the accompanying description and photos in each section. Note that when a pipe section contains too many observations, Vision© Report must hide secondary observations in order to optimize the display.*
60	A number with neither a square nor circle indicates a general observation.
	A circled number indicates a structural anomaly. The color of the circle indicates the severity of the anomaly on a scale of 1 to 5, 5 being the most severe: green=1, blue=2, magenta=3, orange=4 and red=5.
	A number in a square indicates an operation and maintenance anomaly. The color of the square indicates the severity of the anomaly on a scale of 1 to 5, 5 being the most severe: green=1, blue=2, magenta=3, orange=4 and red=5.
◀ 3 / 31 ▶	Indicates the current page number of the inspection report.
	The blue square indicates a section of the pipe; this section is covered in detail on the current page of the report.
	The green line indicates the inspected part of the pipe. The remaining white line indicates the uninspected part of the pipe.
	Indicates the hold points on the camera during an inspection.
	Indicates the hold points on the camera during the reverse inspection.
	Indicates that a reverse inspection was carried out, however the camera did not reach the initial inspection hold point. (the hold point of the initial inspection)
	Indicates that a reverse inspection was carried out and that it has joined (has arrived at) the initial inspection hold point.
401-059B	Identifies the start manhole number. Note that this manhole is not necessarily the upstream manhole of the pipe.
401-631	Identifies the end manhole number. Note that this manhole is not necessarily the downstream manhole of the pipe.
	A downward arrow indicates that the inspection was carried out in the direction of the current, whereas an upward arrow indicates an inspection against the current. Note that the manhole located on the upper left of the page is always the start manhole, but not necessarily the upstream manhole of the pipe.
	This camera followed by a downward arrow is located on the upper left of the vertical pipe; it indicates that an inspection was done from this manhole.
	When the second camera appears on the bottom left page it means that a reverse inspection was carried out. Information about the reverse inspection is included in the report, thereby combining both inspections.
Invert 3.40	The measurement shown under the word <Invert> indicates the measurements between the frame and the pipe captured during the inspection. This measurement is available at the top left for the start manhole and the bottom left for the end manhole. If the invert was not measured during the inspection, an <NA> mark will be displayed.
	The downward bold arrow to the right of the observation number indicates that this observation was captured during the initial inspection.
	The blank arrow pointing upwards and located to the right of the observation number indicates that this observation was taken during the reverse inspection period, thereby confirming that this report combined both inspections.
18.40 m	Located to the right of the observation number is a number identifying the observation distance in relation to the start of the pipe.
SRV - Armature visib	A full description of the observation code according to the protocol used.

*Any hidden observations are readily accessible from the database as well as in other CTSpec report templates.

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Searle, Daniel

From: Searle, Daniel
Sent: Thursday, May 27, 2021 12:25 PM
To: Surprenant, Eric
Cc: Davidson, Steve; Alexander Orakwue
Subject: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion #2 - Follow Up

Hi Eric,

Thank you again for meeting with us today.

Based on our discussion, it is our understanding that the City does not store/maintain the existing SWM model associated with the Fernbank Pond 6 catchment. Instead, what the City may possess is a smaller excerpts of the model prepared for individual development applications. We understand you will be following up with the associated City technical reviewers today to see if any copies of the model are available for use by WSP.

In the event the City does not possess copies of the applicable model(s), you had suggested we reach out to Novatech to request a copy, or similarly, Novatech provide a memo communicated the 100-yr HGL at the subject connection point. As a third option, you had indicated that WSP could use 100-yr HGL values (for the Cope Drive trunk sewer) from previous development servicing/SWM reports and infer a HGL upstream to our connection point. Provided there is technical backing to the approach, WSP understands this approach is acceptable to the City.

On another note, you had also confirmed that the City is not aware of the intended use for the stub (for the foreseeable future) and that the City no concern with the proposed connection from this perspective.

As was communicated, the project has been on hold for nearly two weeks as the current grading approach is directly contingent on the acceptable use of this storm connection. We appreciate your commitment to providing us with a follow-up email by end of day today confirmed whether a model is available for WSP's use.

Please advise if I have misrepresented your comments/position in any way.

Thanks,



Dan Searle, P.Eng.
Municipal Engineer

T+ 1 613-935-0538

M+ 1 613-618-4825

1345 Rosemount Avenue
Cornwall, Ontario
K6J 3E5 Canada

www.wsp.ca

Please consider the environment before printing...

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Searle, Daniel

From: Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Sent: Thursday, May 06, 2021 9:50 AM
To: Davidson, Steve
Cc: Alexander Orakwue; De Santi, Nadia; Searle, Daniel
Subject: Re: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion
Attachments: Robert Grant & Cope.pdf

Hello Steve,

Sorry for the delay, I was trying to locate the Pond 6 design brief, however this pre-dates the electronic files and so you may need to reach out to our records department or designers associated with Pond 6. The other item I was trying to follow up on was the purpose of the storm stub since currently this is the interim Robert Grant cross-section and at some point, the roundabout may transition to a fully signalised intersection when the Middle BRT lanes are implemented and so I was and am still trying to confirm that this wasn't intended for future CBs. I will confirm further on that front and in the meantime have attached the as-built drawing we were looking at during the pre-consult.

Thanks

Eric Surprenant, CET
Sr, Project Manager, Infrastructure Projects, West
Planning, Infrastructure & Economic Development
613 580-2424 ext.: 27794

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Absence alert:

I apologize for any inconvenience.

From: Davidson, Steve <Steve.P.Davidson@wsp.com>
Sent: May 4, 2021 13:13
To: Surprenant, Eric <Eric.Surprenant@ottawa.ca>
Cc: Alexander Orakwue <AOrakwue@richcraft.com>; De Santi, Nadia <nadia.de-santi@wsp.com>; Searle, Daniel <Daniel.Searle@wsp.com>
Subject: RE: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion

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Hi Eric,

I'm just checking in to see if you have an update on our request below? Let me know.

Thanks,
SD

Steve Davidson, P.Eng., OLS (Ret.), MBA
Manager, Municipal Engineering – Kingston & Cornwall



1224 Gardiners Road, Suite 201
Kingston, Ontario
K7P 0G2 Canada
T+ 1 613-634-7373
T+ 1 613-856-0307 (Direct)

steve.p.davidson@wsp.com | wsp.com

From: Davidson, Steve
Sent: April-29-21 11:37 AM
To: Eric.surprenant@ottawa.ca
Cc: Alexander Orakwue <AOrakwue@richcraft.com>; De Santi, Nadia <Nadia.De-Santi@wsp.com>; Searle, Daniel <Daniel.Searle@wsp.com>
Subject: RE: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion

Hi Eric,

Thank you again for the call today, we appreciate your time.

As discussed, please provide any available documentation (incl. As-built DWGs, reports, etc.) related to the SWM works along Cope Drive/Robert Grant Ave, specifically those which related to the 250mm storm services which appears to be stubbed in the SE corner of our site (Block 344 - 620 Bobolink Ridge).

Based on our call, it is our understanding that the City would consider allowing our development to have a secondary storm connection (aside from the dedicated service off Embankment Street) for the sole purpose of providing gravity drainage to a few of the townhome foundation drainage systems. Based the grading differential across the site (from Embankment Street to the intersection of Robert Grant/Cope), these few Townhome foundations currently possess an USF elevation below the site's 100-yr + 300mm HGL. As mentioned, WSP is more than willing to complete an analysis/memo outlining the proposal, which would include a review of the receiving systems HGL as to ensure proper functionality.

If you have any questions or concerns please do not hesitate to reach out.

Regards,
SD

Steve Davidson, P.Eng., OLS (Ret.), MBA
Manager, Municipal Engineering – Kingston & Cornwall



1224 Gardiners Road, Suite 201
Kingston, Ontario
K7P 0G2 Canada
T+ 1 613-634-7373
T+ 1 613-856-0307 (Direct)

steve.p.davidson@wsp.com | wsp.com

-----Original Appointment-----

From: Davidson, Steve

Sent: April-28-21 11:49 AM

To: Davidson, Steve; Eric.surprenant@ottawa.ca; Alexander Orakwue; De Santi, Nadia; Searle, Daniel

Subject: 620 Bobolink Ridge - Request for Meeting re: Storm/Drainage Discussion

When: April-29-21 9:00 AM-10:00 AM (UTC-05:00) Eastern Time (US & Canada).

Where: Microsoft Teams Meeting

The purpose of this meeting is to review some grading/drainage constraints, and we'd like to review a few possible options to see if the City of Ottawa would be in agreeance with our design approach.

If this time doesn't work for anyone, 2-3pm also works for WSP and the City of Ottawa so please let me know if this should be rescheduled to the afternoon.

Regards,
SD

Steve Davidson, P.Eng., OLS (Ret.), MBA
Manager, Municipal Engineering – Kingston & Cornwall



1224 Gardiners Road, Suite 201
Kingston, Ontario
K7P 0G2 Canada
T+ 1 613-634-7373
T+ 1 613-856-0307 (Direct)

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**APPENDIX E –
FERNBANK CROSSING – PHASE 3
SERVICING REPORT**





Engineers, Planners & Landscape Architects

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- Land / Site Development
- Municipal Infrastructure
- Environmental / Water Resources
- Traffic/ Transportation
- Structural
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Planning

- Land/Site Development
- Planning Application Management
- Municipal Planning Documents & Studies
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- Wireless Industry

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- Environmental Restoration
- Sustainable Design

Abbott-Fernbank Holdings Inc. Fernbank Crossing – Phase 3

Stormwater Management Report

Engineering excellence. Planning precision. Inspired landscapes.



**ABBOTT-FERNBANK HOLDINGS INC.
FERNBANK CROSSING**

**STORMWATER MANAGEMENT REPORT
(PHASE 3)**



Prepared By:

NOVATECH

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

March 10, 2015
Revised July 13, 2015

Novatech File: 108180-15
Ref: R-2015-051

July 13, 2015

City of Ottawa
Infrastructure Services and Community Sustainability
110 Laurier Avenue West
Ottawa, ON K1P 1J1

Attention: Ms. Lily Xu

Dear Ms. Xu

**Reference: Stormwater Management Report – Phase 3
Abbott-Fernbank Holdings Inc. - Fernbank Crossing
Our File No.: 108180-15**

Please find enclosed one (1) copy of the Stormwater Management Report for Phase 3 of the Abbott-Fernbank Holdings Inc. lands within the Fernbank Community – Fernbank Crossing. This report outlines the detailed storm drainage and stormwater management strategy for Phase 3 of the Fernbank Crossing development. The stormwater management design has been developed based on the requirements of the City of Ottawa and Rideau Valley Conservation Authority.

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

Sincerely,

NOVATECH



Michael Petepiece, P.Eng.
Project Manager

cc: Mr. Josh Kardish, Regional Group of Companies (1 copy)
Mr. Eric Surprenant, City of Ottawa (3 copies)

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Appendix B SWM Calculations and Design Sheets
Appendix C Autodesk Storm and Sanitary Analysis Model
Appendix D Drawings

1.0 INTRODUCTION

1.1 Background

Novatech has been retained to prepare a detailed stormwater management report for the proposed Phase 3 development of the Abbott-Fernbank Lands (hereafter referred to as Fernbank Crossing). The subject site is located within the new Fernbank Community on the North side of Fernbank Road and west of Terry Fox Drive as shown in **Figure 1**. The lands will be developed as a low to medium density residential subdivision.

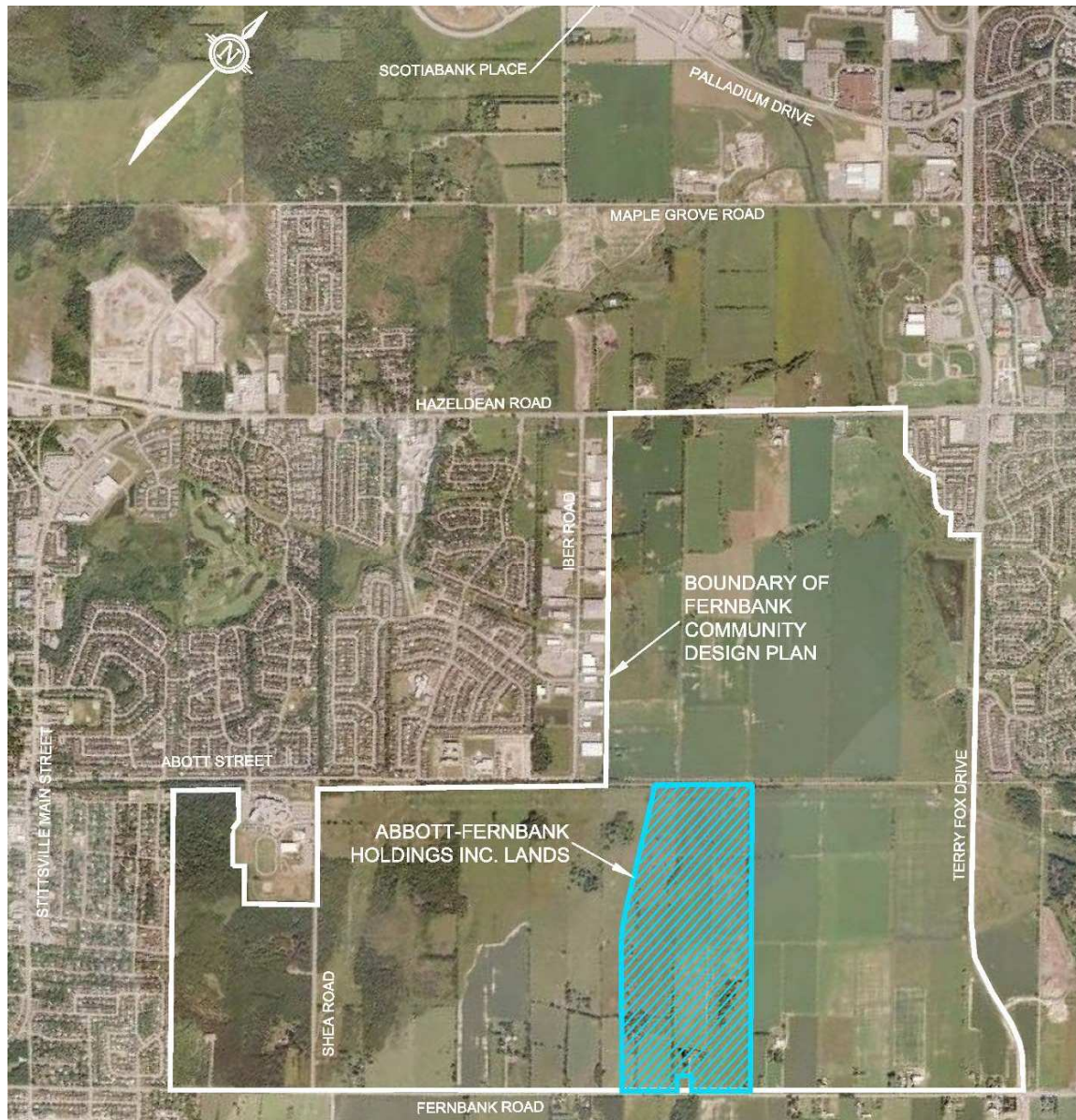


Figure 1: Key Plan

1.2 Land Use

1.2.1 Fernbank Crossing

The Fernbank Crossing subdivision (67.30 ha) will be comprised primarily of low and medium density residential dwellings with a total of 506 singles, 244 towns and 76 stacked units proposed. Medium density residential (6.81ha) and a Community Core Area (7.11ha) are proposed adjacent a new Arterial Road that is to be constructed along the west property line and the hydro corridor. The Community Core is comprised of Mixed-Use land and a Village Green which is a public green space. Two schools (4.95ha) will front onto a Major Collector road which divides the site (North/South). A Park n' Ride facility (1.95ha), and a Paramedic Post (0.71ha) are proposed along Fernbank Road. A Transit Station (1.02ha), Hydro Corridor (3.37ha), a SWM facility (0.93ha) and a Park (1.00ha) make up the remainder of the site. The proposed land use plan is shown in **Figure 2**.

Stormwater Management Draft Conditions are provided in **Appendix A**. The Draft Plan of Subdivision is located in **Appendix D**.

1.2.2 Adjacent Lands

The proposed subdivision will be bordered by future residential lands to the west (CRT Developments Inc.), a hydro corridor and the Trans-Canada Trail to the north, future residential lands to the east (Monarch-Cardel), and agricultural land to the south.

There is ongoing coordination with the both the landowner to the east (Monarch-Cardel) and the landowner to the west (CRT Developments Inc.). The proposed storm drainage system has been designed to accommodate runoff from the adjacent development areas, as well as future phases within the Fernbank Crossing development. The only external area draining to the site is the Phase 5 area which has been included in the modelling.

1.3 Additional Reports

This Stormwater Management Report provides information on the considerations and approach by which Novatech has designed and evaluated the proposed storm drainage system for the Phase 3 lands, and builds upon the recently completed works for the Fernbank Community Design Plan[1] prepared by Walker, Nott, Dragicevic Associates Limited, the Fernbank Master Servicing Study[2] prepared by Novatech, and the Fernbank Environmental Management Plan also prepared by Novatech[3].

This report should be read in conjunction with the following:

- *Geotechnical Investigation, Fernbank Crossing Residential Subdivision Phase 3 and 4, Ottawa, Ontario* prepared by Houle Chevrier Engineering, dated December 2014 (Ref #14-482).
- *Servicing Design Brief (Phase 3) – Abbott-Fernbank Holdings Inc. Fernbank Crossing* prepared by Novatech Engineering Consultants Ltd., dated June 23, 2015 (R-2014-177).



Figure 2: Conceptual Land Use Plan

1.4 Phasing

The Fernbank Crossing subdivision is being developed in phases as shown in Figure 3. This report includes details of the proposed storm drainage and stormwater management design for Phase 3 which includes 128 single family lots, 68 townhomes, 2 medium-density residential blocks, and a park. A conceptual stormwater analysis for all future phases was modeled to evaluate the storm runoff (major and minor system) onto Cope Drive and will be re-evaluated during detailed design of all future phases.

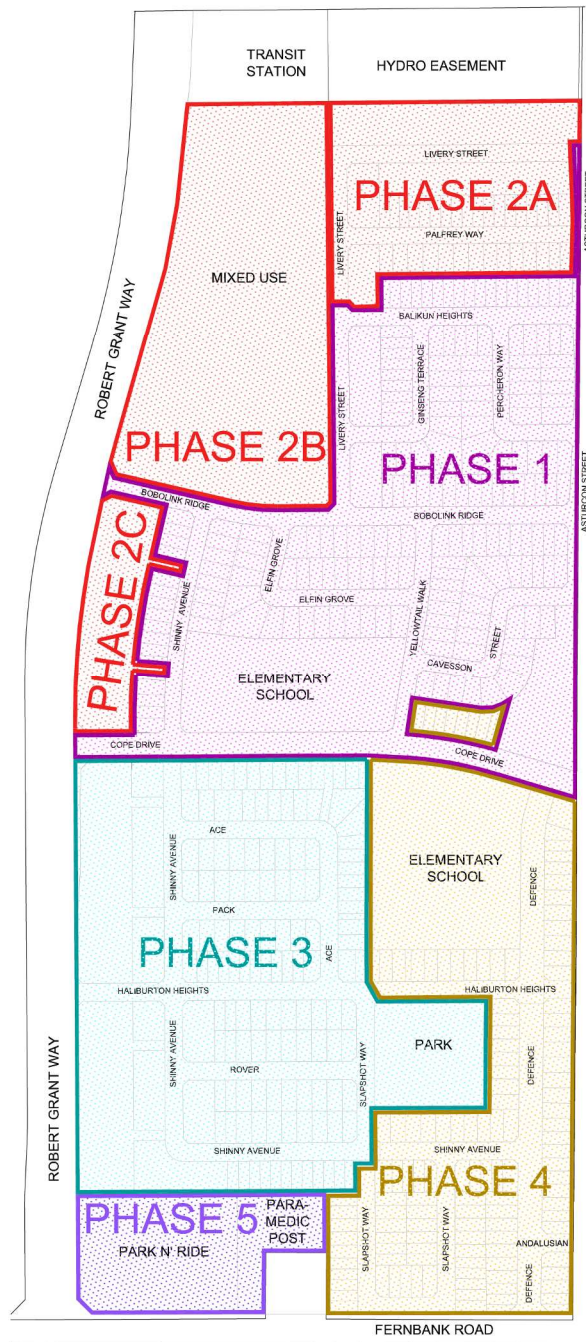


Figure 3: Phasing Plan

2.0 STORMWATER MANAGEMENT CRITERIA

The stormwater management criteria for the proposed development were developed as part of the Fernbank Environmental Management Plan [3] and are based on the recommendations of the Jock River Reach 2 Subwatershed Study and input from Rideau Valley Conservation Authority.

In addition to the SWM criteria outlined in the Fernbank EMP, the proposed stormwater management strategy will need to adhere to all applicable policies and guidelines of the Rideau Valley Conservation Authority, the City of Ottawa, the Ministry of the Environment, and other approvals agencies.

2.1 Quality Control / Quantity Control / Fish Habitat (Pond 6)

- Fernbank Pond 6 has been designed to control post-development peak flows in the Monahan Drain to pre-development levels and ensure no adverse impacts on the function of the Monahan Drain Constructed Wetlands SWM Facility.
- Fernbank Pond 6 has been designed to provide an *Enhanced* level of water quality protection (80% long term TSS removal), as required for lands tributary to the Monahan Drain (Jock River Subwatershed).
- Fernbank Pond 6 will provide temperature mitigation measures to ensure that the temperature of discharged stormwater does not exceed the target values established as part of the Fernbank EMP:
 - Maximum Discharge Temperature = 25°C
 - Preferred Discharge Temperature = 22°C

2.2 Storm Drainage / Conveyance

- Storm sewers are to be designed to convey the 1:5 year post-development peak flow for the proposed development (1:10 year for arterial roads).
- Overland flows are to be confined within the right-of-ways and/or defined drainage easements for all storms up to and including the 1:100 year event.
- ICD flow rates are to be calculated for each drainage area to ensure that the following stormwater management (SWM) objectives are satisfied:
 - Surface water accumulation at street low points, during a 5 year event, shall follow Section 8.3.8.2 of the City of Ottawa Sewer Design Guidelines.
 - Major system storage in backyards is not to be included / accounted for in design computations.
 - Maximum flow depths and elevations on streets shall not exceed 300 mm and shall be confined to the road right-of-way as well as not be within 300 mm (vertical) to the nearest building opening.
 - The maximum flow depth on streets (both public and private and on parking lots) under either static or dynamic conditions shall be 300 mm.
 - The product of the 100 year flow depth (m) on street and flow velocity (m/s) shall not exceed 0.6.
 - The 100 year hydraulic grade line within the storm sewers shall not be within 30 cm (vertical) to adjacent building underside of footing.

2.3 Erosion and Sediment Control

- A qualified inspector should conduct daily visits during construction to ensure that the contractor is working in accord with the design drawings and that mitigation measures are being implemented as specified.
- Silt fencing is to be installed along the upland edge of all fish habitat corridors.
- Straw bale check dams are to be installed at the outlets to roadside ditches.
- Filter fabric is to be placed under all catch basins and storm manhole covers.
- After complete build-out, all sewers are to be inspected and cleaned and all sediment and construction fencing is to be removed.

3.0 EXISTING CONDITIONS

3.1 Topography

The site generally slopes to the northeast at approximately 0.50%. Steeper grades of up to 6.0% are found near the high points along the west and south property boundaries. There is a total elevation differential of approximately 3.75 metres across the site, from a maximum elevation of approximately 106.00 metres in the southwest corner to a minimum elevation of approximately 102.25 metres in the northeast corner.

3.2 Subsurface Conditions

Geotechnical investigations were carried out by Houle Chevrier Engineering [4] [5], and bedrock was encountered between 0.25 and 6.4 metres below the existing ground surface. The area of shallow bedrock is limited to the western boundary of the site, with the shallowest bedrock located in the northwest corner.

3.3 Drainage Outlet

The Fernbank Crossing development is located at the headwaters of the Monahan Drain Subwatershed (part of the Jock River Watershed). **Figure 4** shows the location of the Abbott Fernbank Lands and the existing watershed boundaries.

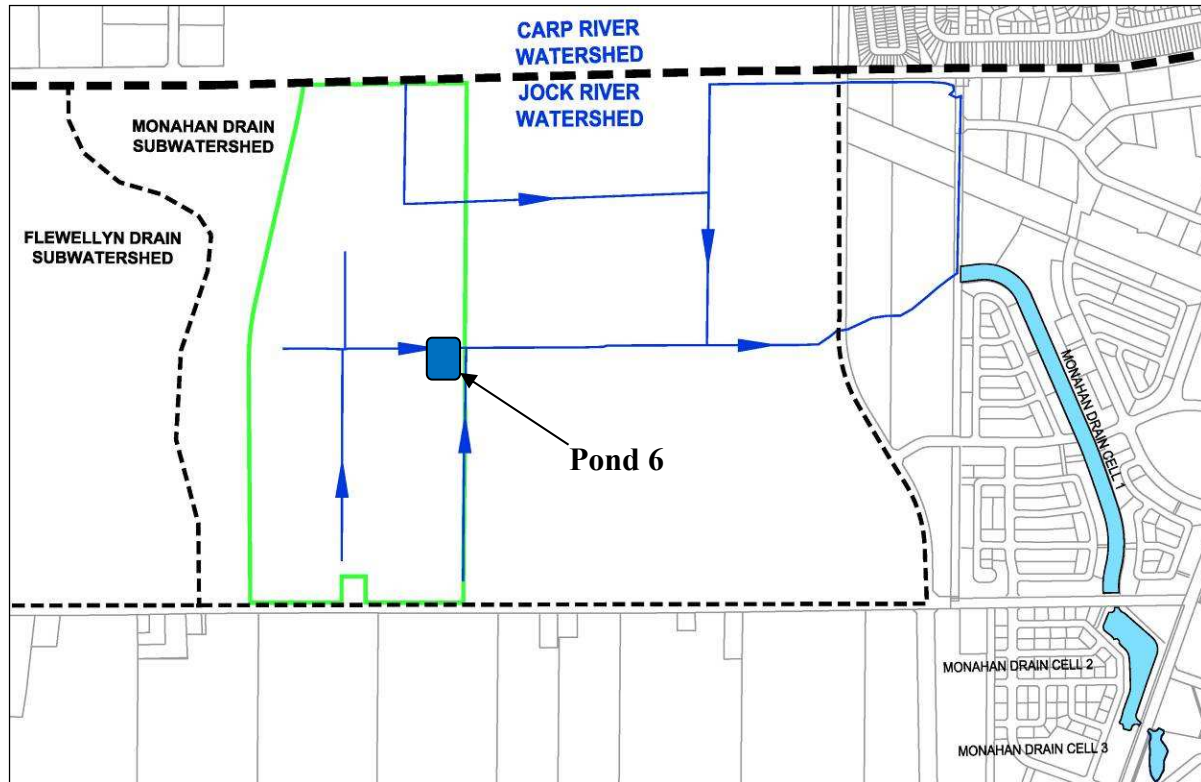


Figure 4: Existing Watershed Boundaries

The Monahan Drain is a municipal drain flowing eastwards towards Terry Fox Drive, with several lateral branches on the north and south sides that connect with the main branch. As specified in the Fernbank Environmental Management Plan, the Monahan Drain upstream of Terry Fox Drive has been classified as an intermittent watercourse that provides indirect habitat supporting tolerant warm/cool water fish communities.

The Monahan Drain has been abandoned upstream of Pond 6, along with the various branch drains within the limits of the Fernbank Community. The branch drains will be filled in as new development within the Fernbank Community proceeds. The main branch between Terry Fox Drive and Pond 6 will be lowered and enhanced using natural channel design techniques to mitigate against the loss of habitat associated with abandoning the various branch drains.

A minimum 40m wide riparian corridor has been designated for the section of the drain to be retained downstream of Pond 6 to protect aquatic habitat and stream function.

4.0 PROPOSED DEVELOPMENT

4.1 Grading Design

The proposed grading for the Abbott Fernbank Lands will closely follow the Grading Plan contained in the Fernbank Master Servicing Study [3]. Grade raise constraints are shown in Geotechnical Report [5] and are limited to the northeast corner of the site (described as Area 2) where the depth of fill material in the vicinity of structures and in garages should be limited to at most 2.0 metres.

Existing elevations will be met along Fernbank Road, Founder Avenue and Cope Drive. Grading will be coordinated with the proposed development to the east and west. A detailed grading plan can be found in the Phase 3 Servicing Design Brief dated December 12, 2014.

The proposed grading will not impede existing major system flow paths. Interim solutions have been proposed based on the area to be constructed as part of Phase 3. Further details are provided in the Phase 3 Servicing Design Brief.

4.2 Storm Sewer Design (Minor System)

The storm sewer system proposed to service Fernbank Crossing is divided into two main trunks with a north and a south inlet to Pond 6. The design of the trunk sewer outlets to Pond 6 are being coordinated with the City and the adjacent landowners. The overall layout of the proposed storm sewer network is shown on **Figure 5**.

The proposed storm sewers have been designed using the Rational Method to convey peak flows associated with a 5-year return period. The storm sewer design sheets are provided in **Appendix B**. The corresponding Storm Drainage Area Plan (Drawing 108180-15-STM) is provided in **Appendix D**. The design criteria used in sizing the storm sewers are summarized in **Table 4.1** and **Table 4.2**.

Table 4.1: Storm Sewer Design Parameters

Parameter	Design Criteria
Local and Collector Roads	5 Year Return Period
Arterial Roads	10 Year Return Period
Storm Sewer Design	Rational Method/Modeling
IDF Rainfall Data	Ottawa Sewer Design Guidelines
Initial Time of Concentration (T_c)	15 minutes (rear yards) / 10 minutes (roads)
Minimum Velocity	0.8 m/s
Maximum Velocity	3.0 m/s
Minimum Diameter	250 mm

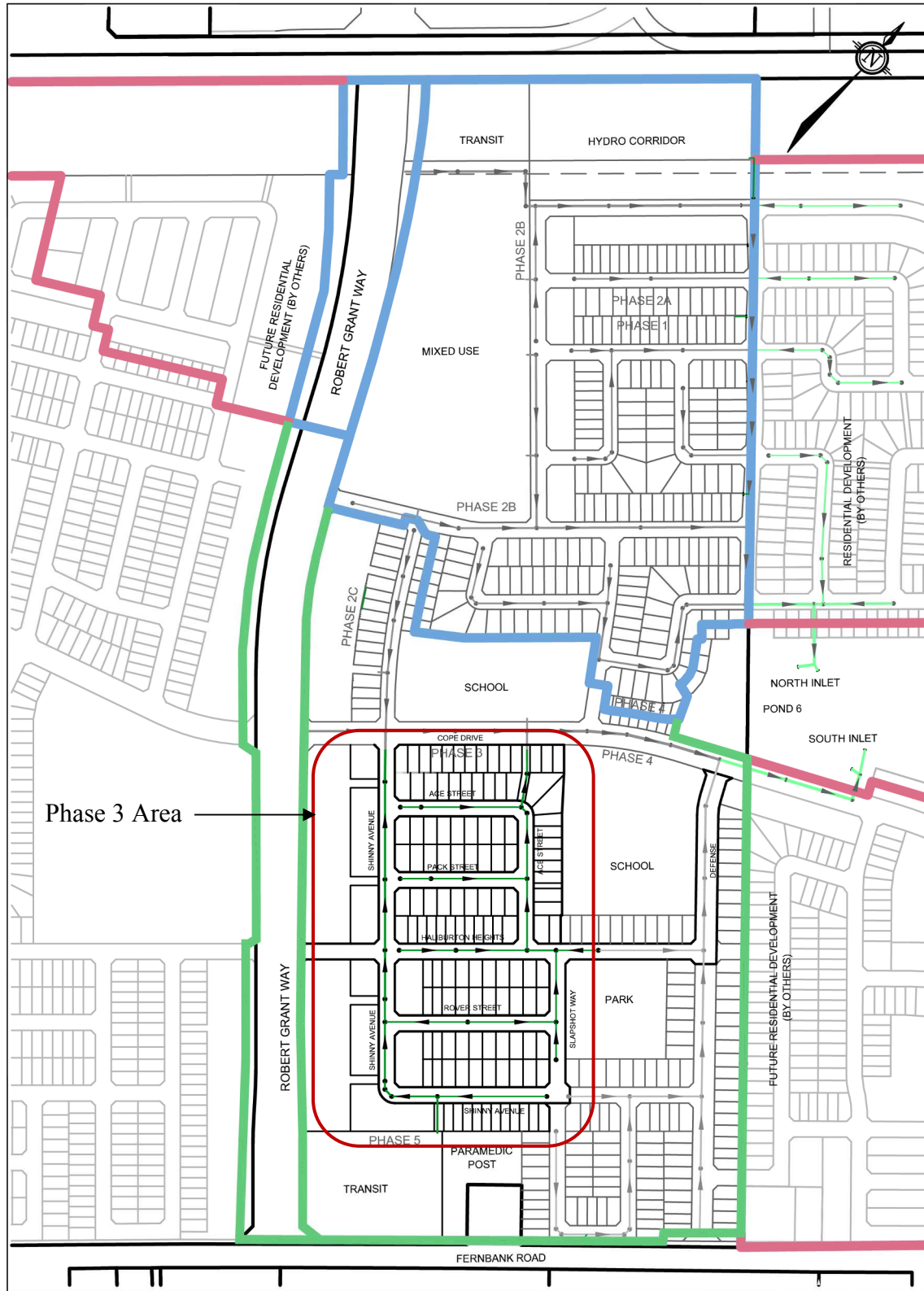


Figure 5: Storm Sewer Network

Table 4.2: Runoff Coefficients

Land Use	Runoff Coefficient
Mixed Use	0.80
Park N' Ride/Paramedic Post	0.80
Arterial Roads	0.90
Schools	0.60
Parks	0.40
Hydro Corridor	0.20
Low Density Front Yards	0.65
Low Density Rear Yards	0.55
Medium Density Front Yards	0.70
Medium Density Rear Yards	0.60

4.2.1 Inlet Control Devices

Inlet control devices (ICDs) will be installed in road and rear yard catch basins as required to limit inflows to the minor system during large (> 1:5 year) storm events. Catch basin leads will typically be interconnected with a single ICD controlling inflow to the storm sewer.

Inlet control devices are proposed at storm sewer inlets as required to ensure inflows to the storm sewer system are regulated to the 5-year peak flow (10-year peak flow for arterial roads and Transitway). ICDs shall be CB lead plug/insertion type and will correspond to the sizes listed in Section 13.1.19 of the Ottawa Sewer Materials Specifications [7].

4.3 Overland Flow Path (Major System)

The rights-of-way have been designed to convey major system overland flow to Pond 6. The road profiles have been graded to ensure that the 100-year peak overland flows are confined within the right-of-way at a maximum flow depth of 0.30 m (static ponding + cascading flow). The major system has been designed to ensure that the product of velocity x depth does not exceed 0.60 during the 100-year event.

4.4 Infiltration Best Management Practices

The Fernbank EMP recommends lot level and infiltration best management practices (BMPs) to mitigate against the potential reduction in infiltration resulting from development. Phase 3 of the Fernbank Crossing subdivision will consist primarily of residential lots. Proposed BMPs for groundwater infiltration include:

- Pipes connecting rear yard CBs will be perforated pipes to promote infiltration of runoff from rear yard areas (as per City of Ottawa Standard Detail S29).
- Roof leaders will be directed to rear yard areas.

By implementing infiltration BMPs as part of the storm drainage design, the impacts of development on the hydrologic cycle can be considerably reduced. Infiltration of clean runoff will have additional benefits for stormwater management. By reducing the volume of “clean” water conveyed to the SWM facility, the end-of-pipe storage requirements can be reduced. The EMP specifies a post-development infiltration target of 110mm of annual rainfall for the site. A water

balance was performed which has been included in Appendix B. The water balance indicates the post-development annual infiltration will be 114mm, which exceeds the minimum recommended by the EMP.

5.0 HYDROLOGIC & HYDRAULIC MODELING

The performance of the proposed storm drainage system for Phase 3 of the Fernbank Crossing subdivision was evaluated using the *Autodesk Storm and Sanitary Analysis* (SSA) hydrologic/hydraulic model. This includes confirmation of the minor system sizing and determination of the 100-year HGL.

5.1 Model Capabilities

The following excerpts are taken from *Autodesk Storm and Sanitary Analysis 2012 – Technical Capabilities and Functionalities* (Autodesk, Inc. 2011) and provide an overview of the hydrologic and hydraulic modeling capabilities of the software.

Hydrologic Modeling Capabilities

Autodesk Storm and Sanitary Analysis accounts for various hydrologic processes that produce runoff from urban areas, including:

- *Time-varying rainfall*
- *Evaporation of standing surface water*
- *Snow accumulation and melting*
- *Rainfall interception from depression storage*
- *Infiltration of rainfall into unsaturated soil layers*
- *Percolation of infiltrated water into groundwater layers*
- *Interflow between groundwater and the drainage system*
- *Nonlinear reservoir routing of overland flow*

Spatial variability in all of these processes is achieved by dividing a study area into a collection of smaller, homogeneous subcatchment areas, each containing its own fraction of pervious and impervious sub-areas. Overland flow can be routed between sub-areas, between subcatchments, or between entry points of a drainage system.

Hydraulic Modeling Capabilities

Autodesk Storm and Sanitary Analysis contains a flexible set of hydraulic modeling capabilities used to help route runoff and external inflows through the drainage system network of pipes, channels, storage/treatment units, and diversion structures. The software can simultaneously simulate dual drainage networks (stormwater sewer network and city streets as separate but connected conveyance pathways) and inlet capacity. It can quickly determine the amount of stormwater flow that is intercepted by the stormwater network inlets and the amount of stormwater flow that bypasses and is then routed further downstream to other inlets. Hydraulic network modeling is performed by the Kinematic Wave or Hydrodynamic (in other words, Saint Venant equation) routing methods.

5.2 Design Storms

The hydrologic analysis was completed using the following synthetic design storms and historical storms. The IDF parameters used to generate the design storms were taken from the Ottawa Design Guidelines - Sewer (October 2012).

3 Hour Chicago Storms:

100-year 3hr Chicago storm

4 Hour Chicago Storms:

5-year 4hr Chicago storm

100-year 4hr Chicago storm

12 Hour SCS Type II Storms:

5-year 12 hour SCS Type II storm

100-year 12 hour SCS Type II storm

24 Hour SCS Type II Storms:

100-year 24 hour SCS Type II storm

Historical Storms:

July 1st, 1979 storm

August, 1988 storm

August, 1996 storm

The 4-hour Chicago distribution generates the highest peak flows for both the minor and major systems and was determined to be the critical storm distribution for the design of the storm drainage system.

The proposed drainage system has also been stress tested using a 4-hour Chicago design storm that has a 20% higher intensity and total volume compared to the 100-year event.

Model results from all storm distributions are provided on the enclosed CD.

5.3 Model Development

The 'Autodesk Storm and Sanitary Analysis' (SSA) model has been developed to account for both minor and major system flows (*dual drainage*), including the routing of flows through the storm sewer network (*minor system*), and overland along the road network (*major system*). The results of the analysis were used to:

- Ensure no ponding in the rights-of-way following a 5-year event;
- Calculate the storm sewer hydraulic grade line for the 100-year storm event;
- Evaluate overland flow depths and ponding volumes in the right-of-way during the 100-year event; and
- Determine the total major and minor system runoff from the site to Pond 6.

The SSA program uses 'conveyance links' to model all minor and major systems during analysis. The conveyance links allow you to input the appropriate road cross sections in the

open channel option so during the analysis the major system is modelled correctly. The conveyance links are connected to ‘junctions’ and ‘storm inlets’ which represent the gutter grades at selected points, catch basins in sags (*low points*) and overtopping points (*high points*). The major system (*road network*) corresponds to the grading plan of the proposed site. The junctions, inlets and conveyance links are used to determine the flows, velocities and ponding depths at specific points on the road. The road networks on the plan and profile drawings are used to create the major system model using all slopes and grades for the site.

The SSA model is capable of accounting for both static and dynamic storage within the right-of-ways, including the overland flow across all high points and capture/bypass curves for inlets on continuous grade. The 100-year flow depths computed by the model represent the total (static + dynamic) ponding depths at low points for areas in road sags, or the gutter flow depth where the inlets are on a continuous grade.

5.3.1 Storm Drainage Area Plan

The Fernbank Crossing subdivision has been divided into subcatchments based on the drainage areas tributary to each inlet of the proposed storm sewer system. The catchment areas are shown on the Storm Drainage Area Plans provided as Drawings 108180-15-STM in **Appendix D**.

5.3.2 Subcatchment Model Parameters

The hydrologic parameters for each subcatchment were developed based on the Land Use Plan (Figure 2) and the Storm Drainage Area Plan specified above. An overview of the modeling parameters is provided in **Table 5.1**. Supporting calculations are provided in **Appendix B**.

Table 5.1: Hydrologic Modeling Parameters

Area ID	Catchment Area (ha)	Runoff Coefficient (C)	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
109b	0.46	0.55	50	100.00	0.50%
624	1.18	0.80	86	53.00	0.50%
625	0.17	0.65	64	18.00	0.50%
627	1.01	0.80	86	53.00	0.50%
628	0.06	0.55	50	16.00	0.50%
629	0.16	0.55	50	40.00	0.50%
630	0.11	0.55	50	30.00	0.50%
632	1.08	0.80	86	88.00	0.50%
633	1.84	0.80	86	120.00	0.50%
634	0.14	0.60	57	28.00	0.50%
638	0.07	0.60	57	25.00	0.50%
639	0.13	0.60	57	40.00	0.50%
641	0.39	0.70	71	50.00	0.50%
642	0.42	0.65	64	48.00	0.50%

Area ID	Catchment Area (ha)	Runoff Coefficient (C)	Percent Impervious (%)	Equivalent Width (m)	Average Slope (%)
643	0.46	0.65	64	48.00	0.50%
663	0.51	0.55	50	100.00	0.50%
664	0.45	0.65	64	48.00	0.50%
666	0.35	0.65	64	48.00	0.50%
667	0.35	0.70	71	50.00	0.50%
668	0.50	0.55	50	100.00	0.50%
670	0.70	0.65	64	48.00	0.50%
671	0.22	0.65	64	38.00	0.50%
672	0.42	0.55	50	100.00	0.50%
673	0.28	0.65	64	38.00	0.50%
674	0.30	0.65	64	38.00	0.50%
675	0.35	0.65	64	48.00	0.50%
704	0.22	0.65	64	22.00	0.50%
708	0.15	0.65	64	25.00	0.50%
713	0.08	0.55	50	40.00	0.50%
716	0.18	0.55	50	40.00	0.50%
717	0.31	0.65	64	48.00	0.50%
718	0.43	0.55	50	100.00	0.50%
719	0.21	0.65	64	38.00	0.50%
720	0.35	0.65	64	48.00	0.50%
721	0.47	0.65	64	48.00	0.50%
722	0.21	0.55	50	40.00	0.50%
723	0.31	0.65	64	38.00	0.50%
730	0.10	0.60	57	25.00	0.50%
739	0.20	0.55	50	40.00	0.50%
700	0.22	0.65	64	25.00	0.50%
TOTAL	15.6	0.68	68	-	-

Infiltration

Infiltration losses for all catchment areas was modeled using Horton's infiltration equation, which defines the infiltration capacity of the soil over the duration of a precipitation event using a decay function that ranges from an initial maximum infiltration rate to a minimum rate as the storm progresses. The default values for the City of Ottawa [6] were used for all catchments.

Horton's Equation:

$$f(t) = f_c + (f_o - f_c)e^{-k(t)}$$

Initial infiltration rate: $f_o = 76.2$ mm/hr
Final infiltration rate: $f_c = 13.2$ mm/hr
Decay Coefficient: $k = 4.14$ /hr

Depression Storage

The default values for depression storage in the City of Ottawa [6] were used for all catchments. Residential rooftops were assumed to provide no depression storage.

- Depression Storage (pervious areas): 4.67 mm
- Depression Storage (impervious areas): 1.57 mm

Impervious Values

Impervious (TIMP) values for each subcatchment area were calculated based on the proposed land use plan (Figure 2) and correspond to the Runoff Coefficients used in the Rational Method calculations using the equation:

$$C = 0.90(\% \text{ IMP}) + 0.20(1 - \% \text{ IMP})$$

To check that the impervious values used in the design are appropriate, the impervious value for a typical lot was calculated for each land use and compared to the values used in the design. The results of this analysis indicate that the Runoff Coefficients and impervious values used in the stormwater management design are slightly higher than the calculated values and therefore represent a slightly conservative design. Supporting calculations are provided in **Appendix B**.

5.3.3 Minor System

Inflows to the storm sewer were modeled based on the characteristics of each inlet.

- For areas where catch basins are located at low points (*represented as junctions*), inflows to the storm sewer are based on the ICD specified for the inlet and the maximum depth of ponding. Storage volumes within the right-of-way are based on the grading design.
- For areas where catch basins are located on a continuous grade (*represented as inlets*), the capture rate is based on the type of grate, the geometry of the road, and the approach flow. Rating curves for approach flow vs. capture rate were input into the model using the appropriate tables from the *Ottawa Design Guidelines – Sewer*.
 - Design Chart 4.04: Gutter Flow Rate for Barrier Curb with Gutter.
 - Design Chart 4.06: Gutter Flow Rate for Mountable Curb with Gutter.
 - Design Chart 4.14: Inlet Capacity for Barrier Curb.
 - Design Chart 4.15: Inlet Capacity for Mountable Curb.
 - Appendix 7-A. Type S22 Curb Inlet Catch Basin with Cross Fall fixed at 3%

5.3.4 Major System

The proposed road network was input into the 'Storm and Sanitary Analysis' model to calculate the total inflow into the storm sewers (minor system), and to calculate the overland flows and flow depths within the right-of-ways (major system).

The roads are represented in the model as open channels. Model input includes:

- Right-of-way cross-sections;
- Length and slope of the road between each high and low point;
- The location of all storm inlets and whether the inlets are in a sag or on-grade.

The elevations used to define the road network are based on the gutter elevations, as opposed to the centerline of road elevations shown on the Grading Plans.

5.3.5 Assumptions for Off-Site / Future Development

The 'Storm and Sanitary Analysis' model developed for Phase 3 of the Fernbank Crossing subdivision has to account for inflows from all future phases, as well as inflows from adjacent development. Where detailed information does not exist, the following assumptions were made in developing the model:

- Inflows from all future development have been accounted for based on the 5-year peak flow (10-year peak flow for arterial roads)
- The maximum release rate for the paramedic station and park and ride facility was established as 150L/s/ha as per the community design plan.

5.3.6 Modeling Files / Schematic

The 'Storm and Sanitary Analysis' modeling files and model schematics are provided in **Appendix C**. Digital copies of the modeling files and model output for all storm events are provided on the enclosed CD.

5.4 Results of Hydrologic Analysis

The 'Autodesk Storm and Sanitary Analysis' hydrologic/hydraulic model was used to evaluate the performance of the proposed storm drainage system for the Phase 3 lands tributary to the South Inlet of Pond 6 and specifically to determine the 100-year hydraulic grade line.

5.4.1 Minor System

The proposed inlet control devices (ICDs) have been sized to allow the capture of the approximate 5-year peak flow at each inlet to the storm sewer. As a result, there will be effectively no ponding within the right-of-ways at the end of the 5-year event. The selection of ICDs takes into account the overland flow that bypasses catch basins on-grade by providing additional capacity at the downstream inlets. The list of ICD sizes and a comparison of storm sewer design sheet peak flow results from modeling peak flow results is provided in **Table 5.2** and **Table 5.3** respectively.

Table 5.2: Inlet Control Device Sizes and Design Flows

Area ID	Structure	ICD Orifice Diameter (mm)	5-year Peak Runoff Rate (L/s)	5-year Inlet Capture Rate (L/s)	100-year Peak Runoff Rate (L/s)	100-year Inlet Capture Rate (L/s)	Excess Runoff Stored and Bypassed (L/s)
109b	RYCBMH-2	152	51	50	128	59	69
625	CB-119	127	30	29	54	35	19
628	RYCB-34	83	7	7	18	18	0
629	RYCB-33	108	19	19	46	37	9
630	RYCB-32	83	13	13	31	18	13
634	RYCB-39	94	18	18	43	25	18
638	RYCB-31	94	12	12	25	25	0
639	RYCB-30	83	21	20	45	22	23
641	CB-129	200 Lead	78	78	141	100	41
642	CB-132	178	75	74	136	78	58
643	CB-134	178	82	81	148	85	63
663	RYCBMH-4	152	52	52	136	62	74
664	CB-125	178	81	81	147	88	59
666	CB-123	178	63	63	115	79	36
667	CB-121	200 Lead	71	71	128	101	27
668	RYCBMH-3	152	52	52	134	64	70
670	CB-97	200 Lead	120	102	218	107	111
671	CB-96	200 Lead	40	40	74	74	0
672	RYCB-24	152	49	48	120	65	55
673	CB-117	152	51	51	93	59	34
674	CB-115	152	54	54	98	58	40
675	CB-93	152	63	63	115	66	49
704	CB-101	108	39	18	71	22	49
708	CB-111	108	27	22	50	22	28
713	E-34	83	13	13	31	18	13
716	RYCB-28	108	20	19	50	35	15
717	CB-91	200 Lead	57	57	104	74	30
718	RYCB-25	127	49	47	121	51	70
719	CB-90	152	38	38	70	48	22
720	CB-87	152	64	64	115	66	49
721	CB-85	200 Lead	85	84	153	97	56
722	RYCBMH-17	127	21	21	55	51	4
723	CB-113	178	55	55	101	85	16
730	RYCB-38	83	15	14	32	16	16
739	RYCB-21	94	21	21	54	27	27
700	CB-127	152	40	40	72	55	17

The Rational Method design sheets (**Appendix B**) were used to calculate the required storm sewer sizes based on capturing the peak flow at each inlet to the storm sewer for a 5-year design return period.

Two sets of storm sewer design sheets are included in **Appendix B**:

- The ‘Standard’ Rational Method design sheets represent the expected 5-year peak flow in the storm sewers.
- The ‘Fixed Tc’ Rational Method design sheets represent the expected 100-year peak flow in the storm sewers based on the following assumptions and were used to determine the boundary conditions for the SSA model:
 - Each inlet is restricted to the 5-year peak flow using ICDs;
 - During the 100-year event, each inlet will contribute their maximum design flow (i.e. 5-year peak flow) simultaneously, which is often the case when ICDs operate at or near their maximum rate for a sustained period of time (i.e. duration of ponding).

5.4.2 Major System

During the 100-year event, the available static storage within road sags will be utilized and overland flow will occur as described in **Table 5.4**. Storm runoff that exceeds the available static storage will be conveyed overland within the right-of-ways and/or defined drainage easements to Pond 6. The major system network was evaluated using the ‘Autodesk Storm and Sanitary Analysis’ model to ensure that the flow depths and velocities conform to City standards.

The results of the 100-year modeling indicate that the overland flow depths on all streets will be less than 0.30m, the product of depth x velocity will be less than 0.60, and major system flows will be confined to the rights-of-way with no encroachment onto private property. The model results for points of maximum overland flow on the site are summarized in **Table 5.3**. Depths recorded in this table reflect depths along the model conduits (i.e. the roadways) and not the depths at the sags.

Table 5.3 also provides the model results for a 20% increase in the 100-year design event. The results of this stress testing indicate that the overland flow depths for the proposed site will be less than or equal to 0.30m. Based on these results, the proposed storm drainage system will not experience any severe flooding even with a 20% increase to the 100-year event. **Table 5.4** describes the ponding depths at roadway sags and the spill flows.

Table 5.3: Maximum Overland Flow Results

Location	Max Static Depth	Chicago 100-year 4 hour				Chicago 100-year 4 hour (+20%)			
		Peak Flow	Velocity	Total Depth (static + dynamic)	Velocity x Depth	Peak Flow	Velocity	Total Depth	Velocity x Depth
		(m ³ /s)	(m/s)	(m)	(m ² /s)	(m ³ /s)	(m/s)	(m)	(m ² /s)
Catch Basins at Low Points									
Ace Street									
CB 85/86	0.30	0.00	0.00	0.19	0.00	0.02	0.16	0.35	0.06
CB 89/90	0.18	0.01	0.20	0.20	0.04	0.09	0.09	0.24	0.02
CB 95/96	0.14	0.00	0.00	0.08	0.00	0.03	0.05	0.18	0.01
Pack Street									
CB 91/92	0.17	0.00	0.00	0.16	0.00	0.04	0.05	0.23	0.01
Shinny Avenue									
CB 115/116	0.18	0.15	0.46	0.26	0.12	0.17	0.47	0.29	0.14
CB 117/118	0.22	0.00	0.00	0.17	0.00	0.15	0.14	0.30	0.04
CB 121/122	0.16	0.06	0.18	0.22	0.04	0.30	0.28	0.27	0.08
CB 129/130	0.13	0.04	0.27	0.18	0.05	0.06	0.28	0.21	0.06
CB 131/132	0.24	0.00	0.00	0.21	0.00	0.01	0.17	0.26	0.04
CB 133/134	0.24	0.00	0.00	0.15	0.00	0.00	0.00	0.20	0.00
Haliburton Heights									
CB 97/98	0.20	0.00	0.00	0.17	0.00	0.01	0.25	0.22	0.06
Slapshot Way									
CB 101/102	0.13	0.11	0.41	0.20	0.08	0.26	0.40	0.23	0.09
CB 127/128	0.08	0.04	0.45	0.13	0.06	0.11	0.55	0.16	0.09
Rover Street									
CB 123/124	0.18	0.10	0.46	0.24	0.11	0.14	0.43	0.27	0.11
CB 125/126	0.04	0.03	0.10	0.09	0.01	0.12	0.16	0.12	0.02
Catch Basins on Continuous Grade									
Ace Street									
CB 87/88	-	0.04	0.52	0.04	0.02	0.07	0.28	0.05	0.01
Pack Street									
CB 93/94	-	0.04	0.49	0.05	0.02	0.07	0.52	0.06	0.03
High Points with Spill									
Haliburton Heights									
8+350	-	0.11	0.41	0.13	0.05	0.26	0.40	0.15	0.06
Shinny Avenue									
4+345	-	0.15	0.46	0.08	0.04	0.17	0.47	0.11	0.05
4+505	-	0.06	0.18	0.08	0.01	0.30	0.28	0.11	0.03
4+605	-	0.04	0.27	0.05	0.01	0.33	1.30	0.08	0.10
Slapshot Way									
6+095	-	0.04	0.45	0.05	0.02	0.11	0.55	0.08	0.05

Table 5.4: Major System Storage Summary

Structure ID	Top of Grate Elevation (m)	Max Static Ponding Elevation (m)	Max Static Ponding Volume (m ³)	Model Results (5yr Event)		Model Results (100yr Event)		
				Depth Used (m)	Storage Used (m ³)	Depth Used (m)	Storage Used (m ³)	Spill Flow (L/s)
CB 115/116	104.31	104.49	19.28	0.01	0.02	0.26	19.28	146
CB 117/118	104.48	104.70	35.75	0.00	0.00	0.17	27.63	0
CB 121/122	104.70	104.86	17.86	0.00	0.00	0.22	17.86	62
CB 129/130	104.88	105.01	6.91	0.00	0.00	0.18	6.91	41
CB 131/132	104.97	105.21	43.39	0.04	7.23	0.21	37.97	0
CB 133/134	105.07	105.31	47.64	0.01	0.12	0.15	29.77	0
CB 127/128	104.53	104.61	3.02	0.00	0.00	0.13	3.02	37
CB 125/126	104.39	104.43	2.44	0.00	0.00	0.09	2.44	41
CB 123/124	104.82	105.00	23.21	0.02	2.58	0.24	23.21	99
CB 101/102	103.60	103.73	5.58	0.00	0.00	0.20	5.58	109
CB 97/98	103.74	103.94	25.96	0.03	0.53	0.17	22.07	0
CB 95/96	103.27	103.41	9.42	0.00	0.00	0.08	5.38	0
CB 91/92	103.15	103.32	7.61	0.00	0.00	0.16	7.16	0
CB 89/90	103.14	103.32	15.36	0.00	0.00	0.20	15.36	12
CB 85/86	103.00	103.30	59.33	0.00	0.00	0.19	37.58	0
RYCBMH-1	103.07	103.30	0	0.00	0	0.29	0	27
RYCBMH-2	103.16	103.30	0	0.00	0	0.24	0	69
RYCBMH-3	104.01	104.14	0	0.00	0	0.23	0	68
RYCBMH-4	104.79	104.87	0	0.00	0	0.17	0	73
RYCB-21	105.31	105.31	0	0.00	0	0.07	0	26
RYCB-24	103.26	103.46	0	0.00	0	0.29	0	55
RYCB-25	103.08	103.28	0	0.00	0	0.30	0	69
RYCB-30	105.06	105.06	0	0.00	0	0.05	0	22
RYCB-33	104.48	104.50	0	0.00	0	0.11	0	22
RYCB-38	105.25	105.35	0	0.00	0	0.16	0	16
RYCB-39	105.28	105.40	0	0.00	0	0.17	0	18

5.4.3 Hydraulic Grade Line

Downstream Boundary Condition – Cope Drive Storm Sewer

The proposed Phase 3 development will have a higher imperviousness than originally accounted for in the design of the Cope Drive storm sewer as outlined in the *Fernbank Crossing Phases 1 & 2 SWM report* (Novatech, July 2012). To provide a 5-year level of service for Phase 3, the minor system capture rate has increased and the peak flow entering the existing Cope Drive storm sewer will be higher for both the 5-year and 100-year events - refer to **Section 5.4.4**.

The previously approved Autodesk SSA model for Phases 1 and 2 was updated to reflect the higher flows from Phase 3 and re-evaluate the 100-year HGL in the Cope Drive storm sewer. For the Phase 3 SSA model, the 100-year boundary condition water levels at Cope Drive were established based on the worst-case (highest elevation) condition of:

- Condition 1: The pipe obvert where the storm sewer connects to the trunk sewer under Cope Drive;
- Condition 2:** The HGL in the Cope Drive storm sewer, as calculated using the storm sewer design sheet (fixed 10 minute time of concentration - represents the controlled 100-year minor system flow) – refer to Appendix B; or
- Condition 3: The modeled HGL for Cope Drive from the updated SSA model for Phases 1 and 2.

From this evaluation, the boundary elevations at Cope Drive for the Phase 3 model have been established as follows:

MH 363: 102.11m (Condition 2)
 MH 341: 100.17m (Condition 3)

HGL Analysis Results – Phase 3

The results of this analysis were used to ensure that a minimum freeboard of 0.30m is provided between the 100-year HGL and the designed underside of footing elevations. The 100-year HGL is indicated on the Plan and Profile Drawings (submitted separately). The 100-year HGL elevations at each storm manhole with the respected range of underside of footing elevations and obvert of pipes are provided below in **Table 5.5**.

Table 5.5: 100-year HGL Elevations

MH ID	Street	Obvert Elevation	T/G Elevation	HGL Elevation	Sur-charge	Clearance from T/G	Minimum USF
		(m)	(m)	(m)	(m)	(m)	(m)
309	Haliburton Heights	101.33	103.86	101.41	0.08	2.45	101.71
343	Ace Street	99.69	103.09	100.63	0.94	2.46	100.93
345	Ace Street	101.76	104.26	101.46	0.00	2.80	101.76
347	Ace Street	100.12	103.46	100.98	0.86	2.48	101.28
349	Pack Street	101.06	104.47	101.26	0.20	3.21	101.56
351	Ace Street	100.37	104.05	101.28	0.91	2.77	101.58
353	Haliburton Heights	101.72	104.86	101.42	0.00	3.44	101.72
357	Slapshot Way	102.50	104.65	102.27	0.00	2.38	102.57
359	Rover Street	102.99	105.24	102.56	0.00	2.68	102.86
373	Shinny Avenue	102.25	104.40	102.24	0.00	2.16	102.54
375	Shinny Avenue	102.44	104.76	102.39	0.00	2.37	102.69
377	Shinny Avenue	102.59	104.98	102.49	0.00	2.49	102.79
379	Shinny Avenue	102.73	104.99	102.62	0.00	2.37	102.92
381	Shinny Avenue	102.79	105.14	102.70	0.00	2.44	103.00
383	Shinny Avenue	102.97	105.23	102.92	0.00	2.31	103.22
385	Shinny Avenue	102.99	105.26	102.98	0.00	2.28	103.28
387	Shinny Avenue	103.10	105.17	103.07	0.00	2.10	103.37

MH ID	Street	Obvert Elevation	T/G Elevation	HGL Elevation	Sur-charge	Clearance from T/G	Minimum USF
		(m)	(m)	(m)	(m)	(m)	(m)
389	Shinny Avenue	103.33	105.46	103.17	0.00	2.29	103.47
391	Maintenance Easement	99.55	103.19	100.40	0.85	2.79	100.70
393	Ace Street	101.59	103.91	101.46	0.00	2.45	101.76
395	Ace Street	99.75	103.18	100.73	0.98	2.45	101.03
397	Pack Street	100.55	103.94	101.57	1.02	2.37	101.87
399	Haliburton Heights	101.17	104.22	101.44	0.27	2.78	101.74
417	Slapshot Way	100.50	103.87	101.40	0.90	2.47	101.70
421	Slapshot Way	102.58	104.86	102.56	0.00	2.30	102.86

5.4.4 Comparison to Previous Studies

While all flow from the site eventually discharges to Pond 6, the infrastructure immediately downstream must also be checked to determine if it has the capacity to convey the proposed conditions flows to the pond. **Table 5.6** summarizes the proposed flows as they compare to previous studies.

Table 5.6: Comparison to Previous Studies

Comparison Location	Proposed Flows (L/s)		Phase 1&2 SWM Report (L/s) ^[8]	
	Minor System	Major System	Minor System	Major System
MH 363	1563	127	1490	1650
MH 341	1165	95	710	530

While the minor system results are increased at MH 341 compared to what had previously been assumed, the total increase to the minor system is 528L/s. As shown in the fixed time of concentration storm sewer design sheet (included in **Appendix B**), the pipe, even under 100-year conditions, has additional capacity of 148 L/s. As such, we can expect that the downstream sewer will exceed capacity by 380 L/s in the 100-year storm. This additional flow was assessed using the approved Phase 1 and 2 SSA model and determined a small increase in HGL as a result of the additional flow. This increased does not have any adverse effect on the upstream or downstream pipe system and does not change established minimum USF elevations in Phase 1. The increase in HGL did, however, necessitate using the Phase 1 and 2 model HGL as the boundary condition for the Phase 3 model at MH 341.

With respect to flows entering Pond 6, they are being significantly reduced as a result of greater than anticipated storage within the proposed subdivision. Comparing the total runoff volumes between the SSA model and IBI's SWMHYMO model used to design the pond, the SWMHYMO model had a runoff volume of 11,139m³ and the SSA model has a runoff volume of 11,245m³, which is an increase of 106m³, or less than 1%. This small increase is within the tolerance of the model. Consequently, Pond 6 will not be adversely affected by any changes in the design.

In addition to the flows reported in Table 5.6, there is major system overland drainage during the 100-year storm to the future Phase 4 area in the amount of 103 L/s east of Haliburton Heights

and 26 L/s south of Slapshot Way. These flows are much reduced from the existing conditions flows in these areas and as such are not anticipated to cause adverse impacts downstream before Phase 4 is developed. During the Phase 4 development process, these flows will be considered and incorporated during the detail design modelling of that phase.

Overall, during the 100-year storm, the average site release rate through the minor system is 175L/s/ha and the major system release rate is 23L/s/ha. During the 5-year storm, the average site release rate through the minor system is 135 L/s/ha.

6.0 CHANGES FROM FERNBANK COMMUNITY DESIGN PLAN

Changes in the proposed storm sewer system are defined as *minor* on page 83 of the Fernbank Master Servicing Study [2] and do not require an amendment to the Environmental Assessment since the results do not appreciably change the expected net impacts associated with the project. A full summary of the changes can be found in the Phase 3 Servicing Design Brief.

7.0 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). Details are provided on the Erosion and Sediment Control Plan (108180-15-ESC) provided in **Appendix D**.

- 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 should conduct daily visits during construction to ensure that the contractor is working in accord 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.
 - Straw bale barriers are to be installed in drainage ditches that will remain open as part of Phase 1 development.
 - Filter cloth is to be placed above the grates of all catch basins and structures within the construction area.
 - 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.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The servicing design generally conforms to the conclusions and recommendations outlined in the Fernbank Master Servicing Study and the Fernbank Environmental Management Plan both of which were approved by Ottawa City Council on June 24, 2009.

The conclusions based on the results of the stormwater management analysis are as follows:

Storm Drainage / Conveyance

- Storm sewers (minor system) have been designed to convey the greater of:
 - The uncontrolled 5-year peak flow, or
 - The controlled 100-year peak flow.
- Inflows to the minor system will be controlled using inlet control devices (ICDs). Where possible, pairs of road catch basins will be interconnected where possible.
- The site has been graded to provide an overland flow route along the road network.
- Overland flows during the 100-year event will not exceed a maximum flow depth of 0.30m within the right-of-way. The product of depth x velocity will be less than 0.6.
- A minimum clearance of 0.30m will be provided between the 100-year hydraulic grade line (HGL) and the designed underside of footing elevations.

Stormwater Management

- Water quality and quantity control for the Fernbank Crossing subdivision will be provided by Fernbank Pond 6 located at the headwaters of the Monahan Drain.
- Pond 6 will control post-development flows to the Monahan Drain to pre-development levels for all storms up to and including the 1:100 year event.
- Pipes connecting rear yard catch basins will be perforated to promote infiltration and reduce the volume of storm runoff to Pond 6.

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



Bryan Orendorff, M.A.Sc., P.Eng.
Water Resources Engineer

Reviewed by



Michael Petepiece, P.Eng.
Project Manager

References

- 1 “Fernbank Community Design Plan, Walker, Nott, Dragicevic Associates Ltd. [June 24, 2009]
- 2 “Fernbank Master Servicing Study”, Novatech Engineering Consultants Ltd. [June 24, 2009]
- 3 “Fernbank Environmental Management Plan”, Novatech Engineering Consultants Ltd. [June 24, 2009]
- 4 “Additional Test Pits East Portion of Brookfield Property, Fernbank Community Design, Ottawa, Ontario” Houle Chevrier Engineering Ltd. [Report No. 08-601, December 2008]
- 5 “Geotechnical Investigation, Fernbank Crossing Residential Subdivision Phase 3 and 4, Ottawa, Ontario” Houle Chevrier Engineering Ltd. [Report No. 14-482, December 2014]
- 6 “Sewer Design Guidelines”, Department of Public Works and Services, City of Ottawa [October 2012]
- 7 “Standard Tender Documents, Material Specifications and Standard Detail Drawings” City of Ottawa, Department of Infrastructure Services and Community Sustainability [March 31, 2009]
- 8 “Fernbank Crossing Stormwater Management Report (Phases 1&2)”, Novatech Engineering Consultants Ltd. [March 9, 2012]

Appendix A
Draft Conditions (SWM)

Stormwater Management

- 97. SW1** The Owner shall provide to the General Manager, Planning and Growth Management any and all stormwater reports that may be required by the City for approval prior to the commencement of any works in any phase of the Plan of Subdivision. Such reports shall be in accordance with any watershed or subwatershed studies, conceptual stormwater reports, City or Provincial standards, specifications and guidelines. The reports shall include, but not be limited to, the provision of erosion and sedimentation control measures, implementation or phasing requirements of interim or permanent measures, and all stormwater monitoring and testing requirements. All reports shall be to the satisfaction of the General Manager, Planning and Growth Management. **OTTAWA Planning and CA**
- 98. SW2** (a) Prior to the commencement of construction of any phase of this Subdivision (roads, utilities, any off site work, etc.) the Owner shall:
- i. have a Stormwater Management Plan and an Erosion and Sediment Control Plan prepared by a Professional Engineer in accordance with Current Best Management Practices,
 - ii. have said plans approved by the General Manager, Planning and Growth Management, and
 - iii. provide certification to the General Manager, Planning and Growth Management through a Professional Engineer that the plans has been implemented.
- (b) Any changes made to the Plan shall be submitted to the satisfaction to the City of Ottawa and the Conservation Authority.
- (c) The Owner shall implement an inspection and monitoring plan to maintain erosion control measures.
- 99. SW3** On completion of all stormwater works, the Owner shall provide certification to the General Manager, Planning and Growth Management through a Professional Engineer that all measures have been implemented in conformity with the approved Stormwater Site Management Plan. **OTTAWA Planning**
- 100. SW4** Prior to the registration, or the making of an application for a Ministry of Environment Certificate of Approval for any stormwater works, whichever event first occurs, the Owner shall prepare a Stormwater Site Management Plan in accordance with a Conceptual Stormwater Site Management Plan (specified by title of plan, date). The Stormwater Site Management Plan shall identify the sequence of its implementation in relation to the construction of the subdivision and shall be to the satisfaction of the General Manager, Planning and Growth Management and the (Specify) Conservation Authority. **OTTAWA Planning and CA**

- 101. SW5** The Owner shall maintain the stormwater management pond in accordance with the recommendations of the Stormwater Management Plan and to the satisfaction of the General Manager, Planning and Growth Management until such time as the stormwater management pond has been given Final Acceptance and assumed by the City of Ottawa. **OTTAWA Planning**
- 102. SW6** The Owner shall design and construct, as part of the stormwater management infrastructure, at no cost to the City, a monitoring facility or facilities and vehicular access to the satisfaction of the General Manager, Planning and Growth Management. **OTTAWA Planning**
- 103. SW7** The Owner agrees that the development of the Subdivision shall be undertaken in such a manner as to prevent any adverse effects, and to protect, enhance or restore any of the existing or natural environment, through the preparation of any storm water management reports, as required by the City. All reports are to be approved by the General Manager, Planning and Growth Management prior to the commencement of any Works. **OTTAWA Planning**
- 104. SW8** The Owner covenants and agrees that the following clause shall be incorporated into all agreements of purchase and sale for the whole or any part of a lot or block on the Plan of Subdivision, and registered separately against the title: **OTTAWA Legal**
- “The Owner acknowledges that some of the rear yards within this subdivision are used for on-site storage of infrequent storm events. Pool installation and/or grading alterations on some of the lots may not be permitted and/or revisions to the approved Subdivision Stormwater Management Plan Report may be required to study the possibility of pool installation on any individual lot. The Owner must obtain approval of the General Manager, Planning and Growth Management of the City of Ottawa prior to undertaking any grading alterations.”
- 105.** The Owner shall acknowledge and agree in the subdivision agreement that the agricultural tile drains encountered during construction shall be decommissioned/removed in accordance with the direction provided in the Fernbank Community Design Plan Environmental Management Plan, as approved by Council June 24, 2009. **OTTAWA Planning**

106. The Owner acknowledges and agrees that prior to early servicing and prior to final approval and registration, a detailed stormwater site management plan in accordance with the Fernbank Community Design Plan, Master Servicing Study and Environmental Management Plan, as approved by Council June 24, 2009 shall be prepared and accepted by the City of Ottawa and Rideau Valley Conservation Authority. The final design shall satisfy the requirements for the receiving stream flow quantity and quality as they relate to natural channel design and the protection of fish habitat and maintenance of the existing hydrological characteristics. The final design shall also account for upstream drainage, including areas serviced by agricultural tiles drains in accordance with the Fernbank Community Design Plan, Master Servicing Study and Environmental Management Plan, as approved by Council June 24, 2009
- OTTAWA
Planning**
107. Prior to early servicing and final approval and registration, the Owner shall provide an implementation/staging plan that clearly describes the coordination between the construction of the Pond 6 stormwater management facility and its outlet, related stormwater infrastructure and the undertaking of modifications and improvement works to the Monahan Drain as described in Section 11.9, 11.9.1 & 11.9.2 of the Fernbank Community Design Plan Environmental Management Plan, as approved by Council June 24, 2009.
- OTTAWA
Planning**
108. The Owner acknowledges and agrees that the proposed stormwater Pond identified as Pond 6 and the outlet to the downstream Monahan Drain shall require an application and approval under Ontario Regulation 174/06 under Section 28 of the Conservation Authorities Act "Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation" prior to undertaking said works. Any applications received in this regard would be assessed within the context of approved policies for the administration of the regulation, including those for the protection of fish habitat.
- OTTAWA
Planning
RVCA**
109. The Owner acknowledges and agrees that the design and construction of the stormwater management facility identified as Pond 6 requires the concurrence and coordination with the adjacent landowner to the west. The Owner shall provide the General Manager, Planning and Growth Management written verification from the abutting owner that there is an agreement with respect to design and construction of Pond 6.
- OTTAWA
Planning**

- 110.** Prior to early servicing and final approval and registration, a report documenting the process for undertaking the construction of the stormwater management facility identified as Pond 6 in coordination with the adjacent landowner to the west shall be prepared to the satisfaction of the Rideau Valley Conservation Authority and the City of Ottawa. **OTTAWA
Planning
RVCA**
- 111.** The Owner acknowledges and agrees that the stormwater management facility identified as Pond 6 is constructed and operational prior to the commissioning of the stormsewers within the plan of subdivision. **OTTAWA
Planning**

Appendix B

SWM Calculations & Design Sheets

Typical Storm Sewer Design Sheet
Fixed Tc Storm Sewer Design Sheet
Catch basin Inlet Curves
Typical Lot Impervious Calculations
Water Balance Calculations

Fernbank Crossing (Phase 3)- Storm Sewer Design Sheet (Traditional Rational Method)

LOCATION			AREA											FLOW					PROPOSED SEWER										
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (ha)	Weighted Runoff Coefficient	Indivi 2.78 AR	Accum 2.78 AR	Time of Concentration	Rain Intensity (mm/hr)		Peak Flow (L/s)	Total Peak Flow (Q) (L/s)	Pipe Type	Size (mm)	Grade (%)	Length (m)	Capacity (l/s)	Full Flow Velocity (m/s)	Time of Flow (min.)	Q/Qfull (%)
																		5yr	10yr										
South Outlet																													
643	389	387							0.46				0.46	0.65	0.83	0.83	10.00	104.2		86.6	86.6	PVC	450	0.19	123.5	129.6	0.79	2.61	66.8%
633, 632, 739, 730	387A	387		2.92						0.20		0.10	3.22	0.78	6.97	6.97	10.00	104.2		725.9	725.9	CONC	900	0.20	41.5	844.6	1.29	0.54	85.9%
642	387	385							0.43				0.43	0.65	0.78	8.57	12.61	92.2		790.5	790.5	CONC	900	0.20	51.8	844.6	1.29	0.67	93.6%
	385	383											0.00	0.00	0.00	8.57	13.28	89.6		768.0	768.0	CONC	900	0.20	10.9	844.6	1.29	0.14	90.9%
634	383	419										0.14	0.14	0.60	0.23	8.81	13.42	89.0		784.3	784.3	CONC	900	0.25	9.3	944.3	1.44	0.11	83.1%
641	419	381										0.39	0.39	0.70	0.76	9.57	13.53	88.6		848.1	848.1	CONC	900	0.25	66.9	944.3	1.44	0.78	89.8%
666	359	381							0.35				0.35	0.65	0.63	0.63	10.00	104.2		65.9	65.9	PVC	375	0.25	93.3	91.5	0.80	1.94	72.1%
639	381	379										0.13	0.13	0.60	0.22	10.42	14.30	85.9		894.6	894.6	CONC	975	0.24	25.9	1145.4	1.49	0.29	78.1%
627	379A	379		1.01									1.01	0.80	2.25	2.25	10.00	104.2		234.0	234.0	CONC	600	0.25	7.5	320.3	1.10	0.11	73.1%
667	379	377										0.35	0.35	0.70	0.68	13.34	14.59	84.9		1132.9	1132.9	CONC	1050	0.25	55.3	1424.4	1.59	0.58	79.5%
625, 638, 630	423	377										0.17	0.18	0.35	0.63	0.63	15.17	83.0		52.4	52.4	PVC	300	1.00	40.0	100.9	1.38	0.48	51.9%
673	377	375										0.28	0.28	0.70	0.54	14.52	15.65	81.5		1183.4	1183.4	CONC	1200	0.17	80.1	1677.0	1.44	0.93	70.6%
674, 629	375	373										0.30	0.16	0.46	0.85	15.37	16.58	78.8		1210.7	1210.7	CONC	1200	0.18	110.5	1725.6	1.48	1.25	70.2%
624	373A	373		1.18									1.18	0.80	2.62	2.62	10.00	104.2		273.4	273.4	CONC	600	0.25	7.5	320.3	1.10	0.11	85.4%
723, 628	373	363										0.31	0.06	0.37	0.70	18.70	17.83	75.4		1410.0	1410.0	CONC	1350	0.20	58.9	2490.2	1.69	0.58	56.6%
108	363	361							0.21				0.21	0.65	0.38	6.14	18.96	72.6		445.8	445.8	CONC	1350	1.74	78.6	7344.9	4.97	0.26	23.5%
109a	361	341							0.33				0.33	0.65	0.60	6.73	19.22	72.0		485.0	485.0	CONC	1350	1.74	81.1	7344.9	4.97	0.27	23.8%
708	309	417							0.25				0.25	0.65	0.45	0.45	10.00	104.2		47.1	47.1	PVC	300	0.65	47.6	81.3	1.11	0.71	57.9%
700, 699, 663	421	357							0.18	0.61			0.79	0.57	1.26	1.26	10.00	104.2		131.1	131.1	PVC	450	0.35	42.8	176.0	1.07	0.67	74.5%
664	359	357							0.45				0.45	0.65	0.81	0.81	10.00	104.2		84.7	84.7	PVC	375	0.50	99.9	129.3	1.13	1.47	65.5%
704, 668	357	417							0.22	0.50			0.72	0.58	1.16	3.23	11.47	97.0		313.7	313.7	CONC	525	2.39	81.2	693.6	3.10	0.44	45.2%
	417	351											0.00	0.00	0.00	3.68	11.90	95.1		350.5	350.5	CONC	675	0.60	32.8	679.3	1.84	0.30	51.6%



Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION			AREA											FLOW								PROPOSED SEWER												
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (10 min)	Total Area (15 min)	Weighted Runoff Coefficient (10 min)	Weighted Runoff Coefficient (15 min)	2.78 AR (10 min)	2.78 AR (15 min)	Rain Intensity (mm/hr)				Peak Flow (10 min) (L/s)	Peak Flow (15 min) (L/s)	Total Peak Flow (Q) (L/s)	Pipe Type	Size (mm)	Grade (%)	Length (m)	Capacity (l/s)	Full Flow Velocity (m/s)	Time of Flow (min.)	Q/Qfull (%)	
																			5yr		10yr													
South Outlet			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60																						
107	FUT	363		5.15					3.90	1.36			9.05	1.36	0.74	0.55	18.50	2.08	104.19	83.56			1927.66	173.75	2101.4	CONC	1350	0.20	58.8	2490.2	1.69	0.58	84.4%	
105	391	363		0.82	5.18				0.22				0.22	0.00	0.65	0.00	0.40	0.00	104.19	83.56			41.42	0.00	1847.2	CONC	1050	0.50	120.4	2014.4	2.25	0.89	91.7%	
101	371	369							0.42	0.09			0.42	0.09	0.65	0.55	0.76	0.14	104.19	83.56			79.08	11.50	90.6	PVC	375	0.65	53.5	147.5	1.29	0.69	61.4%	
	369	367											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	90.6	CONC	450	0.20	50.9	133.0	0.81	1.05	68.1%	
102	367	365							0.35	0.18			0.35	0.18	0.65	0.55	0.63	0.28	104.19	83.56			65.90	23.00	179.5	CONC	600	0.15	59.8	248.1	0.85	1.17	72.3%	
103	365A	365		1.39									1.39	0.00	0.80	0.00	3.09	0.00	104.19	83.56			322.10	0.00	322.1	CONC	600	0.30	8.7	350.8	1.20	0.12	91.8%	
104	365	363							0.18	0.08			0.18	0.08	0.65	0.55	0.33	0.12	104.19	83.56			33.89	10.22	545.7	CONC	825	0.15	66.1	580.0	1.05	1.05	94.1%	
108	363	361							0.20				0.20	0.00	0.65	0.00	0.36	0.00	104.19	83.56			37.66	0.00	4531.9	CONC	1350	1.74	78.6	7344.9	4.97	0.26	61.7%	
109	361	341							0.34	0.36			0.34	0.36	0.65	0.55	0.61	0.55	104.19	83.56			64.01	45.99	4641.9	CONC	1350	1.74	81.1	7344.9	4.97	0.27	63.2%	
111	FUT	341							3.23	1.67			3.23	1.67	0.65	0.55	5.84	2.55	104.19	83.56			608.13	213.36	821.5	CONC	825	1.88	86.2	2053.3	3.72	0.39	40.0%	
110	341A	341				2.12							2.12	0.00	0.60	0.00	3.54	0.00	104.19	83.56			368.44	0.00	368.4	CONC	675	0.25	12.5	438.5	1.19	0.18	84.0%	
112	341	339							0.18				0.18	0.00	0.65	0.00	0.33	0.00	104.19	83.56			33.89	0.00	5865.8	CONC	1650	0.40	67.8	6013.7	2.72	0.41	97.5%	
113	339	337							0.11				0.11	0.00	0.65	0.00	0.20	0.00	104.19	83.56			20.71	0.00	5886.5	CONC	1800	0.25	45.2	5995.9	2.28	0.33	98.2%	
114	337	335							0.29				0.29	0.00	0.65	0.00	0.52	0.00	104.19	83.56			54.60	0.00	5941.1	CONC	1800	0.25	50.8	5995.9	2.28	0.37	99.1%	
115	335A	335				2.83							2.83	0.00	0.60	0.00	4.72	0.00	104.19	83.56			491.84	0.00	491.8	CONC	750	0.25	17.9	580.7	1.27	0.23	84.7%	
116	335	301							0.21				0.21	0.00	0.65	0.00	0.38	0.00	104.19	83.56			39.54	0.00	6472.4	CONC	1800	0.30	57.7	6568.2	2.50	0.38	98.5%	
117	FUT	301					1.20		5.13	1.57			5.13	2.77	0.65	0.49	9.27	3.73	104.19	83.56			965.86	312.08	1277.9	CONC	975	0.61	54.7	1826.0	2.37	0.38	70.0%	
118	301	M97									0.30		0.30	0.00	0.70	0.00	0.58	0.00	104.19	83.56			60.83	0.00	7811.2	CONC	1950	0.30	78.3	8131.0	2.64	0.49	96.1%	
119	M97	M98								0.94	0.40		0.40	0.94	0.70	0.55	0.78	1.44	104.19	83.56			81.10	120.09	8012.4	CONC	2100	0.20	78.0	8089.5	2.26	0.57	99.0%	
	M98	M99											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	8012.4	CONC	2400	0.15	29.6	10002.3	2.14	0.23	80.1%	

Q = 2.78 AIR WHERE : Q = PEAK FLOW IN LITRES PER SECOND (L/s) A = AREA IN HECTARES (ha) I = RAINFALL INTENSITY IN MILLIMETERS PER HOUR (mm/hr) R = WEIGHTED RUNOFF COEFFICIENT

Q = (1/n) A R(2/3)S²(1/2) WHERE : Q = CAPACITY (L/s) n = MANNING COEFFICIENT OF ROUGHNESS (0.013) A = FLOW AREA (m²)

Project: Fernbank Crossing (108180-10) Designed: KJM Checked: MAB Date: August 17, 2012

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.



Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION			AREA											FLOW						Total Peak Flow (Q) (L/s)	PROPOSED SEWER																	
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (10 min)	Total Area (15 min)	Weighted Runoff Coefficient (10 min)	Weighted Runoff Coefficient (15 min)	2.78 AR (10 min)	2.78 AR (15 min)	Rain Intensity (mm/hr)				Peak Flow (10 min) (L/s)	Peak Flow (15 min) (L/s)	Pipe Type	Size (mm)	Grade (%)	Length (m)	Capacity (l/s)	Full Flow Velocity (m/s)	Time of Flow (min.)	Q/Qfull (%)						
																			5yr		10yr	10 min											15 min					
North Outlet			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60								10.00	15.00	10.00	15.00															
CRT	CRT	287						2.91					0.00	13.95		0.38	0.00	14.54	104.2	83.6	10.00	15.00	0.0	1215.2														
1	287	285		0.34	3.11								0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56	122.1	97.85	0.0	0.0														
		285											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56	122.14	97.85	1042.77	0.00														
2	283	281		1.11									1.11	0.00	0.80	0.00	2.47	0.00	104.19	83.56	122.14	97.85	257.22	0.00														
3	281	275	2.00										2.00	0.00	0.80	0.00	4.45	0.00	104.19	83.56	122.14	97.85	463.45	0.00														
4	279	277									0.20		0.20	0.00	0.70	0.00	0.39	0.00	104.19	83.56	122.14	97.85	40.55	0.00														
5	277	275									0.14		0.14	0.00	0.70	0.00	0.27	0.00	104.19	83.56	122.14	97.85	28.39	0.00														
6	275	273									0.35		0.35	0.00	0.70	0.00	0.68	0.00	104.19	83.56	122.14	97.85	70.97	0.00														
7	273	271									0.36		0.36	0.00	0.70	0.00	0.70	0.00	104.19	83.56	122.14	97.85	72.99	0.00														
8	271A	271		0.85									0.85	0.00	0.80	0.00	1.89	0.00	104.19	83.56	122.14	97.85	196.97	0.00														
9,10	271	M40									0.50		0.50	0.00	0.70	0.00	0.97	0.00	104.19	83.56	122.14	97.85	101.38	0.00														
11	269A	M40						2.91					0.00	2.91	0.00	0.20	0.00	1.62	104.19	83.56	122.14	97.85	0.00	135.19														
13	267	265							0.30				0.30	0.00	0.65	0.00	0.54	0.00	104.19	83.56	122.14	97.85	56.48	0.00														
14	265	M41							0.78	0.40			0.78	0.40	0.65	0.55	1.41	0.61	104.19	83.56	122.14	97.85	146.86	51.10														
16	261	259									0.15		0.00	0.15	0.00	0.55	0.00	0.23	104.19	83.56	122.14	97.85	0.00	19.16														
		259											0.00	0.00	0.00	0.90	0.00	0.00	104.19	83.56	122.14	97.85	0.00	0.00														
17	257	253							0.79				0.79	0.00	0.65	0.00	1.43	0.00	104.19	83.56	122.14	97.85	148.74	0.00														
18	255	253							0.19	0.15			0.19	0.15	0.65	0.55	0.34	0.23	104.19	83.56	122.14	97.85	35.77	19.16														
19	253	251							0.21	0.38			0.21	0.38	0.65	0.55	0.38	0.58	104.19	83.56	122.14	97.85	39.54	48.55														
20	251	M42							0.61				0.61	0.00	0.65	0.00	1.10	0.00	104.19	83.56	122.14	97.85	114.85	0.00														

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.



Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION			AREA												FLOW								Total Peak Flow (Q) (L/s)	PROPOSED SEWER									
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (10 min)	Total Area (15 min)	Weighted Runoff Coefficient (10 min)	Weighted Runoff Coefficient (15 min)	2.78 AR (10 min)	2.78 AR (15 min)	Rain Intensity (mm/hr)					Peak Flow (10 min) (L/s)	Peak Flow (15 min) (L/s)	Pipe Type	Size (mm)	Grade (%)	Length (m)	Capacity (l/s)	Full Flow Velocity (m/s)	Time of Flow (min.)	Q/Qfull (%)
																			5yr		10yr												
21	245	243	0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60	0.00	0.32	0.00	0.55	0.00	0.49	104.19	83.56	122.14	97.85	0.00	40.88	40.9	PVC	250	0.65	66.9	50.0	0.99	1.13	81.7%
	243	241											0.35	0.00	0.65	0.00	0.63	0.00	104.19	83.56	122.14	97.85	65.90	0.00	106.8	PVC	375	0.65	12.9	147.5	1.29	0.17	72.4%
22	241	M44							0.30	0.30			0.30	0.30	0.65	0.55	0.54	0.46	104.19	83.56	122.14	97.85	56.48	38.33	201.6	CONC	450	1.00	67.3	297.4	1.81	0.62	67.8%
24	233A	233	3.32										3.32	0.00	0.80	0.00	7.38	0.00	104.19	83.56	122.14	97.85	769.33	0.00	769.3	CONC	825	0.45	8.5	1004.6	1.82	0.08	76.6%
25	233	231									0.35		0.35	0.00	0.70	0.00	0.68	0.00	104.19	83.56	122.14	97.85	70.97	0.00	840.3	CONC	825	0.45	114.0	1004.6	1.82	1.04	83.6%
26	231	229									0.24		0.24	0.00	0.70	0.00	0.47	0.00	104.19	83.56	122.14	97.85	48.66	0.00	889.0	CONC	825	0.50	82.0	1058.9	1.92	0.71	84.0%
27	237A	237	1.58										1.58	0.00	0.80	0.00	3.51	0.00	104.19	83.56	122.14	97.85	366.13	0.00	366.1	CONC	600	0.50	9.0	452.9	1.55	0.10	80.8%
28	237	235									0.15		0.15	0.00	0.70	0.00	0.29	0.00	104.19	83.56	122.14	97.85	30.41	0.00	396.5	CONC	600	1.40	49.0	757.9	2.60	0.31	52.3%
29	235	229							0.37				0.37	0.00	0.65	0.00	0.67	0.00	104.19	83.56	122.14	97.85	69.66	0.00	466.2	CONC	600	1.85	88.1	871.3	2.99	0.49	53.5%
30	229	227							0.57				0.57	0.00	0.65	0.00	1.03	0.00	104.19	83.56	122.14	97.85	107.32	0.00	1462.5	CONC	975	0.50	117.4	1653.2	2.15	0.91	88.5%
31	227	M45							0.73	0.47			0.73	0.47	0.65	0.55	1.32	0.72	104.19	83.56	122.14	97.85	137.44	60.05	1660.0	CONC	975	0.65	120.0	1884.9	2.45	0.82	88.1%
	223	221											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56	122.14	97.85	0.00	0.00	0.0	PVC	250	0.65	57.1	50.0	0.99	0.96	0.0%
	221	219											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56	122.14	97.85	0.00	0.00	0.0	PVC	250	0.65	8.6	50.0	0.99	0.15	0.0%
33	219	217							0.41	0.50			0.41	0.50	0.65	0.55	0.74	0.76	104.19	83.56	122.14	97.85	77.19	63.88	141.1	PVC	375	1.00	76.8	182.9	1.60	0.80	77.1%
34	217	213							0.48				0.48	0.00	0.65	0.00	0.87	0.00	104.19	83.56	122.14	97.85	90.37	0.00	231.4	CONC	450	1.00	71.7	297.4	1.81	0.66	77.8%
35	215	213							0.41				0.00	0.41	0.00	0.55	0.00	0.63	104.19	83.56	122.14	97.85	0.00	52.38	52.4	PVC	300	0.65	42.6	81.3	1.11	0.64	64.4%
36	213	211							0.25	0.14			0.25	0.14	0.65	0.55	0.45	0.21	104.19	83.56	122.14	97.85	47.07	17.89	348.8	CONC	600	0.50	64.9	452.9	1.55	0.70	77.0%
37	211	209							0.25	0.30			0.25	0.30	0.65	0.55	0.45	0.46	104.19	83.56	122.14	97.85	47.07	38.33	434.2	CONC	675	0.30	78.4	480.3	1.30	1.00	90.4%
	209	207											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56	122.14	97.85	0.00	0.00	434.2	CONC	675	0.30	8.7	480.3	1.30	0.11	90.4%
38	207	205							0.41	0.21			0.41	0.21	0.65	0.55	0.74	0.32	104.19	83.56	122.14	97.85	77.19	26.83	538.2	CONC	675	0.45	65.8	588.3	1.59	0.69	91.5%
	205	203											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56	122.14	97.85	0.00	0.00	538.2	CONC	675	0.45	6.0	588.3	1.59	0.06	91.5%
	203	M46							0.21				0.21	0.00	0.65	0.00	0.38	0.00	104.19	83.56	122.14	97.85	39.54	0.00	577.7	CONC	750	0.25	66.3	580.7	1.27	0.87	99.5%

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.

Fernbank Crossing - Storm Sewer Design Sheet (Fixed Tc)

LOCATION			AREA												FLOW						Total Peak Flow (Q) (L/s)	PROPOSED SEWER													
Location	From node	To node	Mixed Use	Park N' Ride Paramedic Post Medium Block	Arterial Road ROW	Schools	Parks	Hydro Corridor	Singles Front Yards	Singles Rear Yard	Towns Front Yard	Towns Rear Yard	Total Area (10 min)	Total Area (15 min)	Weighted Runoff Coefficient (10 min)	Weighted Runoff Coefficient (15 min)	2.78 AR (10 min)	2.78 AR (15 min)	Rain Intensity (mm/hr)				Peak Flow (10 min) (L/s)	Peak Flow (15 min) (L/s)	Pipe Type	Size (mm)	Grade (%)	Length (m)	Capacity (l/s)	Full Flow Velocity (m/s)	Time of Flow (min.)	Q/Qfull (%)			
																			5yr			10yr													
South Outlet			0.80	0.80	0.90	0.60	0.40	0.20	0.65	0.55	0.70	0.60																							
107	FUT	363		5.15					3.90	1.36			9.05	1.36	0.74	0.55	18.50	2.08	104.19	83.56			1927.66	173.75	2101.4	CONC	1350	0.20	58.8	2490.2	1.69	0.58	84.4%		
105	391	363		0.82	5.18				0.22				0.22	0.00	0.65	0.00	0.40	0.00	104.19	83.56			41.42	0.00	1847.2	CONC	1050	0.50	120.4	2014.4	2.25	0.89	91.7%		
101	371	369							0.42	0.09			0.42	0.09	0.65	0.55	0.76	0.14	104.19	83.56			79.08	11.50	90.6	PVC	375	0.65	53.5	147.5	1.29	0.69	61.4%		
	369	367											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	90.6	CONC	450	0.20	50.9	133.0	0.81	1.05	68.1%		
102	367	365							0.35	0.18			0.35	0.18	0.65	0.55	0.63	0.28	104.19	83.56			65.90	23.00	179.5	CONC	600	0.15	59.8	248.1	0.85	1.17	72.3%		
103	365A	365		1.39									1.39	0.00	0.80	0.00	3.09	0.00	104.19	83.56			322.10	0.00	322.1	CONC	600	0.30	8.7	350.8	1.20	0.12	91.8%		
104	365	363							0.18	0.08			0.18	0.08	0.65	0.55	0.33	0.12	104.19	83.56			33.89	10.22	545.7	CONC	825	0.15	66.1	580.0	1.05	1.05	94.1%		
108	363	361							0.20				0.20	0.00	0.65	0.00	0.36	0.00	104.19	83.56			37.66	0.00	4531.9	CONC	1350	1.74	78.6	7344.9	4.97	0.26	61.7%		
109	361	341							0.34	0.36			0.34	0.36	0.65	0.55	0.61	0.55	104.19	83.56			64.01	45.99	4641.9	CONC	1350	1.74	81.1	7344.9	4.97	0.27	63.2%		
111	FUT	341							3.23	1.67			3.23	1.67	0.65	0.55	5.84	2.55	104.19	83.56			608.13	213.36	821.5	CONC	825	1.88	86.2	2053.3	3.72	0.39	40.0%		
110	341A	341				2.12							2.12	0.00	0.60	0.00	3.54	0.00	104.19	83.56			368.44	0.00	368.4	CONC	675	0.25	12.5	438.5	1.19	0.18	84.0%		
112	341	339							0.18				0.18	0.00	0.65	0.00	0.33	0.00	104.19	83.56			33.89	0.00	5865.8	CONC	1650	0.40	67.8	6013.7	2.72	0.41	97.5%		
113	339	337							0.11				0.11	0.00	0.65	0.00	0.20	0.00	104.19	83.56			20.71	0.00	5886.5	CONC	1800	0.25	45.2	5995.9	2.28	0.33	98.2%		
114	337	335							0.29				0.29	0.00	0.65	0.00	0.52	0.00	104.19	83.56			54.60	0.00	5941.1	CONC	1800	0.25	50.8	5995.9	2.28	0.37	99.1%		
115	335A	335				2.83							2.83	0.00	0.60	0.00	4.72	0.00	104.19	83.56			491.84	0.00	491.8	CONC	750	0.25	17.9	580.7	1.27	0.23	84.7%		
116	335	301							0.21				0.21	0.00	0.65	0.00	0.38	0.00	104.19	83.56			39.54	0.00	6472.4	CONC	1800	0.30	57.7	6568.2	2.50	0.38	98.5%		
117	FUT	301							5.13	1.57			5.13	2.77	0.65	0.49	9.27	3.73	104.19	83.56			965.86	312.08	1277.9	CONC	975	0.61	54.7	1826.0	2.37	0.38	70.0%		
118	301	M97									0.30		0.30	0.00	0.70	0.00	0.58	0.00	104.19	83.56			60.83	0.00	7811.2	CONC	1950	0.30	78.3	8131.0	2.64	0.49	96.1%		
119	M97	M98									0.94	0.40	0.40	0.94	0.70	0.55	0.78	1.44	104.19	83.56			81.10	120.09	8012.4	CONC	2100	0.20	78.0	8089.5	2.26	0.57	99.0%		
	M98	M99											0.00	0.00	0.00	0.00	0.00	0.00	104.19	83.56			0.00	0.00	8012.4	CONC	2400	0.15	29.6	10002.3	2.14	0.23	80.1%		

Q = 2.78 AIR WHERE : Q = PEAK FLOW IN LITRES PER SECOND (L/s) A = AREA IN HECTARES (ha) I = RAINFALL INTENSITY IN MILLIMETERS PER HOUR (mm/hr) R = WEIGHTED RUNOFF COEFFICIENT

Q = (1/n) A R(2/3)So(1/2) WHERE : Q = CAPACITY (L/s) n = MANNING COEFFICIENT OF ROUGHNESS (0.013) A = FLOW AREA (m2)

Project: Fernbank Crossing (108180-10) Designed: KJM Checked: MAB Date: August 17, 2012

This design sheet is included in support of the downstream boundary conditions for the SSA modelling.

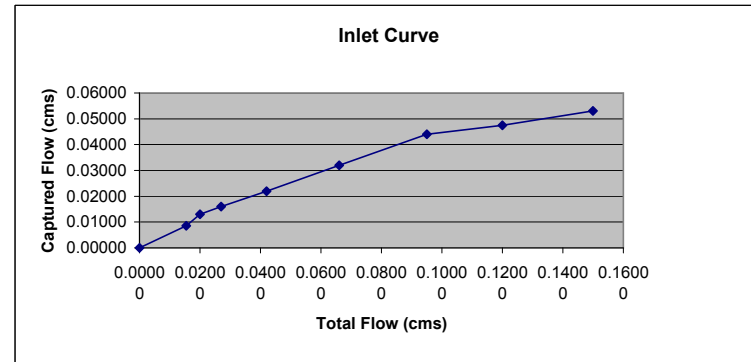


**Fernbank Crossings
Inlet Curves**

**Mountable Curb with Gutter
Gutter Grade= 0.008**

Sx= 0.03		
T m	Qg m ³ /s	Qc m ³ /s
0.00	0	0
0.50	0.0155	0.0085
0.75	0.02	0.013
1.00	0.027	0.016
1.50	0.042	0.022
2.00	0.066	0.032
2.50	0.095	0.044
2.70	0.12	0.0475
3.00	0.15	0.053

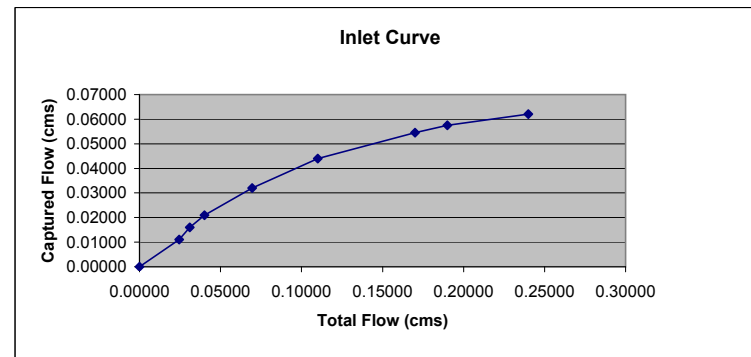
Q Captured	Q Bypass	=	QTOTAL Total
0.00000	0.00000	=	0.00000
0.00850	0.00700	=	0.01550
0.01300	0.00700	=	0.02000
0.01600	0.01100	=	0.02700
0.02200	0.02000	=	0.04200
0.03200	0.03400	=	0.06600
0.04400	0.05100	=	0.09500
0.04750	0.07250	=	0.12000
0.05300	0.09700	=	0.15000



**Barrier Curb with Gutter
Gutter Grade= 0.03**

Sx= 0.03		
T m	Qg m ³ /s	Qc m ³ /s
0.00	0	0
0.50	0.0245	0.011
0.75	0.031	0.016
1.00	0.04	0.021
1.50	0.0695	0.032
2.00	0.11	0.044
2.50	0.17	0.0545
2.70	0.19	0.0575
3.00	0.24	0.062

QIDi Captured	QIDii Bypass	=	QTOTAL Total
0.00000	0.00000	=	0.00000
0.01100	0.01350	=	0.02450
0.01600	0.01500	=	0.03100
0.02100	0.01900	=	0.04000
0.03200	0.03750	=	0.06950
0.04400	0.06600	=	0.11000
0.05450	0.11550	=	0.17000
0.05750	0.13250	=	0.19000
0.06200	0.17800	=	0.24000

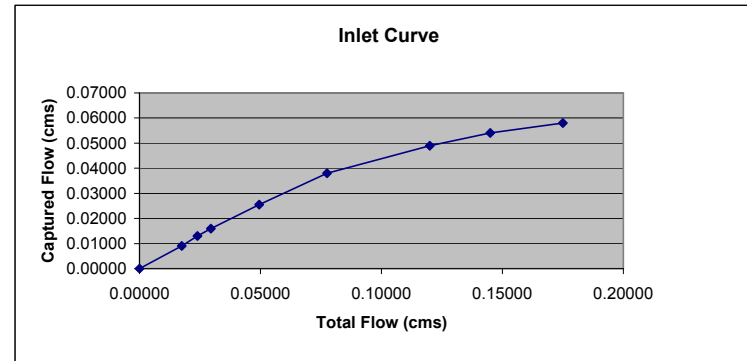


**Fernbank Crossings
Inlet Curves**

**Barrier Curb with Gutter
Gutter Grade= 0.015**

Sx= 0.03		
T m	Qg m ³ /s	Qc m ³ /s
0.00	0	0
0.50	0.0175	0.009
0.75	0.024	0.013
1.00	0.0295	0.016
1.50	0.0495	0.0255
2.00	0.0775	0.038
2.50	0.12	0.049
2.70	0.145	0.054
3.00	0.175	0.058

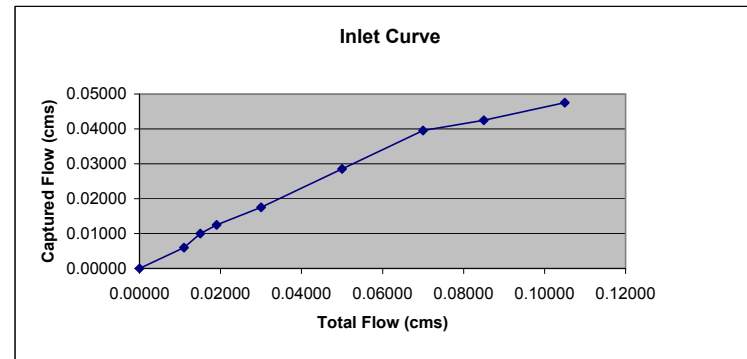
	QIDi Captured	QIDii Bypass	=	QTOTAL Total	
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[0.01300	0.01100	=	0.02400]
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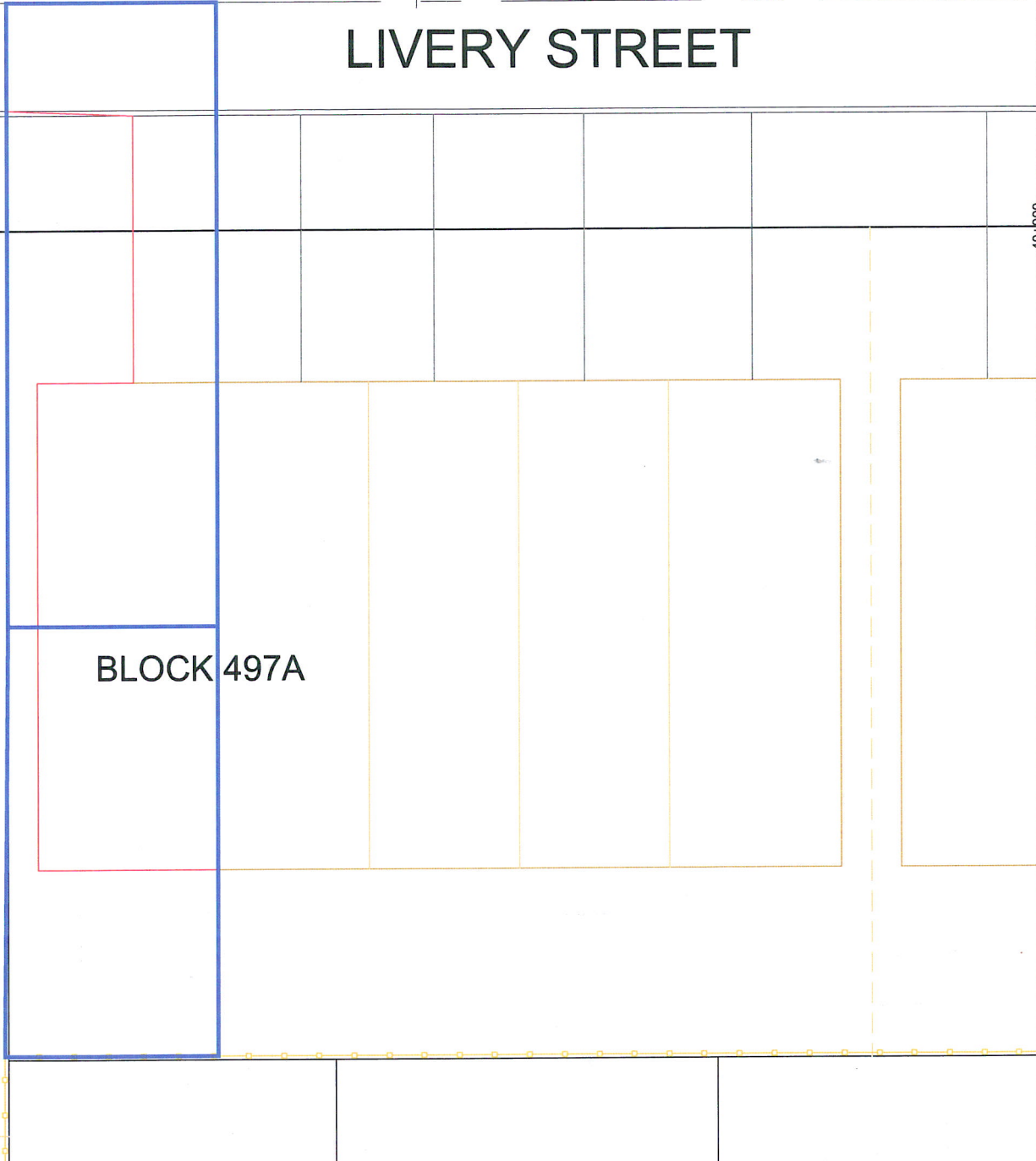
**Barrier Curb with Gutter
Gutter Grade= 0.0065**

Sx= 0.03		
T m	Qg m ³ /s	Qc m ³ /s
0.00	0	0
0.50	0.011	0.006
0.75	0.015	0.01
1.00	0.019	0.0125
1.50	0.03	0.0175
2.00	0.05	0.0285
2.50	0.07	0.0395
2.70	0.085	0.0425
3.00	0.105	0.0475

	QIDi Captured	QIDii Bypass	=	QTOTAL Total	
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[0.04750	0.05750	=	0.10500]



LIVERY STREET



BLOCK 497A

FRONTYARD AREA = 207.151 m²
 AREA OF IMPERVIOUSNESS = 141.718 m²
 TOTAL IMPERVIOUSNESS = 68.4 %

REARYARD AREA = 144.070 m²
 AREA OF IMPERVIOUSNESS = 69.418 m²
 TOTAL IMPERVIOUSNESS = 48.2 %



**ENGINEERING
CONSULTANTS LTD.**
ENGINEERS & PLANNERS

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

Telephone (613) 254-9643
 Facsimile (613) 254-5867
 Email: novainfo@novatech-eng.com

FERNBANK LANDS

EXAMPLE LOT 1 - TOWNS

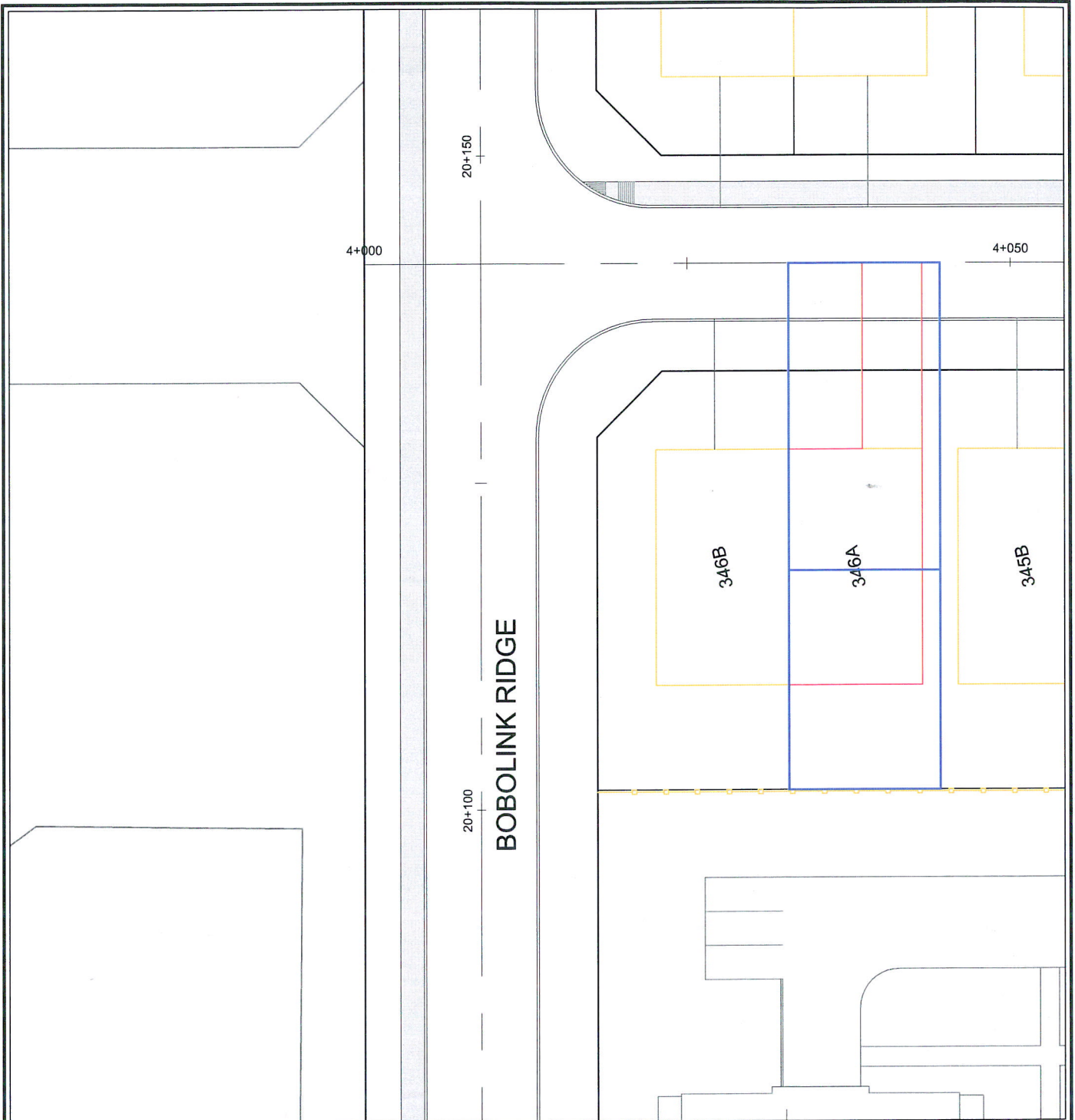
JULY 2012

108180

TOWN 1

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REARYARD AREA = 196.103 m²
 AREA OF IMPERVIOUSNESS = 90.238 m²
 TOTAL IMPERVIOUSNESS = 46.0 %

FRONTYARD AREA = 274.822 m²
 AREA OF IMPERVIOUSNESS = 160.712 m²
 TOTAL IMPERVIOUSNESS = 58.5 %

NOVATECH

ENGINEERING CONSULTANTS LTD.

ENGINEERS & PLANNERS

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

Telephone (613) 254-9643
 Facsimile (613) 254-5867
 Email: novainfo@novatech-eng.com

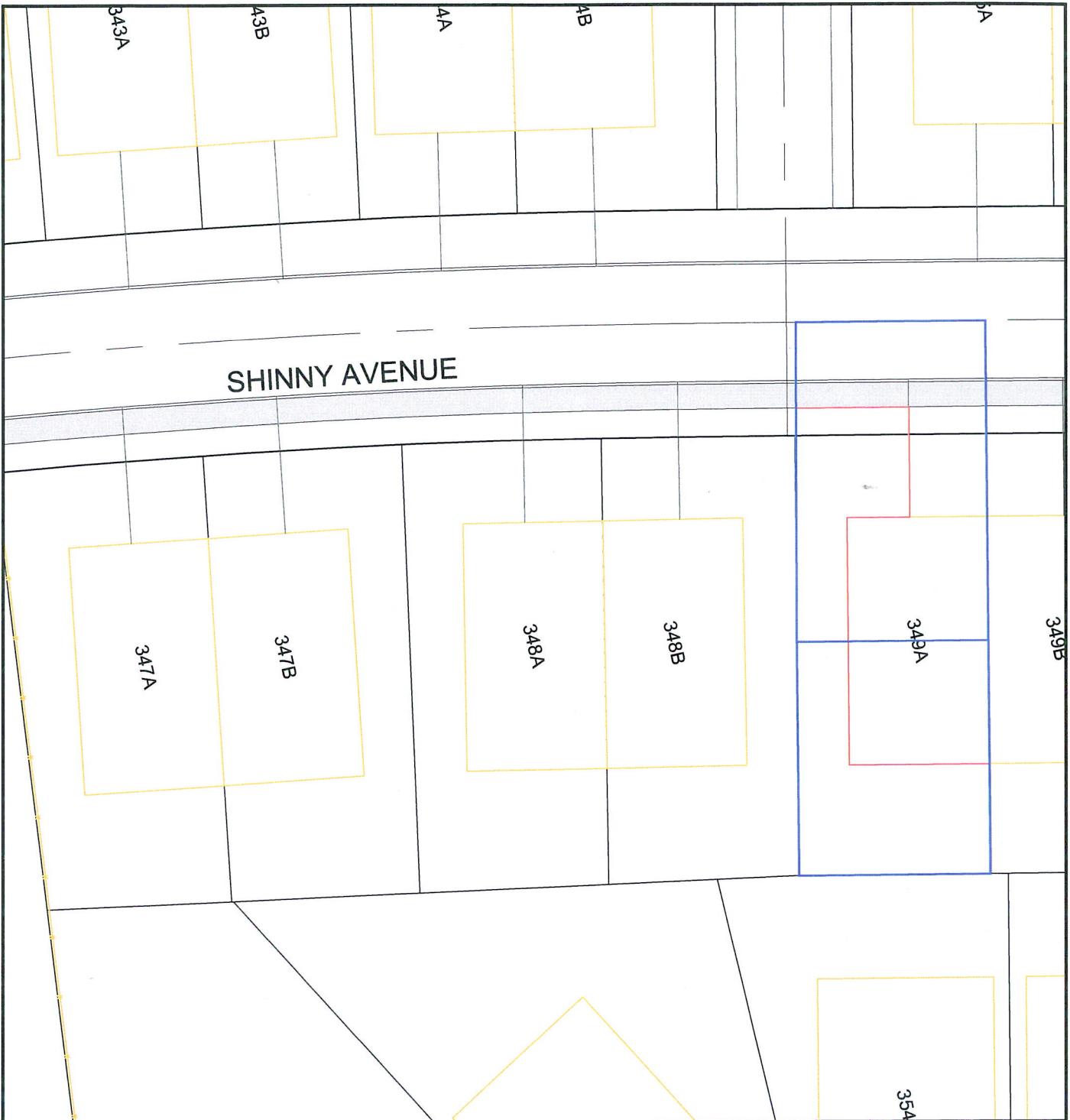
FERNBANK LANDS

EXAMPLE LOT 2 - TOWNS

JULY 2012

108180

TOWN 2



REARYARD AREA = 238.850m²
 AREA OF IMPERVIOUSNESS = 92.700 m²
 TOTAL IMPERVIOUSNESS = 38.8 %

FRONTYARD AREA = 325.1 m²
 AREA OF IMPERVIOUSNESS = 225.272 m²
 TOTAL IMPERVIOUSNESS = 69.3 %



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ENGINEERS & PLANNERS

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

Telephone (613) 254-9643
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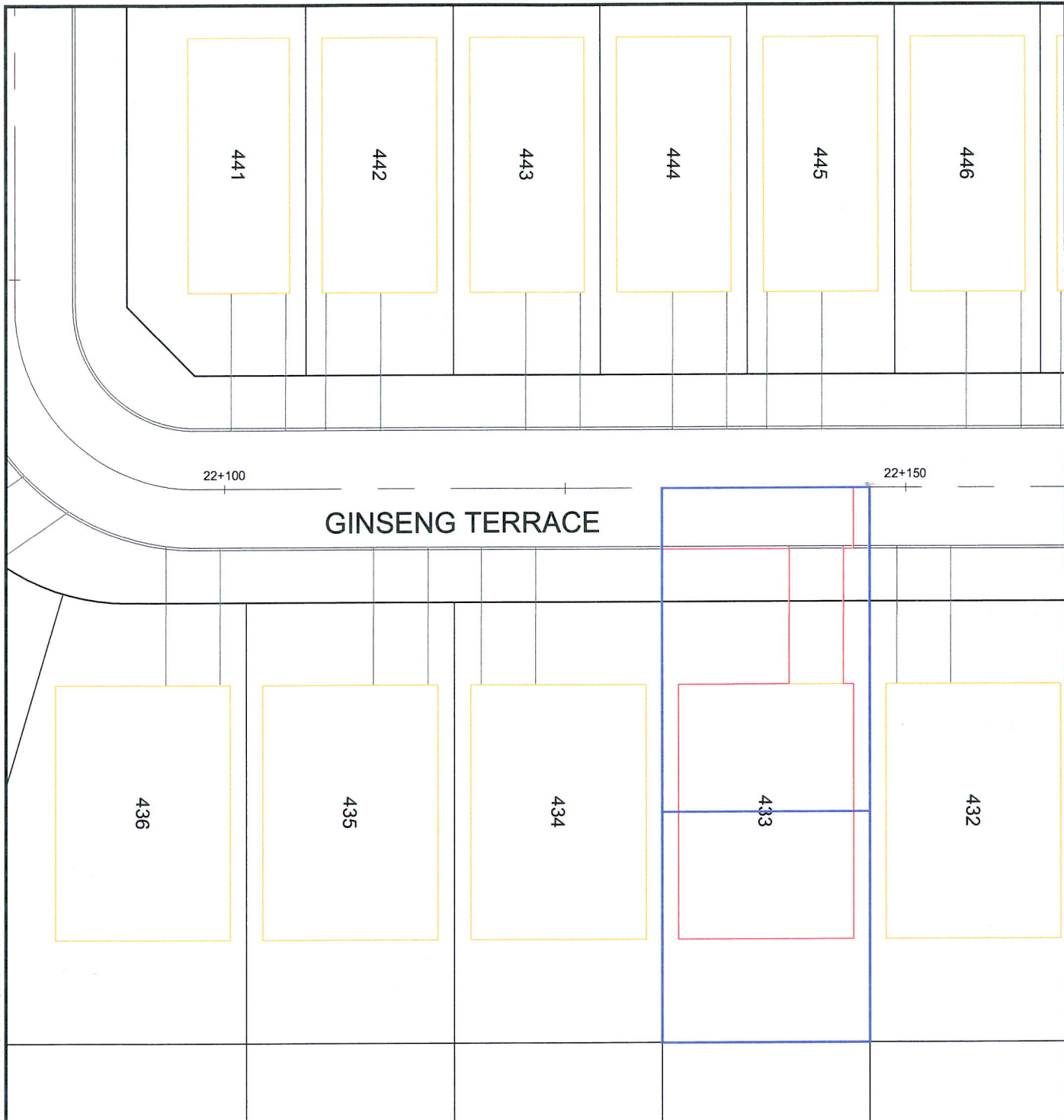
EXAMPLE LOT 3 - TOWNS

JULY 2012

108180

TOWN 3

M:\2008\108180\CAD\design\SWM\108180-AVG-TMP.dwg, Towns3, Jul 05, 2012 - 3:08pm, rlanglois



REARYARD AREA = 255.437 m²
 AREA OF IMPERVIOUSNESS = 118.863 m²
 TOTAL IMPERVIOUSNESS = 46.6 %

FRONTYARD AREA = 358.375 m²
 AREA OF IMPERVIOUSNESS = 220.602 m²
 TOTAL IMPERVIOUSNESS = 61.6 %



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Telephone (613) 254-9643
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FERNBANK LANDS

EXAMPLE LOT- SINGLE

JULY 2012

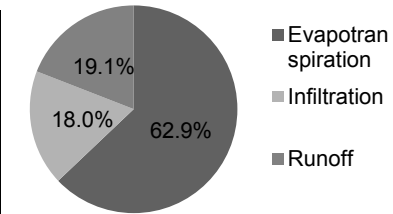
108180

SINGLE

M:\2008\108180\CAD\design\SWM\108180-VG-TIMP.dwg, Single, Jul 05, 2012 - 3:08pm, rianglois

Water Balance Calculations: Stittsville South (Area 6) - Faulkner Drain Upstream Flewellyn Road

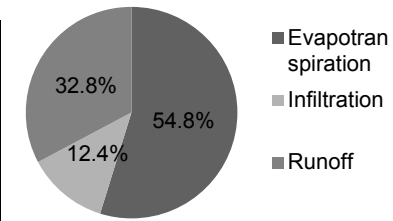
Pre-Development			Infiltration Factor Classification			
Landuse	% of Watershed	Water Holding Capacity (HSG "C")	Land Cover	Soils (Varied)	Topography (Rolling Land)	Infiltration Factor
Mature Forest	10.0%	400 mm	0.20	0.20	0.20	0.49
Pasture/Meadow	85.0%	250 mm	0.10	0.20	0.20	
Urban Lawns	0.0%	125 mm	0.10	0.20	0.20	Runoff Factor
Imp. Areas	5.0%	0 mm	0.00	0.00	0.00	0.52
Average		253 mm	0.11	0.19	0.19	



Total Precipitation (mm)
Potential Evapotranspiration (mm)
 Total Precip. - Potential ET (mm)
 Soil Moisture Storage (mm)
 Change in Soil Moisture Storage (mm)
 Deficit (mm)
Actual Evapotranspiration (mm)
Water Surplus (mm)
Annual Infiltration (mm)
Annual Runoff (mm)

Ottawa CDA (6105976)													
1971-2000													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
P	64	52	65	68	81	91	89	88	87	79	77	74	914
PE	0	0	0	0	112	129	140	115	72	43	0	0	610
P-PE	64	52	65	68	-31	-38	-51	-27	15	36	77	74	
ST	253	253	253	253	224	192	157	141	156	192	253	253	
ΔST	0	0	0	0	-29	-31	-35	-16	15	36	61	0	
D	0	0	0	0	2	7	16	11	0	0	0	0	35
AE	0	0	0	0	110	122	124	104	72	43	0	0	575
S	64	52	65	68	0	0	0	0	0	0	16	74	339
I													164
R													175

Post-Development			Infiltration Factor Classification			
Landuse	% of Watershed	Water Holding Capacity (HSG "B")	Land Cover	Soils (Varied)	Topography (Rolling Land)	Infiltration Factor
Mature Forest	0.0%	400 mm	0.20	0.20	0.20	0.28
Pasture/Meadow	0.0%	250 mm	0.10	0.20	0.20	
Urban Lawns	50.0%	75 mm	0.10	0.25	0.20	Runoff Factor
Imp. Areas	50.0%	0 mm	0.00	0.00	0.00	0.73
Average		38 mm	0.05	0.13	0.10	



Total Precipitation (mm)
Potential Evapotranspiration (mm)
 Total Precip. - Potential Evap. (mm)
 Soil Moisture Storage (mm)
 Change in Soil Moisture Storage (mm)
 Deficit (mm)
Actual Evapotranspiration (mm)
Water Surplus (mm)
Annual Infiltration (mm)
Annual Runoff (mm)

Ottawa CDA (6105976)													
1971-2000													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
P	64	52	65	68	81	91	89	88	87	79	77	74	914
PE	0	0	0	0	112	129	140	115	72	43	0	0	610
P-PE	64	52	65	68	-31	-38	-51	-27	15	36	77	74	
ST	38	38	38	38	16	6	1	1	16	38	38	38	
ΔST	0	0	0	0	-21	-11	-4	-1	15	22	0	0	
D	0	0	0	0	10	27	46	26	0	0	0	0	109
AE	0	0	0	0	102	102	93	88	72	43	0	0	501
S	64	52	65	68	0	0	0	0	0	14	77	74	413
I													114
R													300

- Notes:
- 1) Uses measured average monthly total precipitation and potential evaporation data (converted to evapotranspiration based on a cover coefficient of 1.0).
 - 2) Actual evapotranspiration and water surplus calculated using the Thornthwaite & Mather (1957) methodology.
 - 3) Runoff and infiltration calculated as per the MOE SWM Planning and Design Manual (2003) methodology.
 - 4) Impervious areas consist of rooftops, roads, and driveways.

Annual Summary									
Scenario	Precipitation	Evapotranspiration	Water Surplus	Infiltration	Runoff				
Pre-Development	914 mm	575 mm	339 mm	164 mm	175 mm				
Post-Development	914 mm	501 mm	413 mm	114 mm	300 mm				
Difference (Post - Pre)	0 mm	-74 mm	74 mm	-51 mm	125 mm				

Thornthwaite, C.W., and Mather, J.R. 1957. Instructions and tables for computing potential evapotranspiration and the water balance. Centerton, N.J., Laboratory of Climatology, Publications in Climatology, v.10, no.3, p.185-311

Appendix C

Autodesk Storm and Sanitary Analysis Model

Schematics:

Figure C-1: Overall Model Schematic

Figure C-2: Model Schematic 1

Figure C-3: Model Schematic 2

Figure C-4: Model Schematic 3

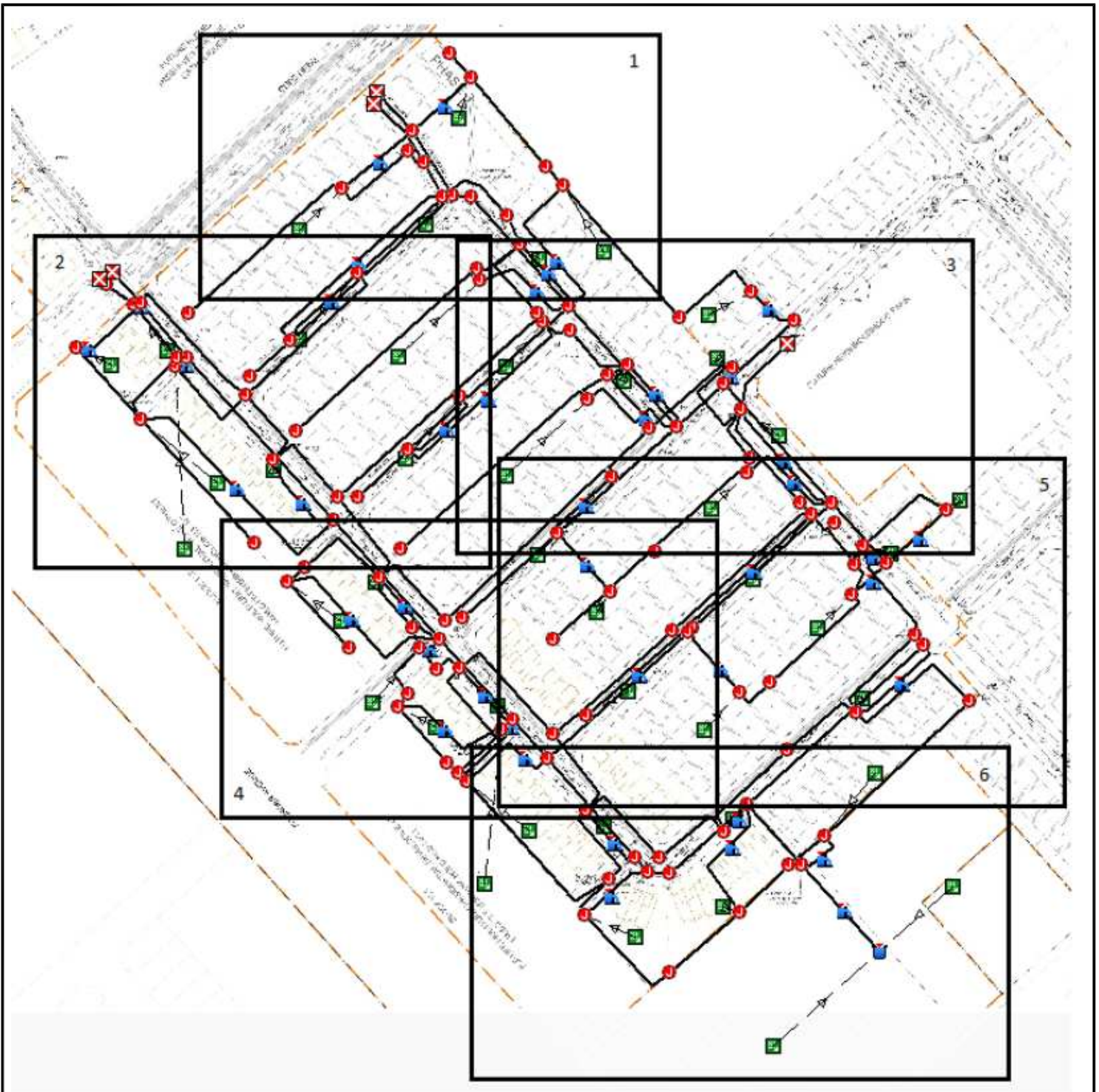
Figure C-5: Model Schematic 4

Figure C-6: Model Schematic 5

Figure C-7: Model Schematic 6

Model Results:

Chicago 100yr-4hr Design Storm Output Results



Engineers, Planners & Landscape Architects
 Suite 200, 240 Michael Cowpland Drive
 Ottawa, Ontario, Canada K2M 1P6

Telephone (613) 254-9643
 Facsimile (613) 254-5867
 Website www.novatech-eng.com

FERNBANK CROSSING PHASE 3

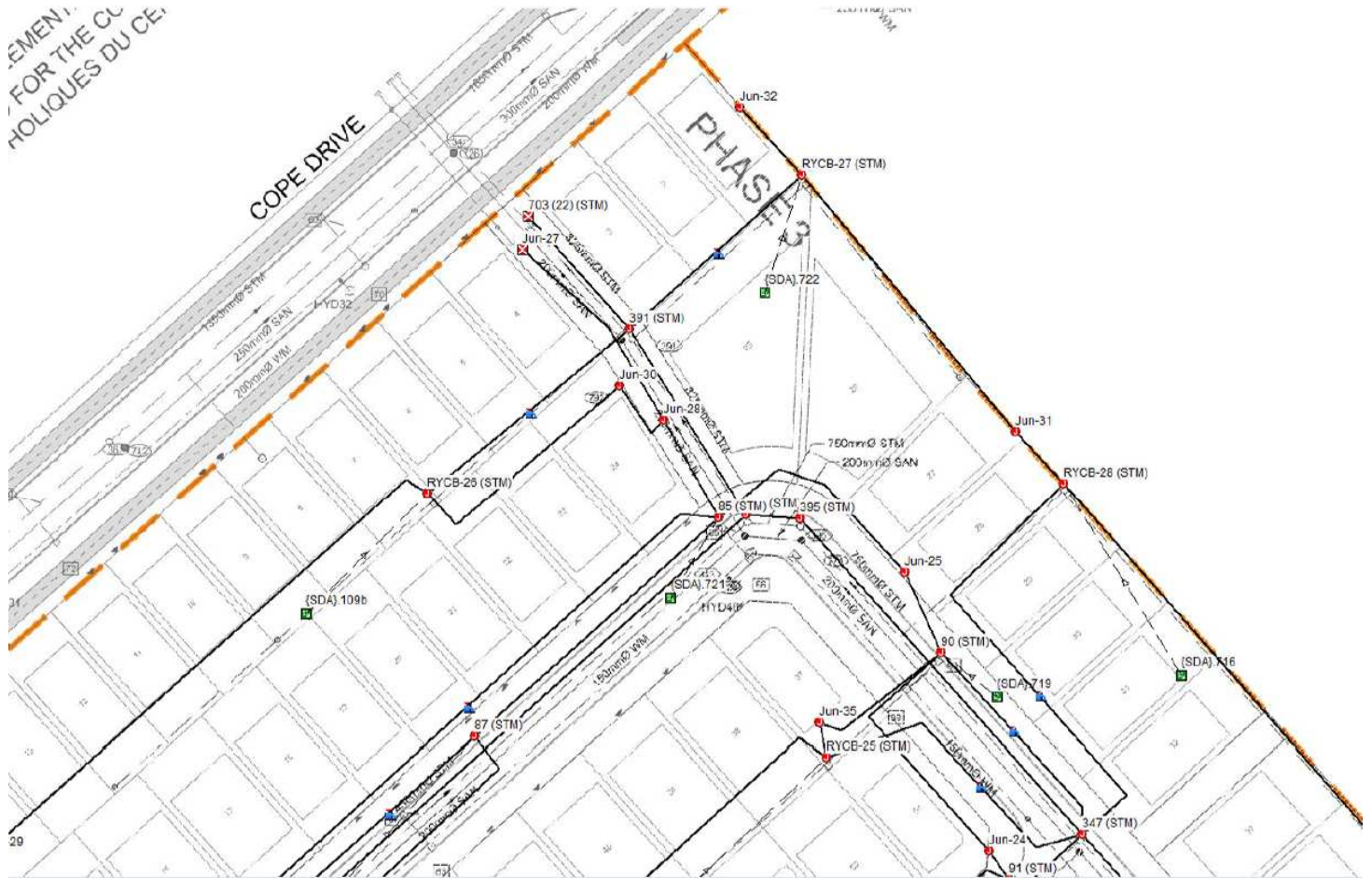
MODEL SCHEMATIC KEY PLAN

DEC 2014

108180

FIGURE C1

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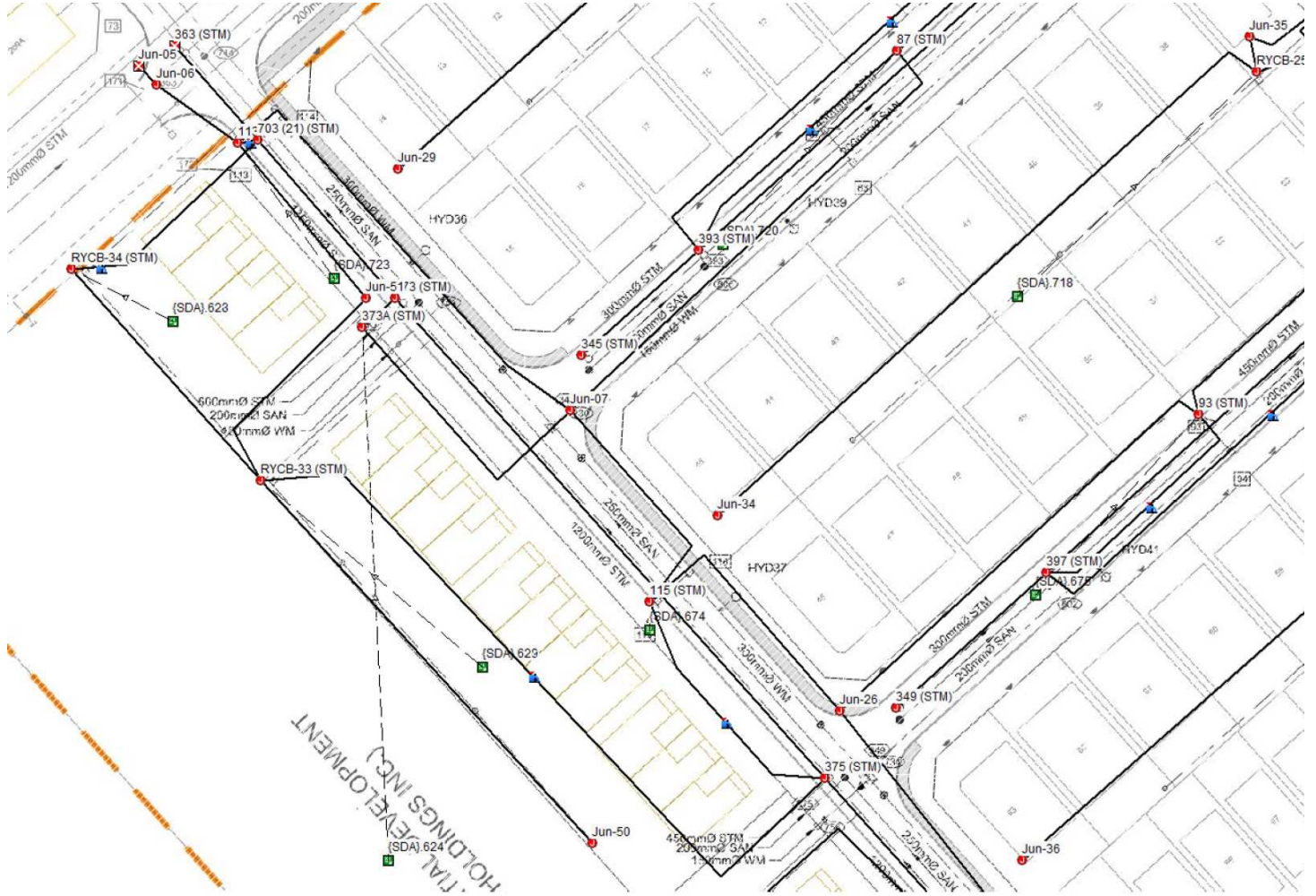
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowpland Drive
Ottawa, Ontario, Canada K2M 1P6

Telephone (613) 254-9643
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FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 1

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Engineers, Planners & Landscape Architects
 Suite 200, 240 Michael Cowpland Drive
 Ottawa, Ontario, Canada K2M 1P6

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 Facsimile (613) 254-5867
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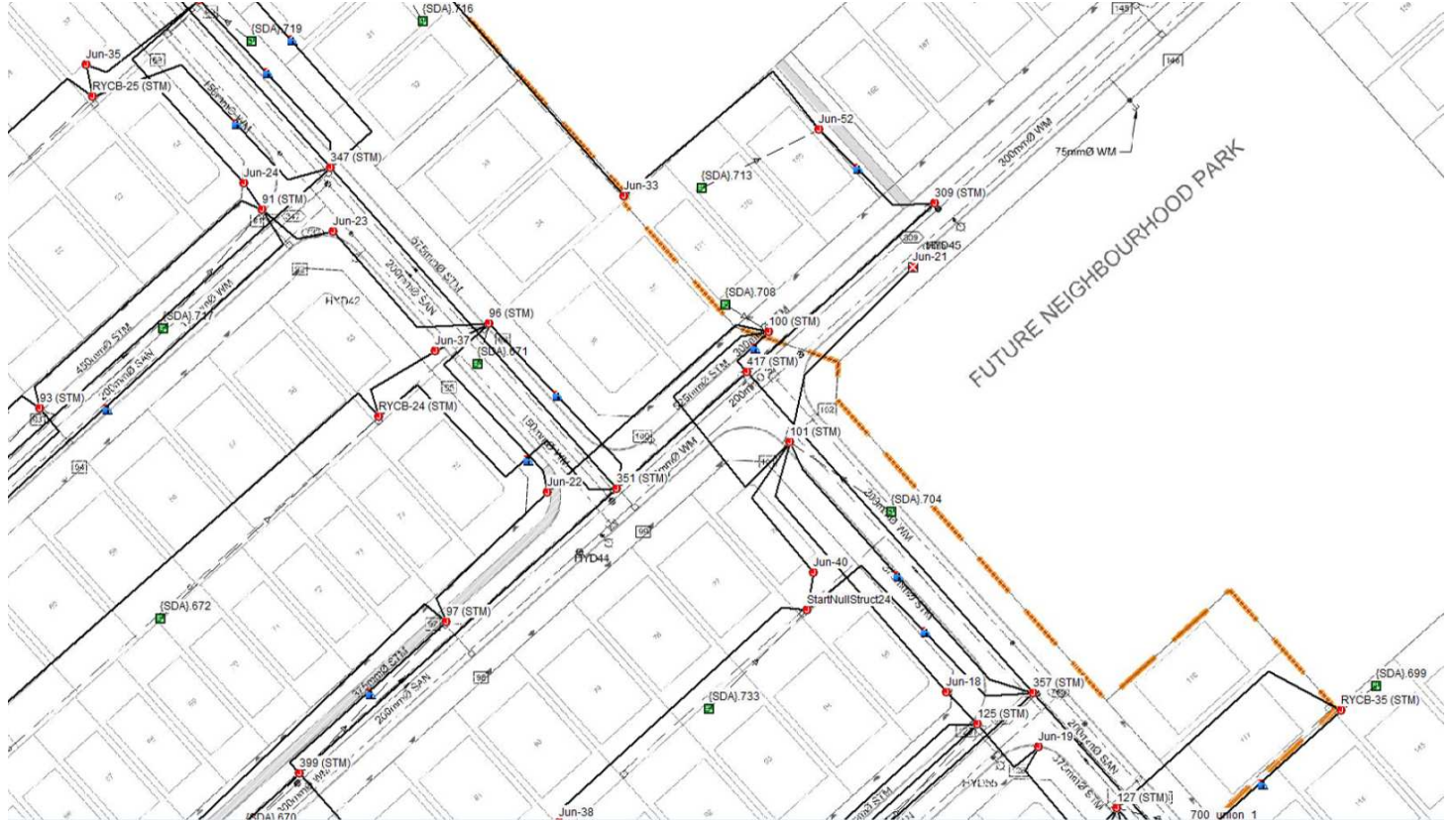
FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 2

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FIGURE C3



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

Telephone (613) 254-9643
Facsimile (613) 254-5867
Website www.novatech-eng.com

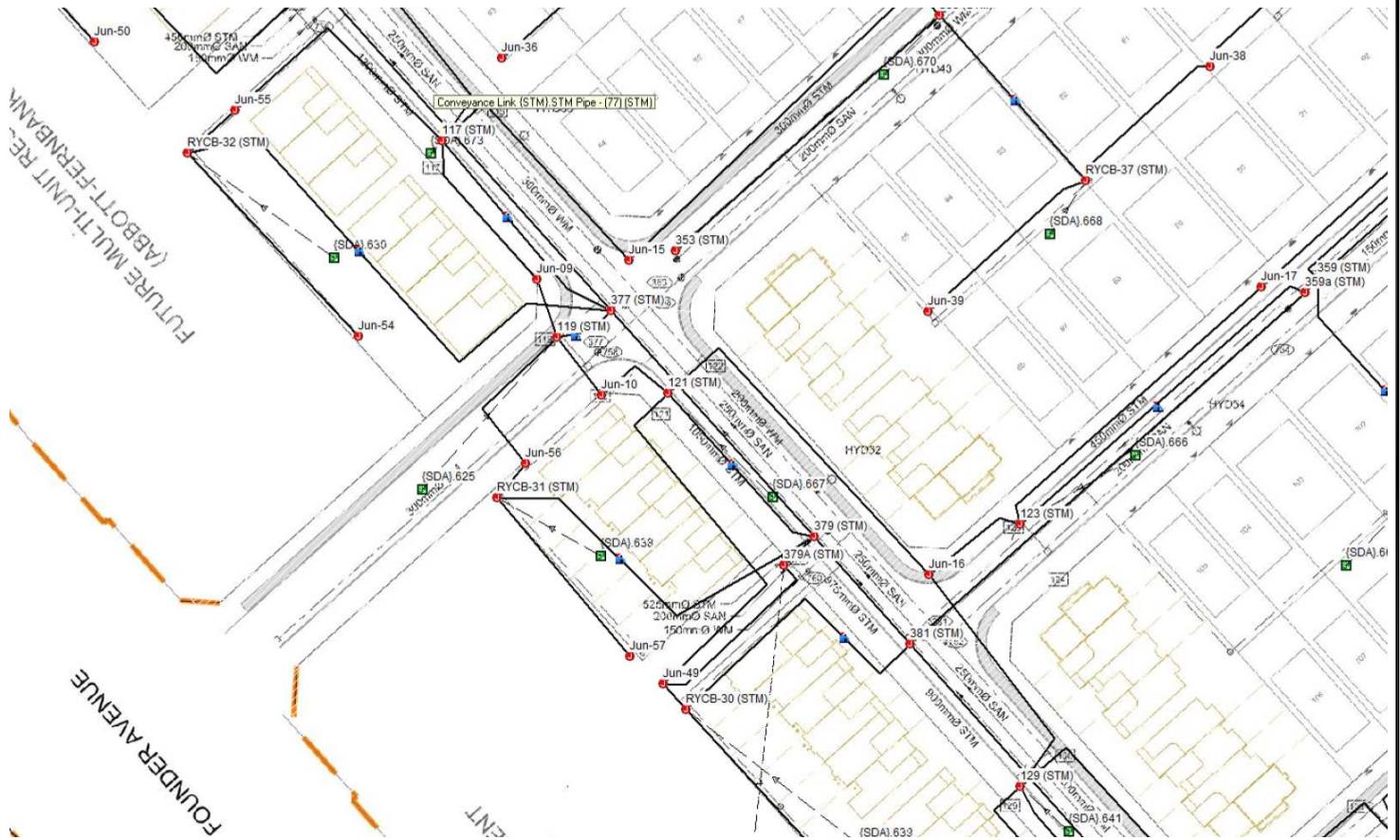
FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 3

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FIGURE C4



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

Telephone (613) 254-9643
 Facsimile (613) 254-5867
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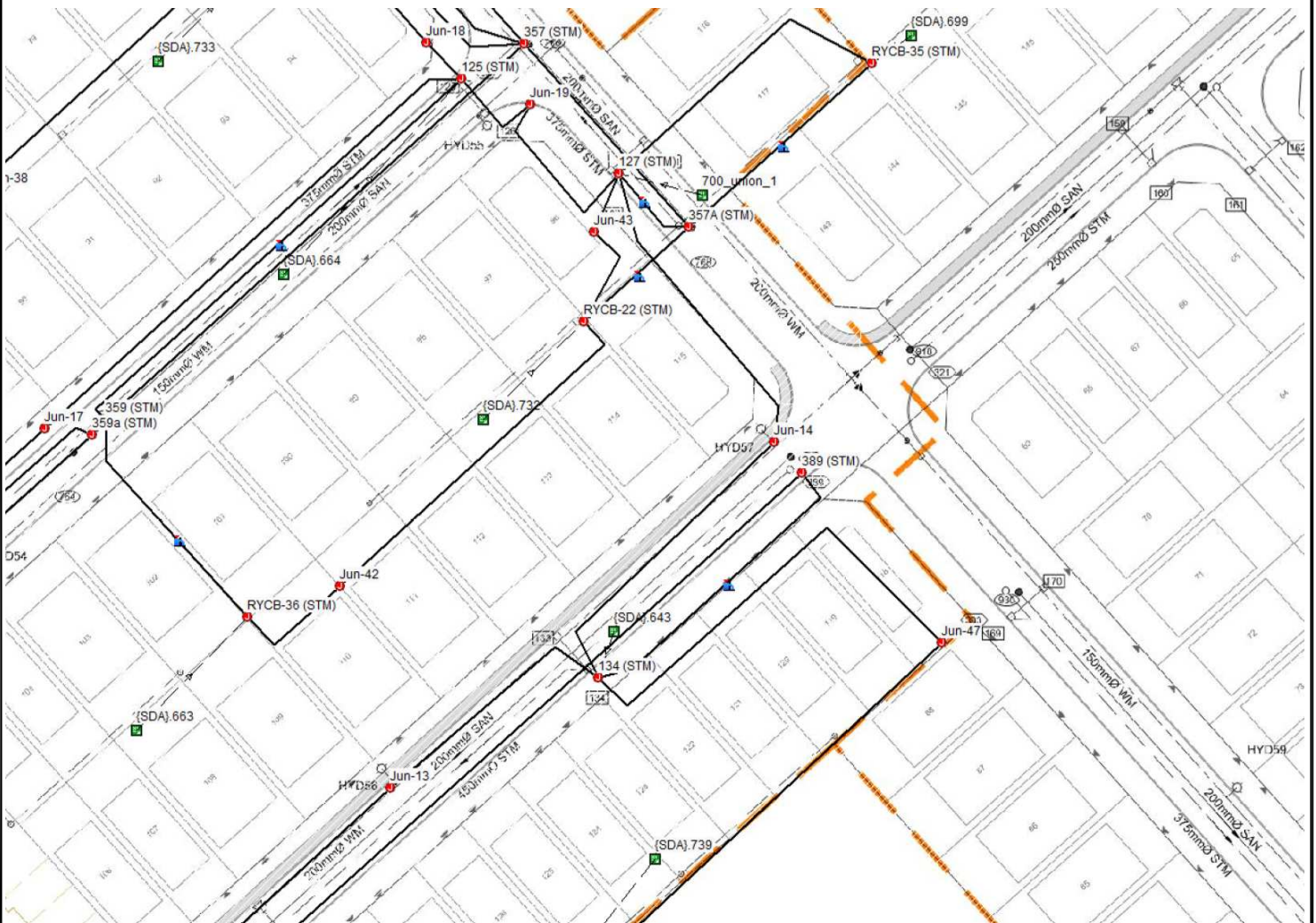
FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 4

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FIGURE C5



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

Telephone (613) 254-9643
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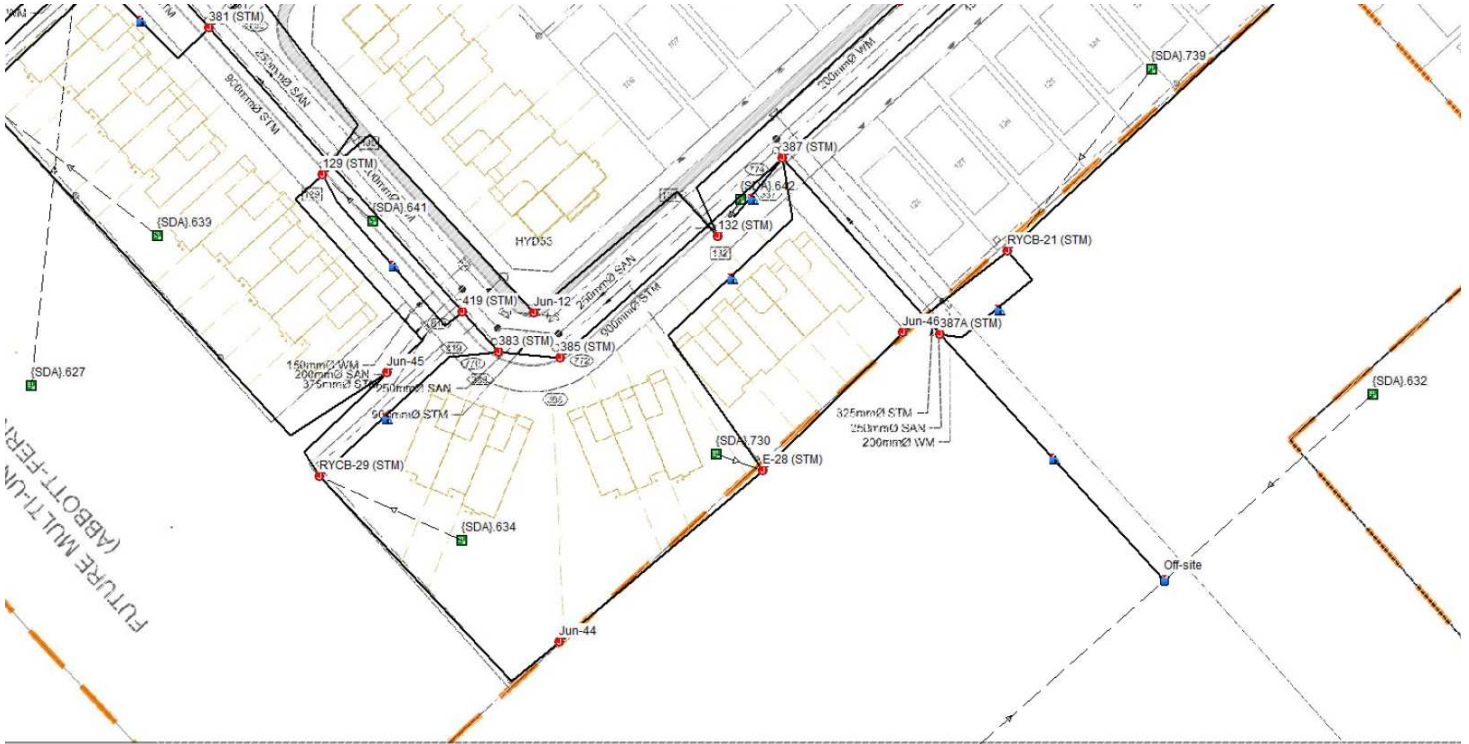
FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 5

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FIGURE C6



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

Telephone (613) 254-9643
 Facsimile (613) 254-5867
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FERNBANK CROSSING PHASE 3

MODEL SCHEMATIC SHEET 6

DEC 2014	108180	FIGURE C7
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100 Year Output Summary.txt

Autodesk® Storm and Sanitary Analysis 2013 - Version 7.1.2186 (Build 1)

Project Description

File Name Phase 3 SSA - 20150708.SPF
Description C:\Users\borendorff.NOVATECH\Desktop\108180-15-STM.dwg

Analysis Options

Flow Units LPS
Subbasin Hydrograph Method. EPA SWMM
Infiltration Method Horton
Link Routing Method Hydrodynamic
Storage Node Exfiltration.. None
Starting Date NOV-25-2014 00:00:00
Ending Date NOV-25-2014 23:59:00
Antecedent Dry Days 0.0
Report Time Step 00:05:00
Wet Time Step 00:05:00
Dry Time Step 01:00:00
Routing Time Step 5.00 sec

Element Count

Number of rain gages 1
Number of subbasins 40
Number of nodes 98
Number of links 133
Number of pollutants 0
Number of land uses 0

Raingage Summary

Gage ID	Data Source	Data Type	Recording Interval	min
Rain Gage-01	C100-4	INTENSITY	10.00	

Subbasin Summary

Subbasin ID	Total Area hectares	Equiv. Width m	Imperv. Area %	Average Slope %	Raingage
{SDA}.109b	0.46	100.00	50.00	0.5000	Rain Gage-01
{SDA}.624	1.18	53.00	86.00	0.5000	Rain Gage-01
{SDA}.625	0.17	18.00	64.00	0.5000	Rain Gage-01
{SDA}.627	1.01	53.00	86.00	0.5000	Rain Gage-01
{SDA}.628	0.06	16.00	50.00	0.5000	Rain Gage-01
{SDA}.629	0.16	40.00	50.00	0.5000	Rain Gage-01
{SDA}.630	0.11	30.00	50.00	0.5000	Rain Gage-01
{SDA}.632	1.08	88.00	86.00	0.5000	Rain Gage-01
{SDA}.633	1.84	120.00	86.00	0.5000	Rain Gage-01
{SDA}.634	0.14	28.00	57.00	0.5000	Rain Gage-01
{SDA}.638	0.07	25.00	57.00	0.5000	Rain Gage-01
{SDA}.639	0.13	40.00	57.00	0.5000	Rain Gage-01
{SDA}.641	0.39	50.00	71.00	0.5000	Rain Gage-01
{SDA}.642	0.42	48.00	64.00	0.5000	Rain Gage-01

100 Year Output Summary.txt

{SDA}.643	0.46	48.00	64.00	0.5000	Rain Gage-01
{SDA}.663	0.51	100.00	50.00	0.5000	Rain Gage-01
{SDA}.664	0.45	48.00	64.00	0.5000	Rain Gage-01
{SDA}.666	0.35	48.00	64.00	0.5000	Rain Gage-01
{SDA}.667	0.35	50.00	71.00	0.5000	Rain Gage-01
{SDA}.668	0.50	100.00	50.00	0.5000	Rain Gage-01
{SDA}.670	0.70	48.00	64.00	0.5000	Rain Gage-01
{SDA}.671	0.22	38.00	64.00	0.5000	Rain Gage-01
{SDA}.672	0.42	100.00	50.00	0.5000	Rain Gage-01
{SDA}.673	0.28	38.00	64.00	0.5000	Rain Gage-01
{SDA}.674	0.30	38.00	64.00	0.5000	Rain Gage-01
{SDA}.675	0.35	48.00	64.00	0.5000	Rain Gage-01
{SDA}.704	0.22	22.00	64.00	0.5000	Rain Gage-01
{SDA}.708	0.15	25.00	64.00	0.5000	Rain Gage-01
{SDA}.713	0.08	40.00	50.00	0.5000	Rain Gage-01
{SDA}.716	0.18	40.00	50.00	0.5000	Rain Gage-01
{SDA}.717	0.31	48.00	64.00	0.5000	Rain Gage-01
{SDA}.718	0.43	100.00	50.00	0.5000	Rain Gage-01
{SDA}.719	0.21	38.00	64.00	0.5000	Rain Gage-01
{SDA}.720	0.35	48.00	64.00	0.5000	Rain Gage-01
{SDA}.721	0.47	48.00	64.00	0.5000	Rain Gage-01
{SDA}.722	0.21	40.00	50.00	0.5000	Rain Gage-01
{SDA}.723	0.31	38.00	64.00	0.5000	Rain Gage-01
{SDA}.730	0.10	25.00	57.00	0.5000	Rain Gage-01
{SDA}.739	0.20	40.00	50.00	0.5000	Rain Gage-01
700_union_1	0.22	25.00	64.00	0.5000	Rain Gage-01

Node Summary

Node ID	Element Type	Invert Elevation m	Maximum Elev. m	Ponded Area m ²	External Inflow
10+053	JUNCTION	103.16	103.46	0.00	
11+001	JUNCTION	104.63	104.93	0.00	
12+001	JUNCTION	104.55	104.85	0.00	
12+185	JUNCTION	103.32	103.62	0.00	
12+228	JUNCTION	103.32	103.62	0.00	
12+254	JUNCTION	103.41	103.71	0.00	
12+309	JUNCTION	103.94	104.24	0.00	
309 (STM)	JUNCTION	100.73	103.86	0.00	
343 (STM)	JUNCTION	98.71	103.09	0.00	
345 (STM)	JUNCTION	101.46	104.26	0.00	
347 (STM)	JUNCTION	99.08	103.46	0.00	
349 (STM)	JUNCTION	100.76	104.47	0.00	
351 (STM)	JUNCTION	99.61	104.05	0.00	
353 (STM)	JUNCTION	101.42	104.86	0.00	
357 (STM)	JUNCTION	101.97	104.65	0.00	
357A (STM)	JUNCTION	102.34	104.86	0.00	
359 (STM)	JUNCTION	102.53	105.24	0.00	
359A (STM)	JUNCTION	102.63	105.24	0.00	
373 (STM)	JUNCTION	100.88	104.40	0.00	
373A (STM)	JUNCTION	101.65	104.85	0.00	
375 (STM)	JUNCTION	101.22	104.76	0.00	
377 (STM)	JUNCTION	101.37	104.98	0.00	
379 (STM)	JUNCTION	101.66	104.99	0.00	
379A (STM)	JUNCTION	102.13	105.60	0.00	
381 (STM)	JUNCTION	101.80	105.14	0.00	
383 (STM)	JUNCTION	102.06	105.23	0.00	
385 (STM)	JUNCTION	102.08	105.26	0.00	
387 (STM)	JUNCTION	102.19	105.17	0.00	
387A (STM)	JUNCTION	102.34	105.19	0.00	
389 (STM)	JUNCTION	102.87	105.46	0.00	
391 (STM)	JUNCTION	98.64	103.19	0.00	
393 (STM)	JUNCTION	101.13	103.91	0.00	
395 (STM)	JUNCTION	98.79	103.18	0.00	
397 (STM)	JUNCTION	100.09	103.94	0.00	
399 (STM)	JUNCTION	100.71	104.22	0.00	

100 Year Output Summary.txt

4+345	JUNCTION	104.49	104.79	0.00
4+420	JUNCTION	104.70	105.00	0.00
4+510	JUNCTION	104.74	105.16	0.00
4+568	JUNCTION	105.00	105.31	0.00
4+665	JUNCTION	105.21	105.51	0.00
4+750	JUNCTION	105.31	105.61	0.00
4+828	JUNCTION	105.41	105.71	0.00
417 (STM)	JUNCTION	99.89	103.87	0.00
419 (STM)	JUNCTION	102.04	105.17	0.00
6+088	JUNCTION	104.43	104.73	0.00
6+102	JUNCTION	104.61	104.91	0.00
7+096	JUNCTION	105.19	105.49	0.00
703 (STM)	JUNCTION	100.80	106.80	0.00
8+128	JUNCTION	104.86	105.16	0.00
8+150	JUNCTION	104.77	105.07	0.00
CB101-102 (STM)	JUNCTION	102.90	103.90	0.00
CB111-112	JUNCTION	103.02	104.12	0.00
CB113-114 (STM)	JUNCTION	102.61	104.42	0.00
CB115-116 (STM)	JUNCTION	102.99	104.61	0.00
CB117-118 (STM)	JUNCTION	103.20	104.78	0.00
CB119-120 (STM)	JUNCTION	103.81	105.04	0.00
CB121-122 (STM)	JUNCTION	103.40	105.25	0.00
CB123-124 (STM)	JUNCTION	103.54	105.12	0.00
CB125-126 (STM)	JUNCTION	102.60	104.74	0.00
CB127-128 (STM)	JUNCTION	103.35	104.83	0.00
CB129-130 (STM)	JUNCTION	103.58	105.30	0.00
CB131-132 (STM)	JUNCTION	103.73	105.50	0.00
CB133-134 (STM)	JUNCTION	103.57	105.37	0.00
CB85-86 (STM)	JUNCTION	101.80	103.60	0.00
CB87-88 (STM)	JUNCTION	101.54	103.86	0.00
CB89-90 (STM)	JUNCTION	102.29	103.44	0.00
CB91-92 (STM)	JUNCTION	102.46	103.45	0.00
CB93-94 (STM)	JUNCTION	101.69	103.89	0.00
CB95-96 (STM)	JUNCTION	102.48	103.57	0.00
CB97-98 (STM)	JUNCTION	102.24	104.04	0.00
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Jun-37	JUNCTION	103.46	103.76	0.00
Jun-40	JUNCTION	104.14	104.44	0.00
Jun-43	JUNCTION	104.87	105.17	0.00
Jun-51	JUNCTION	104.45	104.75	0.00
RYCB-21 (STM)	JUNCTION	102.98	105.60	0.00
RYCB-22 (STM)	JUNCTION	102.99	104.91	0.00
RYCB-23 (STM)	JUNCTION	102.21	104.31	0.00
RYCB-24 (STM)	JUNCTION	101.36	103.45	0.00
RYCB-25 (STM)	JUNCTION	100.85	103.32	0.00
RYCB-27 (STM)	JUNCTION	101.23	103.70	0.00
RYCB-28 (STM)	JUNCTION	101.16	103.75	0.00
RYCB-30 (STM)	JUNCTION	102.52	105.30	0.00
RYCB-31 (STM)	JUNCTION	102.83	105.86	0.00
RYCB-32 (STM)	JUNCTION	102.84	105.00	0.00
RYCB-33 (STM)	JUNCTION	101.90	104.80	0.00
RYCB-34 (STM)	JUNCTION	102.16	105.27	0.00
RYCB-38 (STM)	JUNCTION	103.92	105.65	0.00
RYCB-39 (STM)	JUNCTION	103.68	105.70	0.00
RYCBMH-2 (STM)	JUNCTION	101.60	103.60	0.00
EX341 (STM)	OUTFALL	98.53	99.44	0.00
EX363 (STM)	OUTFALL	100.40	102.13	0.00
MAJ-Easement	OUTFALL	103.00	103.30	0.00
MAJ-Haliburton	OUTFALL	103.73	104.03	0.00
MAJ-Shinny	OUTFALL	104.12	104.43	0.00
MAJ-Slapshot	OUTFALL	105.10	105.50	0.00
off-site	STORAGE	102.36	104.79	0.00

Link Summary

Link Manning's	From Node	To Node	Element	Length	Slope
----------------	-----------	---------	---------	--------	-------

100 Year Output Summary.txt
Type

ID	Roughness	Type	m	%
0.1928	{STM}.STM Pipe - (190) (STM)387A (STM) 0.0130	387 (STM) CONDUIT		41.5
0.8996	{STM}.STM Pipe - (199) (STM)357A (STM) 0.0130	357 (STM) CONDUIT		41.1
2.4755	{STM}.STM Pipe - (390) (STM)357 (STM) 0.0130	417 (STM) CONDUIT		81.2
0.1825	{STM}.STM Pipe - (69) (1) (1) (STM)343 (STM) 0.0130	391 (STM) CONDUIT		38.3
0.4118	{STM}.STM Pipe - (69) (1) (STM)391 (STM) 0.0130	EX341 (STM) CONDUIT		26.7
0.3504	{STM}.STM Pipe - (70) (1) (STM)347 (STM) 0.0130	395 (STM) CONDUIT		74.2
0.5308	{STM}.STM Pipe - (70) (STM)395 (STM) 0.0130	343 (STM) CONDUIT		9.4
0.3515	{STM}.STM Pipe - (71) (STM)351 (STM) 0.0130	347 (STM) CONDUIT		81.1
1.9336	{STM}.STM Pipe - (72) (1) (STM)309 (STM) 0.0130	417 (STM) CONDUIT		47.6
0.6284	{STM}.STM Pipe - (72) (STM)417 (STM) 0.0130	351 (STM) CONDUIT		32.8
0.2173	{STM}.STM Pipe - (75) (2) (1) (STM)373 (STM) 0.0130	703 (STM) CONDUIT		35.9
0.1860	{STM}.STM Pipe - (75) (STM)703 (STM) 0.0130	EX363 (STM) CONDUIT		21.5
0.1756	{STM}.STM Pipe - (76) (STM)375 (STM) 0.0130	373 (STM) CONDUIT		110.5
0.1847	{STM}.STM Pipe - (77) (STM)377 (STM) 0.0130	375 (STM) CONDUIT		80.1
0.6510	{STM}.STM Pipe - (78) (1) (STM)345 (STM) 0.0130	393 (STM) CONDUIT		26.9
0.4996	{STM}.STM Pipe - (78) (STM)393 (STM) 0.0130	343 (STM) CONDUIT		109.7
1.4939	{STM}.STM Pipe - (79) (1) (STM)349 (STM) 0.0130	397 (STM) CONDUIT		34.8
0.4978	{STM}.STM Pipe - (79) (STM)397 (STM) 0.0130	347 (STM) CONDUIT		108.5
0.9999	{STM}.STM Pipe - (80) (1) (STM)353 (STM) 0.0130	399 (STM) CONDUIT		64.0
1.0005	{STM}.STM Pipe - (80) (STM)399 (STM) 0.0130	351 (STM) CONDUIT		80.5
0.2530	{STM}.STM Pipe - (81) (STM)379 (STM) 0.0130	377 (STM) CONDUIT		55.3
0.2434	{STM}.STM Pipe - (82) (STM)381 (STM) 0.0130	379 (STM) CONDUIT		25.9
0.2583	{STM}.STM Pipe - (83) (1) (STM)383 (STM) 0.0130	419 (STM) CONDUIT		9.3
0.2495	{STM}.STM Pipe - (83) (STM)419 (STM) 0.0130	381 (STM) CONDUIT		66.9
0.2016	{STM}.STM Pipe - (84) (STM)385 (STM) 0.0130	383 (STM) CONDUIT		10.9
0.2006	{STM}.STM Pipe - (85) (STM)387 (STM) 0.0130	385 (STM) CONDUIT		52.3
0.2000	{STM}.STM Pipe - (86) (STM)389 (STM) 0.0130	387 (STM) CONDUIT		120.0
0.2381	{STM}.STM Pipe - (87) (STM)359A (STM) 0.0130	381 (STM) CONDUIT		96.6
0.5339	{STM}.STM Pipe - (88) (STM)359 (STM) 0.0130	357 (STM) CONDUIT		93.7
0.0130	Link-02 359A (STM) 359 (STM)	CONDUIT	2.9	0.0105
0.0130	Link-07 MAJ-Shinny CB113-114 (STM)	CHANNEL	17.1	0.0583
0.0130	Link-09 4+828 CB133-134 (STM)	CHANNEL	63.0	0.5333
0.0130	Link-10 4+750 CB133-134 (STM)	CHANNEL	39.0	0.6051

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Link-101	Jun-51	CB113-114 (STM)	CHANNEL	10.0	3.2800
0.0350					
Link-106	RYCB-32 (STM)	RYCB-33 (STM)	CHANNEL	20.0	1.0000
0.0350					
Link-11	4+750	CB131-132 (STM)	CHANNEL	48.0	0.6292
0.0130					
Link-112	RYCB-34 (STM)	RYCB-33 (STM)	CHANNEL	10.0	4.7000
0.0350					
Link-113	379A (STM)	4+568	CHANNEL	25.0	1.2000
0.0130					
Link-114	373A (STM)	4+345	CHANNEL	10.0	0.6000
0.0130					
Link-115	11+001	CB93-94 (STM)	CHANNEL	76.4	1.3609
0.0130					
Link-116	8+150	CB97-98 (STM)	CHANNEL	107.8	0.9579
0.0130					
Link-117	12+001	CB87-88 (STM)	CHANNEL	87.5	1.1314
0.0130					
Link-118	RYCB-39 (STM)	CB129-130 (STM)	CHANNEL	10.0	4.0000
0.0350					
Link-119	RYCB-27 (STM)	10+053	CHANNEL	10.0	2.4000
0.0350					
Link-12	4+665	CB131-132 (STM)	CHANNEL	36.0	0.5611
0.0130					
Link-120	10+053	MAJ-Easement	CHANNEL	26.2	0.6102
0.0350					
Link-13	4+665	CB129-130 (STM)	CHANNEL	45.0	0.7267
0.0130					
Link-14	4+568	CB129-130 (STM)	CHANNEL	42.0	0.3024
0.0130					
Link-16	8+128	CB121-122 (STM)	CHANNEL	17.8	0.9291
0.0130					
Link-17	8+128	CB119-120 (STM)	CHANNEL	7.5	1.6000
0.0130					
Link-18	4+510	CB119-120 (STM)	CHANNEL	8.2	1.4616
0.0130					
Link-19	4+510	CB117-118 (STM)	CHANNEL	45.0	0.5778
0.0130					
Link-22	4+345	CB115-116 (STM)	CHANNEL	20.0	0.9000
0.0130					
Link-23	4+345	CB113-114 (STM)	CHANNEL	74.0	0.4973
0.0130					
Link-25	4+568	CB121-122 (STM)	CHANNEL	52.0	0.5865
0.0130					
Link-26	4+568	CB123-124 (STM)	CHANNEL	25.0	0.7360
0.0130					
Link-30	7+096	CB123-124 (STM)	CHANNEL	61.0	0.6130
0.0130					
Link-31	7+096	CB125-126 (STM)	CHANNEL	91.8	0.8661
0.0130					
Link-32	6+088	CB125-126 (STM)	CHANNEL	8.4	0.4177
0.0130					
Link-33	4+828	CB127-128 (STM)	CHANNEL	50.0	1.7520
0.0130					
Link-34	6+102	CB127-128 (STM)	CHANNEL	10.0	0.7600
0.0130					
Link-35	6+102	CB125-126 (STM)	CHANNEL	14.0	0.5000
0.0130					
Link-38	6+088	CB101-102 (STM)	CHANNEL	59.0	1.4068
0.0130					
Link-40	12+309	CB97-98 (STM)	CHANNEL	36.0	0.5639
0.0130					
Link-44	CB111-112	CB101-102 (STM)	CHANNEL	25.8	0.8544
0.0130					
Link-45	MAJ-Haliburton	CB101-102 (STM)	CHANNEL	12.0	1.0833
0.0130					
Link-47	12+309	CB95-96 (STM)	CHANNEL	33.5	1.9970
0.0130					
Link-48	12+254	CB95-96 (STM)	CHANNEL	20.0	0.7000
0.0130					

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Link-49	12+254	CB91-92 (STM)	CHANNEL	14.1	1.8434
0.0130					
Link-51	12+228	CB91-92 (STM)	CHANNEL	11.0	1.5364
0.0130					
Link-52	12+228	CB89-90 (STM)	CHANNEL	32.0	0.5625
0.0130					
Link-53	12+185	CB89-90 (STM)	CHANNEL	13.0	1.3846
0.0130					
Link-54	4+420	CB117-118 (STM)	CHANNEL	27.0	0.8148
0.0130					
Link-55	4+420	CB115-116 (STM)	CHANNEL	60.0	0.6500
0.0130					
Link-57	CB93-94 (STM)	CB91-92 (STM)	CHANNEL	56.6	0.7753
0.0130					
Link-59	CB87-88 (STM)	CB85-86 (STM)	CHANNEL	57.9	0.9751
0.0130					
Link-60	12+185	CB85-86 (STM)	CHANNEL	22.0	1.4773
0.0130					
Link-61	CB85-86 (STM)	10+053	CHANNEL	28.0	0.5000
0.0350					
Link-64	RYCBMH-2 (STM)	10+053	CHANNEL	10.0	1.4000
0.0350					
Link-70	RYCB-28 (STM)	RYCB-27 (STM)	CHANNEL	10.0	0.5000
0.0350					
Link-71	E-34	RYCB-28 (STM)	CHANNEL	50.0	1.0200
0.0350					
Link-72	Jun-35	RYCB-25 (STM)	CHANNEL	9.7	2.6832
0.0350					
Link-74	Jun-35	CB89-90 (STM)	CHANNEL	19.9	0.9839
0.0350					
Link-75	Jun-37	RYCB-24 (STM)	CHANNEL	10.3	3.0039
0.0350					
Link-77	Jun-37	CB95-96 (STM)	CHANNEL	19.4	1.3378
0.0350					
Link-80	Jun-40	RYCB-23 (STM)	CHANNEL	12.6	1.0317
0.0350					
Link-82	Jun-40	CB101-102 (STM)	CHANNEL	19.4	2.7878
0.0350					
Link-85	Jun-43	RYCB-22 (STM)	CHANNEL	15.9	1.6332
0.0350					
Link-86	Jun-43	CB127-128 (STM)	CHANNEL	10.6	3.1758
0.0350					
Link-91	RYCB-38 (STM)	CB131-132 (STM)	CHANNEL	10.0	1.5000
0.0350					
Link-93	RYCB-21 (STM)	MAJ-Slapshot	CHANNEL	10.0	1.0000
0.0350					
Link-96	RYCB-30 (STM)	CB121-122 (STM)	CHANNEL	10.0	0.5000
0.0350					
Link-97	RYCB-31 (STM)	CB121-122 (STM)	CHANNEL	10.0	6.1000
0.0350					
Link-99	RYCB-33 (STM)	Jun-51	CHANNEL	10.0	0.5000
0.0350					
{STM}.CBL109 (STM)	CB113-114 (STM)	703 (STM)	ORIFICE		
{STM}.CBL111 (STM)	CB115-116 (STM)	375 (STM)	ORIFICE		
{STM}.CBL113 (STM)	CB117-118 (STM)	377 (STM)	ORIFICE		
{STM}.CBL115 (STM)	CB119-120 (STM)	377 (STM)	ORIFICE		
{STM}.CBL117 (STM)	CB121-122 (STM)	379 (STM)	ORIFICE		
{STM}.CBL119 (STM)	CB123-124 (STM)	359A (STM)	ORIFICE		
{STM}.CBL123 (STM)	CB127-128 (STM)	357A (STM)	ORIFICE		
{STM}.CBL125 (STM)	CB129-130 (STM)	419 (STM)	ORIFICE		
{STM}.CBL128 (STM)	CB131-132 (STM)	387 (STM)	ORIFICE		
{STM}.CBL130 (STM)	CB133-134 (STM)	389 (STM)	ORIFICE		
{STM}.CBL85 (STM)	CB89-90 (STM)	347 (STM)	ORIFICE		
{STM}.CBL87 (STM)	CB91-92 (STM)	397 (STM)	ORIFICE		
{STM}.CBL91 (STM)	CB95-96 (STM)	351 (STM)	ORIFICE		
{STM}.CBL93 (STM)	CB97-98 (STM)	399 (STM)	ORIFICE		
{STM}.CBL97 (STM)	CB101-102 (STM)	357 (STM)	ORIFICE		
{STM}.STM Pipe - (182)	(STM)373A (STM)	373 (STM)	ORIFICE		
{STM}.STM Pipe - (183)	(STM)379A (STM)	379 (STM)	ORIFICE		
{STM}.STM Pipe - (389)	(STM)CB87-88 (STM)	393 (STM)	ORIFICE		

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{STM}.STM Pipe - (391)	(STM)CB85-86	(STM)	393	(STM)	ORIFICE
{STM}.STM Pipe - (392)	(STM)CB93-94	(STM)	397	(STM)	ORIFICE
{STM}.STM Pipe - (393)	(STM)CB125-126	(STM)	359	(STM)	ORIFICE
{STM}.STM Pipe - (397)	(STM)RYCB-21	(STM)	387A	(STM)	ORIFICE
{STM}.STM Pipe - (400)	(STM)RYCB-22	(STM)	357A	(STM)	ORIFICE
{STM}.STM Pipe - (403)	(STM)RYCB-23	(STM)	357	(STM)	ORIFICE
{STM}.STM Pipe - (406)	(STM)RYCB-24	(STM)	351	(STM)	ORIFICE
{STM}.STM Pipe - (409)	(STM)RYCB-25	(STM)	347	(STM)	ORIFICE
{STM}.STM Pipe - (412)	(STM)RYCBMH-2	(STM)	391	(STM)	ORIFICE
{STM}.STM Pipe - (414)	(STM)RYCB-27	(STM)	391	(STM)	ORIFICE
{STM}.STM Pipe - (417)	(STM)RYCB-28	(STM)	347	(STM)	ORIFICE
{STM}.STM Pipe - (419)	(STM)RYCB-38	(STM)	387A	(STM)	ORIFICE
{STM}.STM Pipe - (421)	(STM)RYCB-39	(STM)	383	(STM)	ORIFICE
{STM}.STM Pipe - (425)	(STM)RYCB-30	(STM)	381	(STM)	ORIFICE
{STM}.STM Pipe - (427)	(STM)RYCB-31	(STM)	377	(STM)	ORIFICE
{STM}.STM Pipe - (429)	(STM)RYCB-32	(STM)	377	(STM)	ORIFICE
{STM}.STM Pipe - (433)	(STM)RYCB-33	(STM)	375	(STM)	ORIFICE
{STM}.STM Pipe - (435)	(STM)RYCB-34	(STM)	703	(STM)	ORIFICE
Link-01	off-site		387A	(STM)	ORIFICE
Link-102	E-34		309	(STM)	ORIFICE
O-111	CB111-112		417	(STM)	ORIFICE

Cross Section Summary

Link Flow ID Hydraulic Radius	Design Capacity LPS	Shape Flow	Depth/ Diameter m	Width m	No. of Barrels	Cross Sectional Area m ²	Full

{STM}.STM Pipe - (190)	(STM)	CIRCULAR		0.91	0.91	1	
0.66	0.23	828.28					
{STM}.STM Pipe - (199)	(STM)	CIRCULAR		0.46	0.46	1	
0.16	0.11	281.79					
{STM}.STM Pipe - (390)	(STM)	CIRCULAR		0.53	0.53	1	
0.22	0.13	704.54					
{STM}.STM Pipe - (69)	(1) (1) (STM)	CIRCULAR		0.91	0.91	1	1
0.66	0.23	806.02					
{STM}.STM Pipe - (69)	(1) (STM)	CIRCULAR		0.91	0.91	1	
0.66	0.23	1210.53					
{STM}.STM Pipe - (70)	(1) (STM)	CIRCULAR		0.91	0.91	1	
0.66	0.23	1116.74					
{STM}.STM Pipe - (70)	(STM)	CIRCULAR		0.91	0.91	1	
0.66	0.23	1374.48					
{STM}.STM Pipe - (71)	(STM)	CIRCULAR		0.76	0.76	1	
0.46	0.19	688.61					
{STM}.STM Pipe - (72)	(1) (STM)	CIRCULAR		0.30	0.30	1	
0.07	0.08	140.53					
{STM}.STM Pipe - (72)	(STM)	CIRCULAR		0.69	0.69	1	
0.37	0.17	695.73					
{STM}.STM Pipe - (75)	(2) (1) (STM)	CIRCULAR		1.37	1.37	1	1
1.48	0.34	2597.59					
{STM}.STM Pipe - (75)	(STM)	CIRCULAR		1.37	1.37	1	
1.48	0.34	2403.74					
{STM}.STM Pipe - (76)	(STM)	CIRCULAR		1.22	1.22	1	
1.17	0.30	1703.53					
{STM}.STM Pipe - (77)	(STM)	CIRCULAR		1.22	1.22	1	
1.17	0.30	1747.31					
{STM}.STM Pipe - (78)	(1) (STM)	CIRCULAR		0.30	0.30	1	
0.07	0.08	81.54					
{STM}.STM Pipe - (78)	(STM)	CIRCULAR		0.46	0.46	1	
0.16	0.11	210.00					
{STM}.STM Pipe - (79)	(1) (STM)	CIRCULAR		0.30	0.30	1	

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0.07	0.08	123.53					
{STM}.STM Pipe -	(79)	(STM) CIRCULAR	0.46	0.46	1		
0.16	0.11	209.62					
{STM}.STM Pipe -	(80)	(1) (STM) CIRCULAR	0.30	0.30	1		1
0.07	0.08	101.06					
{STM}.STM Pipe -	(80)	(STM) CIRCULAR	0.46	0.46	1		
0.16	0.11	297.17					
{STM}.STM Pipe -	(81)	(STM) CIRCULAR	1.07	1.07	1		
0.89	0.27	1433.75					
{STM}.STM Pipe -	(82)	(STM) CIRCULAR	0.99	0.99	1		
0.77	0.25	1154.69					
{STM}.STM Pipe -	(83)	(1) (STM) CIRCULAR	0.91	0.91	1		1
0.66	0.23	958.70					
{STM}.STM Pipe -	(83)	(STM) CIRCULAR	0.91	0.91	1		
0.66	0.23	942.25					
{STM}.STM Pipe -	(84)	(STM) CIRCULAR	0.91	0.91	1		
0.66	0.23	847.10					
{STM}.STM Pipe -	(85)	(STM) CIRCULAR	0.91	0.91	1		
0.66	0.23	845.04					
{STM}.STM Pipe -	(86)	(STM) CIRCULAR	0.46	0.46	1		
0.16	0.11	132.87					
{STM}.STM Pipe -	(87)	(STM) CIRCULAR	0.46	0.46	1		
0.16	0.11	144.96					
{STM}.STM Pipe -	(88)	(STM) CIRCULAR	0.46	0.46	1		
0.16	0.11	217.08					
Link-02		CIRCULAR	0.45	0.45	1		0.16
0.11	29.18						
Link-07		IRREGULAR	0.30	18.00	1		2.83
0.17	1599.37						
Link-09		IRREGULAR	0.30	18.00	1		2.83
0.17	4835.64						
Link-10		IRREGULAR	0.30	18.00	1		2.83
0.17	5150.85						
Link-101		IRREGULAR	0.30	10.00	1		1.50
0.15	2182.86						
Link-106		IRREGULAR	0.30	10.00	1		1.50
0.15	1205.28						
Link-11		IRREGULAR	0.30	18.00	1		2.83
0.17	5252.16						
Link-112		IRREGULAR	0.30	10.00	1		1.50
0.15	2612.99						
Link-113		IRREGULAR	0.30	18.00	1		2.83
0.17	7253.46						
Link-114		IRREGULAR	0.30	18.00	1		2.83
0.17	5128.97						
Link-115		IRREGULAR	0.30	18.00	1		2.83
0.17	7724.46						
Link-116		IRREGULAR	0.30	18.00	1		2.83
0.17	6480.60						
Link-117		IRREGULAR	0.30	18.00	1		2.83
0.17	7043.17						
Link-118		IRREGULAR	0.30	10.00	1		1.50
0.15	2410.57						
Link-119		IRREGULAR	0.30	10.00	1		1.50
0.15	1867.22						
Link-12		IRREGULAR	0.30	18.00	1		2.83
0.17	4959.97						
Link-120		IRREGULAR	0.30	7.00	1		0.92
0.16	615.70						
Link-13		IRREGULAR	0.30	18.00	1		2.83
0.17	5644.46						
Link-14		IRREGULAR	0.30	18.00	1		2.83
0.17	3641.10						
Link-16		IRREGULAR	0.30	18.00	1		2.83
0.17	6382.27						
Link-17		IRREGULAR	0.20	20.00	1		2.00
0.10	4181.01						
Link-18		IRREGULAR	0.30	18.00	1		2.83
0.17	8005.23						
Link-19		IRREGULAR	0.30	18.00	1		2.83

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0.17	5033.10					
Link-22		IRREGULAR	0.30	18.00	1	2.83
0.17	6281.68					
Link-23		IRREGULAR	0.30	18.00	1	2.83
0.17	4669.42					
Link-25		IRREGULAR	0.30	18.00	1	2.83
0.17	5071.11					
Link-26		IRREGULAR	0.30	18.00	1	2.83
0.17	5680.59					
Link-30		IRREGULAR	0.30	18.00	1	2.83
0.17	5184.30					
Link-31		IRREGULAR	0.30	18.00	1	2.83
0.17	6162.27					
Link-32		IRREGULAR	0.30	18.00	1	2.83
0.17	4279.24					
Link-33		IRREGULAR	0.30	18.00	1	2.83
0.17	8764.39					
Link-34		IRREGULAR	0.30	18.00	1	2.83
0.17	5772.47					
Link-35		IRREGULAR	0.20	20.00	1	2.00
0.10	2337.25					
Link-38		IRREGULAR	0.30	18.00	1	2.83
0.17	7853.58					
Link-40		IRREGULAR	0.30	18.00	1	2.83
0.17	4972.23					
Link-44		IRREGULAR	0.30	18.00	1	2.83
0.17	6120.37					
Link-45		IRREGULAR	0.30	18.00	1	2.83
0.17	6891.85					
Link-47		IRREGULAR	0.30	18.00	1	2.83
0.17	9357.20					
Link-48		IRREGULAR	0.30	18.00	1	2.83
0.17	5539.93					
Link-49		IRREGULAR	0.30	18.00	1	2.83
0.17	8990.14					
Link-51		IRREGULAR	0.30	18.00	1	2.83
0.17	8207.33					
Link-52		IRREGULAR	0.30	18.00	1	2.83
0.17	4966.11					
Link-53		IRREGULAR	0.30	18.00	1	2.83
0.17	7791.47					
Link-54		IRREGULAR	0.30	18.00	1	2.83
0.17	5977.01					
Link-55		IRREGULAR	0.30	18.00	1	2.83
0.17	5338.41					
Link-57		IRREGULAR	0.30	18.00	1	2.83
0.17	5830.45					
Link-59		IRREGULAR	0.30	18.00	1	2.83
0.17	6538.68					
Link-60		IRREGULAR	0.30	18.00	1	2.83
0.17	8047.95					
Link-61		IRREGULAR	0.30	7.00	1	0.92
0.16	557.33					
Link-64		IRREGULAR	0.30	10.00	1	1.50
0.15	1426.11					
Link-70		IRREGULAR	0.30	10.00	1	1.50
0.15	852.26					
Link-71		IRREGULAR	0.30	10.00	1	1.50
0.15	1217.28					
Link-72		IRREGULAR	0.30	10.00	1	1.50
0.15	1974.30					
Link-74		IRREGULAR	0.30	10.00	1	1.50
0.15	1195.56					
Link-75		IRREGULAR	0.30	10.00	1	1.50
0.15	2088.96					
Link-77		IRREGULAR	0.30	10.00	1	1.50
0.15	1394.08					
Link-80		IRREGULAR	0.30	10.00	1	1.50
0.15	1224.27					
Link-82		IRREGULAR	0.30	10.00	1	1.50

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0.15	2012.43					
Link-85		IRREGULAR	0.30	10.00	1	1.50
0.15	1540.30					
Link-86		IRREGULAR	0.30	10.00	1	1.50
0.15	2147.91					
Link-91		IRREGULAR	0.30	10.00	1	1.50
0.15	1476.16					
Link-93		IRREGULAR	0.30	10.00	1	1.50
0.15	1205.28					
Link-96		IRREGULAR	0.30	10.00	1	1.50
0.15	852.26					
Link-97		IRREGULAR	0.30	10.00	1	1.50
0.15	2976.83					
Link-99		IRREGULAR	0.30	10.00	1	1.50
0.15	852.26					

Transect Summary

Transect 18m ROW
Area:

0.0005	0.0018	0.0041	0.0073	0.0114
0.0165	0.0224	0.0293	0.0370	0.0457
0.0553	0.0658	0.0773	0.0896	0.1029
0.1171	0.1321	0.1481	0.1651	0.1829
0.2016	0.2211	0.2405	0.2600	0.2795
0.2993	0.3200	0.3413	0.3634	0.3863
0.4099	0.4342	0.4593	0.4852	0.5117
0.5391	0.5671	0.5960	0.6255	0.6558
0.6869	0.7187	0.7513	0.7846	0.8186
0.8534	0.8889	0.9252	0.9622	1.0000

Hrad:

0.0176	0.0351	0.0527	0.0702	0.0878
0.1053	0.1229	0.1405	0.1580	0.1756
0.1931	0.2107	0.2282	0.2458	0.2634
0.2809	0.2985	0.3160	0.3336	0.3511
0.3687	0.3990	0.4334	0.4678	0.5021
0.5361	0.5683	0.5989	0.6277	0.6551
0.6811	0.7058	0.7292	0.7514	0.7726
0.7928	0.8120	0.8304	0.8479	0.8647
0.8808	0.8962	0.9109	0.9251	0.9388
0.9519	0.9646	0.9768	0.9886	1.0000

width:

0.0240	0.0479	0.0719	0.0959	0.1199
0.1438	0.1678	0.1918	0.2158	0.2397
0.2637	0.2877	0.3117	0.3356	0.3596
0.3836	0.4076	0.4315	0.4555	0.4795
0.5035	0.5098	0.5102	0.5107	0.5111
0.5307	0.5502	0.5698	0.5893	0.6089
0.6284	0.6480	0.6676	0.6871	0.7067
0.7262	0.7458	0.7653	0.7849	0.8044
0.8240	0.8436	0.8631	0.8827	0.9022
0.9218	0.9413	0.9609	0.9804	1.0000

Transect Backyard Swale
Area:

0.0004	0.0016	0.0036	0.0064	0.0100
0.0144	0.0196	0.0256	0.0324	0.0400
0.0484	0.0576	0.0676	0.0784	0.0900
0.1024	0.1156	0.1296	0.1444	0.1600
0.1764	0.1936	0.2116	0.2304	0.2500
0.2704	0.2916	0.3136	0.3364	0.3600
0.3844	0.4096	0.4356	0.4624	0.4900
0.5184	0.5476	0.5776	0.6084	0.6400
0.6724	0.7056	0.7396	0.7744	0.8100
0.8464	0.8836	0.9216	0.9604	1.0000

Hrad:

0.0200	0.0400	0.0600	0.0800	0.1000
--------	--------	--------	--------	--------

100 Year Output Summary.txt

	0.1200	0.1400	0.1600	0.1800	0.2000
	0.2200	0.2400	0.2600	0.2800	0.3000
	0.3200	0.3400	0.3600	0.3800	0.4000
	0.4200	0.4400	0.4600	0.4800	0.5000
	0.5200	0.5400	0.5600	0.5800	0.6000
	0.6200	0.6400	0.6600	0.6800	0.7000
	0.7200	0.7400	0.7600	0.7800	0.8000
	0.8200	0.8400	0.8600	0.8800	0.9000
	0.9200	0.9400	0.9600	0.9800	1.0000
width:					
	0.0200	0.0400	0.0600	0.0800	0.1000
	0.1200	0.1400	0.1600	0.1800	0.2000
	0.2200	0.2400	0.2600	0.2800	0.3000
	0.3200	0.3400	0.3600	0.3800	0.4000
	0.4200	0.4400	0.4600	0.4800	0.5000
	0.5200	0.5400	0.5600	0.5800	0.6000
	0.6200	0.6400	0.6600	0.6800	0.7000
	0.7200	0.7400	0.7600	0.7800	0.8000
	0.8200	0.8400	0.8600	0.8800	0.9000
	0.9200	0.9400	0.9600	0.9800	1.0000

Transect Outlet Swale
Area:

	0.0004	0.0016	0.0035	0.0062	0.0097
	0.0140	0.0191	0.0249	0.0315	0.0389
	0.0471	0.0560	0.0658	0.0763	0.0876
	0.0996	0.1125	0.1261	0.1405	0.1557
	0.1716	0.1884	0.2059	0.2242	0.2432
	0.2631	0.2837	0.3051	0.3273	0.3503
	0.3740	0.3985	0.4238	0.4499	0.4768
	0.5044	0.5328	0.5620	0.5920	0.6227
	0.6542	0.6866	0.7203	0.7556	0.7924
	0.8308	0.8708	0.9123	0.9554	1.0000
Hrad:					
	0.0183	0.0365	0.0548	0.0730	0.0913
	0.1095	0.1278	0.1461	0.1643	0.1826
	0.2008	0.2191	0.2373	0.2556	0.2738
	0.2921	0.3104	0.3286	0.3469	0.3651
	0.3834	0.4016	0.4199	0.4382	0.4564
	0.4747	0.4929	0.5112	0.5294	0.5477
	0.5660	0.5842	0.6025	0.6207	0.6390
	0.6572	0.6755	0.6938	0.7120	0.7303
	0.7485	0.7727	0.8072	0.8396	0.8701
	0.8989	0.9261	0.9520	0.9765	1.0000
width:					
	0.0171	0.0343	0.0514	0.0686	0.0857
	0.1029	0.1200	0.1371	0.1543	0.1714
	0.1886	0.2057	0.2229	0.2400	0.2571
	0.2743	0.2914	0.3086	0.3257	0.3429
	0.3600	0.3771	0.3943	0.4114	0.4286
	0.4457	0.4629	0.4800	0.4971	0.5143
	0.5314	0.5486	0.5657	0.5829	0.6000
	0.6171	0.6343	0.6514	0.6686	0.6857
	0.7029	0.7257	0.7600	0.7943	0.8286
	0.8629	0.8971	0.9314	0.9657	1.0000

Transect ROW Crown
Area:

	0.0004	0.0016	0.0036	0.0064	0.0100
	0.0144	0.0196	0.0256	0.0324	0.0400
	0.0484	0.0576	0.0676	0.0784	0.0900
	0.1024	0.1156	0.1296	0.1444	0.1600
	0.1764	0.1936	0.2116	0.2304	0.2500
	0.2704	0.2916	0.3136	0.3364	0.3600
	0.3844	0.4096	0.4356	0.4624	0.4900
	0.5184	0.5476	0.5776	0.6084	0.6400
	0.6724	0.7056	0.7396	0.7744	0.8100
	0.8464	0.8836	0.9216	0.9604	1.0000
Hrad:					
	0.0200	0.0400	0.0600	0.0800	0.1000

100 Year Output Summary.txt

	0.1200	0.1400	0.1600	0.1800	0.2000
	0.2200	0.2400	0.2600	0.2800	0.3000
	0.3200	0.3400	0.3600	0.3800	0.4000
	0.4200	0.4400	0.4600	0.4800	0.5000
	0.5200	0.5400	0.5600	0.5800	0.6000
	0.6200	0.6400	0.6600	0.6800	0.7000
	0.7200	0.7400	0.7600	0.7800	0.8000
	0.8200	0.8400	0.8600	0.8800	0.9000
	0.9200	0.9400	0.9600	0.9800	1.0000
width:	0.0200	0.0400	0.0600	0.0800	0.1000
	0.1200	0.1400	0.1600	0.1800	0.2000
	0.2200	0.2400	0.2600	0.2800	0.3000
	0.3200	0.3400	0.3600	0.3800	0.4000
	0.4200	0.4400	0.4600	0.4800	0.5000
	0.5200	0.5400	0.5600	0.5800	0.6000
	0.6200	0.6400	0.6600	0.6800	0.7000
	0.7200	0.7400	0.7600	0.7800	0.8000
	0.8200	0.8400	0.8600	0.8800	0.9000
	0.9200	0.9400	0.9600	0.9800	1.0000

*****	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
*****	-----	-----
Total Precipitation	1.181	76.023
Evaporation Loss	0.000	0.000
Infiltration Loss	0.269	17.285
Surface Runoff	0.911	58.618
Final Surface Storage	0.010	0.660
Continuity Error (%)	-0.710	

*****	Volume	Volume
Flow Routing Continuity	hectare-m	Mliters
*****	-----	-----
Dry weather Inflow	0.000	0.000
Wet weather Inflow	0.911	9.109
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.066	0.662
External Outflow	0.972	9.717
Surface Flooding	0.000	0.000
Evaporation Loss	0.000	0.000
Initial Stored Volume	0.040	0.405
Final Stored Volume	0.045	0.452
Continuity Error (%)	0.070	

EPA SWMM Time of Concentration Computations Report

$$T_c = (0.94 * (L^{0.6}) * (n^{0.6})) / ((i^{0.4}) * (S^{0.3}))$$

where:

- Tc = Time of Concentration (min)
- L = Flow Length (ft)
- n = Manning's Roughness
- i = Rainfall Intensity (in/hr)
- S = Slope (ft/ft)

Subbasin {SDA}.109b

Flow length (m): 46.40
Pervious Manning's Roughness: 0.25000

100 Year Output Summary.txt

Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 35.44

subbasin {SDA}.624

Flow length (m): 222.64
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 54.42

subbasin {SDA}.625

Flow length (m): 91.67
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 46.41

subbasin {SDA}.627

Flow length (m): 191.32
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 49.69

subbasin {SDA}.628

Flow length (m): 38.75
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 31.81

subbasin {SDA}.629

Flow length (m): 40.25
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 32.55

subbasin {SDA}.630

100 Year Output Summary.txt

Flow length (m): 35.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 29.93

subbasin {SDA}.632

Flow length (m): 122.95
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 38.11

subbasin {SDA}.633

Flow length (m): 153.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 43.45

subbasin {SDA}.634

Flow length (m): 50.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 34.77

subbasin {SDA}.638

Flow length (m): 27.60
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 24.34

subbasin {SDA}.639

Flow length (m): 32.50
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 26.85

subbasin {SDA}.641

100 Year Output Summary.txt

Flow length (m): 78.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 38.51

subbasin {SDA}.642

Flow length (m): 86.67
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 44.87

subbasin {SDA}.643

Flow length (m): 95.21
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 47.48

subbasin {SDA}.663

Flow length (m): 51.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 37.51

subbasin {SDA}.664

Flow length (m): 94.58
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 47.29

subbasin {SDA}.666

Flow length (m): 72.50
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 40.32

100 Year Output Summary.txt

subbasin {SDA}.667

Flow length (m):	70.20
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	19.00583
Impervious Rainfall Intensity (mm/hr):	19.00583
Slope (%):	0.50000
Computed TOC (minutes):	36.15

subbasin {SDA}.668

Flow length (m):	50.00
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	19.00583
Impervious Rainfall Intensity (mm/hr):	19.00583
Slope (%):	0.50000
Computed TOC (minutes):	37.07

subbasin {SDA}.670

Flow length (m):	145.83
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	19.00583
Impervious Rainfall Intensity (mm/hr):	19.00583
Slope (%):	0.50000
Computed TOC (minutes):	61.32

subbasin {SDA}.671

Flow length (m):	57.89
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	19.00583
Impervious Rainfall Intensity (mm/hr):	19.00583
Slope (%):	0.50000
Computed TOC (minutes):	35.23

subbasin {SDA}.672

Flow length (m):	42.40
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	19.00583
Impervious Rainfall Intensity (mm/hr):	19.00583
Slope (%):	0.50000
Computed TOC (minutes):	33.58

subbasin {SDA}.673

Flow length (m):	73.95
Pervious Manning's Roughness:	0.25000
Impervious Manning's Roughness:	0.01300
Pervious Rainfall Intensity (mm/hr):	19.00583
Impervious Rainfall Intensity (mm/hr):	19.00583
Slope (%):	0.50000

100 Year Output Summary.txt
Computed TOC (minutes): 40.80

subbasin {SDA}.674

Flow length (m): 78.16
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 42.17

subbasin {SDA}.675

Flow length (m): 72.08
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 40.18

subbasin {SDA}.704

Flow length (m): 100.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 48.90

subbasin {SDA}.708

Flow length (m): 59.60
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 35.84

subbasin {SDA}.713

Flow length (m): 20.75
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 21.87

subbasin {SDA}.716

Flow length (m): 45.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583

100 Year Output Summary.txt

Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 34.80

subbasin {SDA}.717

Flow length (m): 65.00
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 37.76

subbasin {SDA}.718

Flow length (m): 42.60
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 33.67

subbasin {SDA}.719

Flow length (m): 54.74
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 34.06

subbasin {SDA}.720

Flow length (m): 72.71
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 40.39

subbasin {SDA}.721

Flow length (m): 98.75
Pervious Manning's Roughness: 0.25000
Impervious Manning's Roughness: 0.01300
Pervious Rainfall Intensity (mm/hr): 19.00583
Impervious Rainfall Intensity (mm/hr): 19.00583
Slope (%): 0.50000
Computed TOC (minutes): 48.53

subbasin {SDA}.722

Flow length (m): 52.50
Pervious Manning's Roughness: 0.25000

100 Year Output Summary.txt

Impervious Manning's Roughness: 0.01300
 Pervious Rainfall Intensity (mm/hr): 19.00583
 Impervious Rainfall Intensity (mm/hr): 19.00583
 Slope (%): 0.50000
 Computed TOC (minutes): 38.17

 Subbasin {SDA}.723

Flow length (m): 80.53
 Pervious Manning's Roughness: 0.25000
 Impervious Manning's Roughness: 0.01300
 Pervious Rainfall Intensity (mm/hr): 19.00583
 Impervious Rainfall Intensity (mm/hr): 19.00583
 Slope (%): 0.50000
 Computed TOC (minutes): 42.94

 Subbasin {SDA}.730

Flow length (m): 40.00
 Pervious Manning's Roughness: 0.25000
 Impervious Manning's Roughness: 0.01300
 Pervious Rainfall Intensity (mm/hr): 19.00583
 Impervious Rainfall Intensity (mm/hr): 19.00583
 Slope (%): 0.50000
 Computed TOC (minutes): 30.41

 Subbasin {SDA}.739

Flow length (m): 50.25
 Pervious Manning's Roughness: 0.25000
 Impervious Manning's Roughness: 0.01300
 Pervious Rainfall Intensity (mm/hr): 19.00583
 Impervious Rainfall Intensity (mm/hr): 19.00583
 Slope (%): 0.50000
 Computed TOC (minutes): 37.18

 Subbasin 700_union_1

Flow length (m): 88.00
 Pervious Manning's Roughness: 0.25000
 Impervious Manning's Roughness: 0.01300
 Pervious Rainfall Intensity (mm/hr): 19.00583
 Impervious Rainfall Intensity (mm/hr): 19.00583
 Slope (%): 0.50000
 Computed TOC (minutes): 45.29

 Subbasin Runoff Summary

Subbasin ID	Time of Concentration days hh:mm:ss	Total Rainfall mm	Total Runon mm	Total Evap. mm	Total Infil. mm	Total Runoff mm	Peak Runoff LPS	Runoff Coefficient
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100 Year Output Summary.txt

----- {SDA}.109b 0 00:35:26	76.02	0.00	0.00	30.69	46.00	128.03	0.605
{SDA}.624 0 00:54:25	76.02	0.00	0.00	7.12	68.52	439.00	0.901
{SDA}.625 0 00:46:24	76.02	0.00	0.00	18.38	57.12	53.70	0.751
{SDA}.627 0 00:49:41	76.02	0.00	0.00	7.03	68.64	389.72	0.903
{SDA}.628 0 00:31:48	76.02	0.00	0.00	30.44	46.26	18.04	0.609
{SDA}.629 0 00:32:32	76.02	0.00	0.00	30.49	46.21	46.38	0.608
{SDA}.630 0 00:29:55	76.02	0.00	0.00	30.31	46.40	31.31	0.610
{SDA}.632 0 00:38:06	76.02	0.00	0.00	6.83	68.53	446.34	0.901
{SDA}.633 0 00:43:27	76.02	0.00	0.00	6.93	68.39	734.36	0.900
{SDA}.634 0 00:34:46	76.02	0.00	0.00	27.35	49.40	42.73	0.650
{SDA}.638 0 00:24:20	76.02	0.00	0.00	26.84	49.92	25.30	0.657
{SDA}.639 0 00:26:50	76.02	0.00	0.00	26.95	49.81	44.80	0.655
{SDA}.641 0 00:38:30	76.02	0.00	0.00	14.40	61.38	141.30	0.807
{SDA}.642 0 00:44:52	76.02	0.00	0.00	18.30	57.51	135.96	0.756
{SDA}.643 0 00:47:28	76.02	0.00	0.00	18.44	57.36	148.32	0.754
{SDA}.663 0 00:37:30	76.02	0.00	0.00	30.84	45.84	136.12	0.603
{SDA}.664 0 00:47:17	76.02	0.00	0.00	18.43	57.37	147.42	0.755
{SDA}.666 0 00:40:18	76.02	0.00	0.00	18.05	57.77	115.18	0.760
{SDA}.667 0 00:36:09	76.02	0.00	0.00	14.30	61.49	128.10	0.809
{SDA}.668 0 00:37:04	76.02	0.00	0.00	30.80	45.87	134.43	0.603
{SDA}.670 0 01:01:19	76.02	0.00	0.00	19.16	56.59	218.44	0.744
{SDA}.671 0 00:35:13	76.02	0.00	0.00	17.78	58.05	73.94	0.764
{SDA}.672 0 00:33:34	76.02	0.00	0.00	30.56	46.14	120.34	0.607
{SDA}.673 0 00:40:47	76.02	0.00	0.00	18.08	57.74	92.88	0.759
{SDA}.674 0 00:42:10	76.02	0.00	0.00	18.15	57.66	97.79	0.758
{SDA}.675 0 00:40:10	76.02	0.00	0.00	18.05	57.77	114.56	0.760
{SDA}.704 0 00:48:53	76.02	0.00	0.00	18.52	56.97	71.12	0.749
{SDA}.708 0 00:35:50	76.02	0.00	0.00	17.81	58.02	49.98	0.763
{SDA}.713 0 00:21:52	76.02	0.00	0.00	29.83	46.91	30.76	0.617
{SDA}.716 0 00:34:47	76.02	0.00	0.00	30.64	46.05	50.16	0.606
{SDA}.717 0 00:37:45	76.02	0.00	0.00	17.92	57.91	104.03	0.762
{SDA}.718 0 00:33:40	76.02	0.00	0.00	30.56	46.13	120.74	0.607
{SDA}.719 0 00:34:03	76.02	0.00	0.00	17.72	58.12	70.17	0.764
{SDA}.720 0 00:40:23	76.02	0.00	0.00	18.06	57.76	115.48	0.760
{SDA}.721	76.02	0.00	0.00	18.50	57.30	153.40	0.754

100 Year Output Summary.txt

0 00:48:31	{SDA}.722	76.02	0.00	0.00	30.89	45.79	55.44	0.602
0 00:38:10	{SDA}.723	76.02	0.00	0.00	18.20	57.62	100.54	0.758
0 00:42:56	{SDA}.730	76.02	0.00	0.00	27.12	49.64	32.20	0.653
0 00:30:24	{SDA}.739	76.02	0.00	0.00	30.81	45.86	53.94	0.603
0 00:37:10	700_union_1	76.02	0.00	0.00	18.32	57.48	71.82	0.756
0 00:45:17								

Node Depth Summary

Node ID	Average Depth Attained m	Maximum Depth Attained m	Maximum HGL Attained m	Time of Max Occurrence days hh:mm	Total Flooded Volume ha-mm	Total Time Flooded minutes	Retention Time hh:mm:ss
10+053	0.00	0.16	103.32	0 01:56	0	0	0:00:00
11+001	0.00	0.00	104.63	0 00:00	0	0	0:00:00
12+001	0.00	0.00	104.55	0 00:00	0	0	0:00:00
12+185	0.00	0.02	103.34	0 02:00	0	0	0:00:00
12+228	0.00	0.02	103.34	0 02:01	0	0	0:00:00
12+254	0.00	0.00	103.41	0 00:00	0	0	0:00:00
12+309	0.00	0.00	103.94	0 00:00	0	0	0:00:00
309 (STM)	0.31	0.68	101.41	0 01:56	0	0	0:00:00
343 (STM)	1.47	1.92	100.63	0 01:56	0	0	0:00:00
345 (STM)	0.00	0.01	101.46	0 01:55	0	0	0:00:00
347 (STM)	1.11	1.90	100.98	0 01:56	0	0	0:00:00
349 (STM)	0.01	0.50	101.26	0 01:55	0	0	0:00:00
351 (STM)	0.58	1.67	101.28	0 01:56	0	0	0:00:00
353 (STM)	0.00	0.00	101.42	0 01:47	0	0	0:00:00
357 (STM)	0.05	0.30	102.27	0 01:56	0	0	0:00:00
357A (STM)	0.01	0.22	102.56	0 02:08	0	0	0:00:00
359 (STM)	0.02	0.27	102.80	0 01:56	0	0	0:00:00
359A (STM)	0.01	0.17	102.80	0 01:56	0	0	0:00:00
373 (STM)	1.24	1.36	102.24	0 01:56	0	0	0:00:00
373A (STM)	0.52	3.00	104.65	0 01:50	0	0	0:00:00
375 (STM)	0.90	1.17	102.39	0 01:56	0	0	0:00:00
377 (STM)	0.75	1.12	102.49	0 01:56	0	0	0:00:00
379 (STM)	0.46	0.96	102.62	0 01:57	0	0	0:00:00
379A (STM)	0.10	3.26	105.39	0 01:50	0	0	0:00:00
381 (STM)	0.33	0.91	102.70	0 01:58	0	0	0:00:00
383 (STM)	0.09	0.86	102.92	0 01:59	0	0	0:00:00
385 (STM)	0.08	0.90	102.98	0 02:00	0	0	0:00:00
387 (STM)	0.06	0.89	103.07	0 02:00	0	0	0:00:00
387A (STM)	0.06	0.79	103.13	0 02:00	0	0	0:00:00
389 (STM)	0.02	0.30	103.17	0 02:00	0	0	0:00:00
391 (STM)	1.53	1.76	100.40	0 01:56	0	0	0:00:00
393 (STM)	0.02	0.34	101.46	0 01:55	0	0	0:00:00
395 (STM)	1.39	1.94	100.73	0 01:56	0	0	0:00:00
397 (STM)	0.10	1.48	101.57	0 01:43	0	0	0:00:00
399 (STM)	0.02	0.73	101.44	0 01:47	0	0	0:00:00
4+345	0.00	0.08	104.57	0 01:53	0	0	0:00:00
4+420	0.00	0.00	104.70	0 00:00	0	0	0:00:00
4+510	0.00	0.05	104.79	0 01:55	0	0	0:00:00
4+568	0.00	0.07	105.07	0 01:50	0	0	0:00:00
4+665	0.00	0.00	105.21	0 00:00	0	0	0:00:00
4+750	0.00	0.00	105.31	0 00:00	0	0	0:00:00
4+828	0.00	0.00	105.41	0 00:00	0	0	0:00:00
417 (STM)	0.31	1.51	101.40	0 01:56	0	0	0:00:00
419 (STM)	0.11	0.82	102.86	0 01:59	0	0	0:00:00

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6+088	0.00	0.04	104.47	0	01:52	0	0	0:00:00
6+102	0.00	0.05	104.66	0	01:57	0	0	0:00:00
7+096	0.00	0.00	105.19	0	00:00	0	0	0:00:00
703 (STM)	1.31	1.37	102.17	0	01:56	0	0	0:00:00
8+128	0.00	0.05	104.91	0	01:55	0	0	0:00:00
8+150	0.00	0.00	104.77	0	00:00	0	0	0:00:00
CB101-102 (STM)	0.18	0.90	103.80	0	01:56	0	0	0:00:00
CB111-112	0.03	0.84	103.86	0	01:50	0	0	0:00:00
CB113-114 (STM)	0.04	1.63	104.24	0	01:54	0	0	0:00:00
CB115-116 (STM)	0.06	1.58	104.57	0	01:54	0	0	0:00:00
CB117-118 (STM)	0.05	1.45	104.65	0	02:01	0	0	0:00:00
CB119-120 (STM)	0.03	1.10	104.91	0	01:54	0	0	0:00:00
CB121-122 (STM)	0.04	1.51	104.91	0	01:54	0	0	0:00:00
CB123-124 (STM)	0.05	1.52	105.06	0	01:56	0	0	0:00:00
CB125-126 (STM)	0.05	1.90	104.49	0	01:51	0	0	0:00:00
CB127-128 (STM)	0.04	1.31	104.66	0	01:57	0	0	0:00:00
CB129-130 (STM)	0.04	1.48	105.06	0	01:54	0	0	0:00:00
CB131-132 (STM)	0.05	1.45	105.18	0	01:56	0	0	0:00:00
CB133-134 (STM)	0.05	1.65	105.22	0	01:54	0	0	0:00:00
CB85-86 (STM)	0.04	1.39	103.19	0	01:54	0	0	0:00:00
CB87-88 (STM)	0.05	2.06	103.60	0	01:50	0	0	0:00:00
CB89-90 (STM)	0.04	1.05	103.34	0	02:00	0	0	0:00:00
CB91-92 (STM)	0.03	0.85	103.31	0	01:54	0	0	0:00:00
CB93-94 (STM)	0.04	1.95	103.64	0	01:50	0	0	0:00:00
CB95-96 (STM)	0.02	0.87	103.35	0	01:58	0	0	0:00:00
CB97-98 (STM)	0.06	1.67	103.91	0	01:57	0	0	0:00:00
E-34	0.03	1.49	104.01	0	01:52	0	0	0:00:00
Jun-35	0.00	0.10	103.38	0	01:55	0	0	0:00:00
Jun-37	0.00	0.09	103.55	0	01:55	0	0	0:00:00
Jun-40	0.00	0.08	104.22	0	01:55	0	0	0:00:00
Jun-43	0.00	0.08	104.95	0	01:55	0	0	0:00:00
Jun-51	0.00	0.05	104.50	0	01:55	0	0	0:00:00
RYCB-21 (STM)	0.35	2.40	105.38	0	01:55	0	0	0:00:00
RYCB-22 (STM)	0.35	1.97	104.96	0	01:55	0	0	0:00:00
RYCB-23 (STM)	0.35	2.03	104.24	0	01:55	0	0	0:00:00
RYCB-24 (STM)	0.43	2.19	103.55	0	01:55	0	0	0:00:00
RYCB-25 (STM)	0.36	2.54	103.39	0	01:55	0	0	0:00:00
RYCB-27 (STM)	0.04	2.23	103.46	0	01:55	0	0	0:00:00
RYCB-28 (STM)	0.34	2.38	103.54	0	01:55	0	0	0:00:00
RYCB-30 (STM)	0.35	2.57	105.09	0	01:51	0	0	0:00:00
RYCB-31 (STM)	0.32	2.07	104.90	0	01:51	0	0	0:00:00
RYCB-32 (STM)	0.33	1.91	104.75	0	01:55	0	0	0:00:00
RYCB-33 (STM)	0.34	2.69	104.59	0	01:55	0	0	0:00:00
RYCB-34 (STM)	0.32	1.83	103.99	0	01:55	0	0	0:00:00
RYCB-38 (STM)	0.33	1.49	105.41	0	01:55	0	0	0:00:00
RYCB-39 (STM)	0.04	1.77	105.45	0	01:55	0	0	0:00:00
RYCBMH-2 (STM)	0.34	1.80	103.40	0	01:55	0	0	0:00:00
EX341 (STM)	1.64	1.64	100.17	0	00:00	0	0	0:00:00
EX363 (STM)	1.71	1.71	102.11	0	00:00	0	0	0:00:00
MAJ-Easement	0.00	0.16	103.16	0	01:56	0	0	0:00:00
MAJ-Haliburton	0.02	0.06	103.79	0	01:56	0	0	0:00:00
MAJ-Shinny	0.00	0.00	104.12	0	00:00	0	0	0:00:00
MAJ-Slapshot	0.00	0.00	105.10	0	00:00	0	0	0:00:00
Off-site	0.12	2.38	104.74	0	02:02	0	0	0:00:00

Node Flow Summary

Node ID	Element Type	Maximum Lateral Inflow LPS	Peak Inflow LPS	Time of Peak Inflow Occurrence days hh:mm	Maximum Flooding Overflow LPS	Time of Peak Flooding Occurrence days hh:mm
10+053	JUNCTION	0.00	116.76	0 01:55	0.00	
11+001	JUNCTION	0.00	0.00	0 00:00	0.00	
12+001	JUNCTION	0.00	0.00	0 00:00	0.00	
12+185	JUNCTION	0.00	16.98	0 01:55	0.00	

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12+228	JUNCTION	0.00	17.13	0	01:56	0.00
12+254	JUNCTION	0.00	0.00	0	00:00	0.00
12+309	JUNCTION	0.00	0.00	0	00:00	0.00
309 (STM)	JUNCTION	0.00	19.11	0	01:47	0.00
343 (STM)	JUNCTION	0.00	1056.66	0	01:56	0.00
345 (STM)	JUNCTION	0.00	0.12	0	01:48	0.00
347 (STM)	JUNCTION	0.00	890.41	0	01:56	0.00
349 (STM)	JUNCTION	0.00	21.59	0	01:43	0.00
351 (STM)	JUNCTION	0.00	615.76	0	01:59	0.00
353 (STM)	JUNCTION	0.00	0.22	0	01:47	0.00
357 (STM)	JUNCTION	0.00	328.42	0	01:55	0.00
357A (STM)	JUNCTION	0.00	117.23	0	01:55	0.00
359 (STM)	JUNCTION	0.00	126.09	0	01:44	0.00
359A (STM)	JUNCTION	0.00	80.89	0	01:56	0.00
373 (STM)	JUNCTION	0.00	1465.43	0	01:57	0.00
373A (STM)	JUNCTION	439.00	439.00	0	01:50	0.00
375 (STM)	JUNCTION	0.00	1298.54	0	01:57	0.00
377 (STM)	JUNCTION	0.00	1201.13	0	01:57	0.00
379 (STM)	JUNCTION	0.00	1072.64	0	02:01	0.00
379A (STM)	JUNCTION	389.72	389.72	0	01:50	0.00
381 (STM)	JUNCTION	0.00	830.64	0	02:01	0.00
383 (STM)	JUNCTION	0.00	672.93	0	02:11	0.00
385 (STM)	JUNCTION	0.00	655.59	0	02:11	0.00
387 (STM)	JUNCTION	0.00	639.85	0	02:02	0.00
387A (STM)	JUNCTION	0.00	476.90	0	02:02	0.00
389 (STM)	JUNCTION	0.00	84.54	0	01:54	0.00
391 (STM)	JUNCTION	0.00	1166.12	0	01:56	0.00
393 (STM)	JUNCTION	0.00	166.56	0	01:53	0.00
395 (STM)	JUNCTION	0.00	890.41	0	01:56	0.00
397 (STM)	JUNCTION	0.00	141.46	0	01:54	0.00
399 (STM)	JUNCTION	0.00	106.97	0	01:57	0.00
4+345	JUNCTION	0.00	269.92	0	01:50	0.00
4+420	JUNCTION	0.00	0.00	0	00:00	0.00
4+510	JUNCTION	0.00	55.53	0	01:54	0.00
4+568	JUNCTION	0.00	245.28	0	01:50	0.00
4+665	JUNCTION	0.00	0.00	0	00:00	0.00
4+750	JUNCTION	0.00	0.00	0	00:00	0.00
4+828	JUNCTION	0.00	0.00	0	00:00	0.00
417 (STM)	JUNCTION	0.00	372.97	0	02:04	0.00
419 (STM)	JUNCTION	0.00	767.22	0	02:02	0.00
6+088	JUNCTION	0.00	42.99	0	01:51	0.00
6+102	JUNCTION	0.00	44.16	0	01:56	0.00
7+096	JUNCTION	0.00	0.00	0	00:00	0.00
703 (STM)	JUNCTION	0.00	1565.99	0	01:56	0.00
8+128	JUNCTION	0.00	62.75	0	01:52	0.00
8+150	JUNCTION	0.00	0.00	0	00:00	0.00
CB101-102 (STM)	JUNCTION	71.12	175.33	0	01:51	0.00
CB111-112	JUNCTION	49.98	49.98	0	01:50	0.00
CB113-114 (STM)	JUNCTION	100.54	249.88	0	01:53	0.00
CB115-116 (STM)	JUNCTION	97.79	244.87	0	01:50	0.00
CB117-118 (STM)	JUNCTION	92.88	97.85	0	01:54	0.00
CB119-120 (STM)	JUNCTION	53.70	257.60	0	02:05	0.00
CB121-122 (STM)	JUNCTION	128.10	237.25	0	01:50	0.00
CB123-124 (STM)	JUNCTION	115.18	214.44	0	01:50	0.00
CB125-126 (STM)	JUNCTION	147.42	147.42	0	01:50	0.00
CB127-128 (STM)	JUNCTION	71.82	115.60	0	01:52	0.00
CB129-130 (STM)	JUNCTION	141.30	194.73	0	01:50	0.00
CB131-132 (STM)	JUNCTION	135.96	149.91	0	01:50	0.00
CB133-134 (STM)	JUNCTION	148.32	148.32	0	01:50	0.00
CB85-86 (STM)	JUNCTION	153.40	193.96	0	01:50	0.00
CB87-88 (STM)	JUNCTION	115.48	115.48	0	01:50	0.00
CB89-90 (STM)	JUNCTION	70.17	117.79	0	01:51	0.00
CB91-92 (STM)	JUNCTION	104.03	146.01	0	01:50	0.00
CB93-94 (STM)	JUNCTION	114.56	114.56	0	01:50	0.00
CB95-96 (STM)	JUNCTION	73.94	103.23	0	01:52	0.00
CB97-98 (STM)	JUNCTION	218.44	218.44	0	01:50	0.00
E-34	JUNCTION	30.76	30.76	0	01:50	0.00
Jun-35	JUNCTION	0.00	69.68	0	01:55	0.00
Jun-37	JUNCTION	0.00	55.24	0	01:55	0.00
Jun-40	JUNCTION	0.00	69.90	0	01:55	0.00

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Jun-43	JUNCTION	0.00	73.35	0	01:55	0.00
Jun-51	JUNCTION	0.00	21.74	0	01:55	0.00
RYCB-21 (STM)	JUNCTION	53.94	53.94	0	01:55	0.00
RYCB-22 (STM)	JUNCTION	136.12	136.12	0	01:55	0.00
RYCB-23 (STM)	JUNCTION	134.43	134.43	0	01:55	0.00
RYCB-24 (STM)	JUNCTION	120.34	120.34	0	01:55	0.00
RYCB-25 (STM)	JUNCTION	120.74	120.74	0	01:55	0.00
RYCB-27 (STM)	JUNCTION	55.44	78.89	0	01:55	0.00
RYCB-28 (STM)	JUNCTION	50.16	60.04	0	01:55	0.00
RYCB-30 (STM)	JUNCTION	44.80	44.80	0	01:50	0.00
RYCB-31 (STM)	JUNCTION	25.30	25.30	0	01:50	0.00
RYCB-32 (STM)	JUNCTION	31.31	31.31	0	01:55	0.00
RYCB-33 (STM)	JUNCTION	46.38	59.21	0	01:55	0.00
RYCB-34 (STM)	JUNCTION	18.04	18.04	0	01:55	0.00
RYCB-38 (STM)	JUNCTION	32.20	32.20	0	01:55	0.00
RYCB-39 (STM)	JUNCTION	42.73	42.73	0	01:55	0.00
RYCBMH-2 (STM)	JUNCTION	128.03	128.03	0	01:55	0.00
EX341 (STM)	OUTFALL	0.00	1166.13	0	01:56	0.00
EX363 (STM)	OUTFALL	0.00	1566.02	0	01:56	0.00
MAJ-Easement	OUTFALL	0.00	105.29	0	01:56	0.00
MAJ-Haliburton	OUTFALL	0.00	113.37	0	01:56	0.00
MAJ-Shinny	OUTFALL	0.00	128.49	0	01:54	0.00
MAJ-Slapshot	OUTFALL	0.00	26.54	0	01:55	0.00
Off-site	STORAGE	1180.70	1180.70	0	01:50	0.00

Storage Node Summary

Storage Node ID	Maximum Maximum	Maximum Time of Max.	Maximum Total Pounded	Time of Max Pounded	Average Pounded	Average Pounded	Storage
Node	Exfiltration Rate	Exfiltration Volume	Exfiltration Volume	Exfiltration volume	Exfiltration volume	Exfiltration volume	Storage
Outflow	Rate	Rate	Rate	Rate	Rate	Rate	Rate
LPS	cmm	1000 m ³ / hh:mm:ss	1000 m ³ / (%)	days hh:mm	1000 m ³	(%)	
off-site	0.00	0.438	73	0 02:02	0.010	2	
448.44		0:00:00	0.000				

Outfall Loading Summary

Outfall Node ID	Flow Frequency (%)	Average Flow LPS	Peak Inflow LPS
EX341 (STM)	100.00	46.87	1166.13
EX363 (STM)	79.33	80.10	1566.02
MAJ-Easement	3.39	23.58	105.29
MAJ-Haliburton	99.99	7.70	113.37
MAJ-Shinny	1.62	66.10	128.49
MAJ-Slapshot	1.52	14.26	26.54
System	47.64	238.62	3100.89

Link Flow Summary

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Link ID	Ratio of	Element	Time of	Maximum	Length	Peak Flow	Design
Ratio of	Ratio of	Total	Reported	Velocity	Factor	during	Flow
Maximum	Maximum	Type	Peak Flow	Attained		Analysis	Capacity
/Design	Flow	Time	Occurrence	m/sec		LPS	LPS
Flow	Depth	minutes	days hh:mm				
Flow	Depth	minutes	days hh:mm				
{STM}.STM Pipe - (190)	0.58	(STM) CONDUIT	0 02:14	1.10	1.00	482.39	
828.28	0.88	0	Calculated				
{STM}.STM Pipe - (199)	0.42	(STM) CONDUIT	0 01:55	1.42	1.00	117.25	
281.79	0.56	0	Calculated				
{STM}.STM Pipe - (390)	0.47	(STM) CONDUIT	0 02:04	1.81	1.00	332.11	
704.54	0.78	0	Calculated				
{STM}.STM Pipe - (69)	1.31	(1) (1) (STM) CONDUIT	0 01:56	1.61	1.00	1056.68	
806.02	1.00	1439 SURCHARGED					
{STM}.STM Pipe - (69)	0.96	(1) (STM) CONDUIT	0 01:56	1.78	1.00	1166.13	
1210.53	1.00	1439 SURCHARGED					
{STM}.STM Pipe - (70)	0.80	(1) (STM) CONDUIT	0 01:56	1.36	1.00	890.41	
1116.74	1.00	1438 SURCHARGED					
{STM}.STM Pipe - (70)	0.65	(STM) CONDUIT	0 01:57	1.36	1.00	890.46	
1374.48	1.00	1439 SURCHARGED					
{STM}.STM Pipe - (71)	0.90	(STM) CONDUIT	0 01:59	1.35	1.00	616.50	
688.61	1.00	40 SURCHARGED					
{STM}.STM Pipe - (72)	0.19	(1) (STM) CONDUIT	0 02:04	0.41	1.00	26.38	
140.53	1.00	13 SURCHARGED					
{STM}.STM Pipe - (72)	0.54	(STM) CONDUIT	0 02:04	1.01	1.00	372.63	
695.73	1.00	35 SURCHARGED					
{STM}.STM Pipe - (75)	0.56	(2) (1) (STM) CONDUIT	0 01:57	0.99	1.00	1465.53	
2597.59	1.00	0	Calculated				
{STM}.STM Pipe - (75)	0.65	(STM) CONDUIT	0 01:56	1.06	1.00	1566.02	
2403.74	0.99	0	Calculated				
{STM}.STM Pipe - (76)	0.76	(STM) CONDUIT	0 01:57	1.12	1.00	1298.78	
1703.53	0.97	0	Calculated				
{STM}.STM Pipe - (77)	0.69	(STM) CONDUIT	0 01:57	1.06	1.00	1201.30	
1747.31	0.94	0	Calculated				
{STM}.STM Pipe - (78)	0.00	(1) (STM) CONDUIT	0 01:48	0.01	1.00	0.12	
81.54	0.32	0	Calculated				
{STM}.STM Pipe - (78)	0.79	(STM) CONDUIT	0 01:55	1.40	1.00	166.37	
210.00	0.68	0	Calculated				
{STM}.STM Pipe - (79)	0.17	(1) (STM) CONDUIT	0 01:43	0.57	1.00	21.59	
123.53	1.00	17 SURCHARGED					
{STM}.STM Pipe - (79)	0.67	(STM) CONDUIT	0 01:54	0.86	1.00	141.43	
209.62	1.00	29 SURCHARGED					
{STM}.STM Pipe - (80)	0.00	(1) (STM) CONDUIT	0 01:47	0.01	1.00	0.22	
101.06	0.50	0	Calculated				
{STM}.STM Pipe - (80)	0.46	(STM) CONDUIT	0 02:12	1.01	1.00	135.97	
297.17	1.00	19 SURCHARGED					
{STM}.STM Pipe - (81)	0.75	(STM) CONDUIT	0 02:03	1.27	1.00	1073.54	
1433.75	0.90	0	Calculated				
{STM}.STM Pipe - (82)	0.72	(STM) CONDUIT	0 02:04	1.23	1.00	836.15	
1154.69	0.90	0	Calculated				
{STM}.STM Pipe - (83)	0.71	(1) (STM) CONDUIT	0 02:10	1.16	1.00	676.78	
958.70	0.92	0	Calculated				
{STM}.STM Pipe - (83)	0.81	(STM) CONDUIT	0 02:06	1.31	1.00	766.51	
942.25	0.91	0	Calculated				
{STM}.STM Pipe - (84)	0.78	(STM) CONDUIT	0 02:11	1.06	1.00	657.15	
847.10	0.96	0	Calculated				
{STM}.STM Pipe - (85)	0.78	(STM) CONDUIT	0 02:11	1.04	1.00	655.59	
845.04	0.98	0	Calculated				
{STM}.STM Pipe - (86)	0.63	(STM) CONDUIT	0 02:08	0.80	1.00	84.27	
132.87	0.82	0	Calculated				
{STM}.STM Pipe - (87)		(STM) CONDUIT	0 01:56	0.77	1.00	43.99	

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144.96	0.30	0.52	0	Calculated				
{STM}.STM Pipe - (88)		(STM) CONDUIT	0	01:57	1.33	1.00	124.75	
217.08	0.57	0.56	0	Calculated				
Link-02		CONDUIT	0	02:07	0.97	1.00	48.64	29.18
1.67	0.38	0	>	CAPACITY				
Link-07		CHANNEL	0	01:54	0.37	1.00	128.49	1599.37
0.08	0.33	0	Calculated					
Link-09		CHANNEL	0	00:00	0.00	1.00	0.00	4835.64
0.00	0.24	0	Calculated					
Link-10		CHANNEL	0	00:00	0.00	1.00	0.00	5150.85
0.00	0.24	0	Calculated					
Link-101		CHANNEL	0	01:55	0.18	1.00	21.68	2182.86
0.01	0.29	0	Calculated					
Link-106		CHANNEL	0	01:55	0.25	1.00	12.84	1205.28
0.01	0.24	0	Calculated					
Link-11		CHANNEL	0	00:00	0.00	1.00	0.00	5252.16
0.00	0.29	0	Calculated					
Link-112		CHANNEL	0	00:00	0.00	1.00	0.00	2612.99
0.00	0.14	0	Calculated					
Link-113		CHANNEL	0	01:50	1.20	1.00	245.28	7253.46
0.03	0.25	0	Calculated					
Link-114		CHANNEL	0	01:50	1.04	1.00	269.92	5128.97
0.05	0.28	0	Calculated					
Link-115		CHANNEL	0	00:00	0.00	1.00	0.00	7724.46
0.00	0.08	0	Calculated					
Link-116		CHANNEL	0	00:00	0.00	1.00	0.00	6480.60
0.00	0.28	0	Calculated					
Link-117		CHANNEL	0	00:00	0.00	1.00	0.00	7043.17
0.00	0.07	0	Calculated					
Link-118		CHANNEL	0	01:55	0.46	1.00	17.89	2410.57
0.01	0.18	0	Calculated					
Link-119		CHANNEL	0	01:55	0.14	1.00	27.73	1867.22
0.01	0.37	0	Calculated					
Link-12		CHANNEL	0	00:00	0.00	1.00	0.00	4959.97
0.00	0.29	0	Calculated					
Link-120		CHANNEL	0	01:56	0.41	1.00	105.29	615.70
0.17	0.53	0	Calculated					
Link-13		CHANNEL	0	00:00	0.00	1.00	0.00	5644.46
0.00	0.29	0	Calculated					
Link-14		CHANNEL	0	01:50	0.27	1.00	42.23	3641.10
0.01	0.37	0	Calculated					
Link-16		CHANNEL	0	01:52	0.11	1.00	62.75	6382.27
0.01	0.44	0	Calculated					
Link-17		CHANNEL	0	01:55	0.18	1.00	89.71	4181.01
0.02	0.54	0	Calculated					
Link-18		CHANNEL	0	02:05	0.61	1.00	241.66	8005.23
0.03	0.36	0	Calculated					
Link-19		CHANNEL	0	01:55	0.14	1.00	49.35	5033.10
0.01	0.36	0	Calculated					
Link-22		CHANNEL	0	01:50	0.47	1.00	150.01	6281.68
0.02	0.57	0	Calculated					
Link-23		CHANNEL	0	01:53	0.49	1.00	162.91	4669.42
0.03	0.33	0	Calculated					
Link-25		CHANNEL	0	01:50	0.43	1.00	91.45	5071.11
0.02	0.45	0	Calculated					
Link-26		CHANNEL	0	01:50	0.46	1.00	102.45	5680.59
0.02	0.49	0	Calculated					
Link-30		CHANNEL	0	00:00	0.00	1.00	0.00	5184.30
0.00	0.40	0	Calculated					
Link-31		CHANNEL	0	00:00	0.00	1.00	0.00	6162.27
0.00	0.16	0	Calculated					
Link-32		CHANNEL	0	01:51	0.27	1.00	42.99	4279.24
0.01	0.22	0	Calculated					
Link-33		CHANNEL	0	00:00	0.00	1.00	0.00	8764.39
0.00	0.22	0	Calculated					
Link-34		CHANNEL	0	01:56	0.16	1.00	44.16	5772.47
0.01	0.29	0	Calculated					
Link-35		CHANNEL	0	01:57	0.45	1.00	43.82	2337.25
0.02	0.22	0	Calculated					
Link-38		CHANNEL	0	01:52	0.09	1.00	39.54	7853.58

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0.01	0.40	0	Calculated					
Link-40		CHANNEL	0	00:00	0.00	1.00	0.00	4972.23
0.00	0.28	0	Calculated					
Link-44		CHANNEL	0	01:50	0.16	1.00	27.40	6120.37
0.00	0.38	0	Calculated					
Link-45		CHANNEL	0	01:56	0.41	1.00	113.37	6891.85
0.02	0.44	0	Calculated					
Link-47		CHANNEL	0	00:00	0.00	1.00	0.00	9357.20
0.00	0.14	0	Calculated					
Link-48		CHANNEL	0	00:00	0.00	1.00	0.00	5539.93
0.00	0.14	0	Calculated					
Link-49		CHANNEL	0	00:00	0.00	1.00	0.00	8990.14
0.00	0.27	0	Calculated					
Link-51		CHANNEL	0	02:01	0.23	1.00	10.26	8207.33
0.00	0.29	0	Calculated					
Link-52		CHANNEL	0	01:56	0.05	1.00	17.13	4966.11
0.00	0.38	0	Calculated					
Link-53		CHANNEL	0	01:55	0.05	1.00	16.98	7791.47
0.00	0.38	0	Calculated					
Link-54		CHANNEL	0	00:00	0.00	1.00	0.00	5977.01
0.00	0.29	0	Calculated					
Link-55		CHANNEL	0	00:00	0.00	1.00	0.00	5338.41
0.00	0.44	0	Calculated					
Link-57		CHANNEL	0	01:50	0.27	1.00	42.67	5830.45
0.01	0.33	0	Calculated					
Link-59		CHANNEL	0	01:50	0.57	1.00	41.31	6538.68
0.01	0.38	0	Calculated					
Link-60		CHANNEL	0	02:00	0.19	1.00	10.32	8047.95
0.00	0.33	0	Calculated					
Link-61		CHANNEL	0	01:55	0.18	1.00	20.53	557.33
0.04	0.37	0	Calculated					
Link-64		CHANNEL	0	01:55	2.54	1.00	68.96	1426.11
0.05	0.42	0	Calculated					
Link-70		CHANNEL	0	01:55	0.26	1.00	23.60	852.26
0.03	0.25	0	Calculated					
Link-71		CHANNEL	0	01:52	0.21	1.00	11.08	1217.28
0.01	0.22	0	Calculated					
Link-72		CHANNEL	0	01:55	0.13	1.00	69.68	1974.30
0.04	0.67	0	Calculated					
Link-74		CHANNEL	0	01:55	0.18	1.00	68.99	1195.56
0.06	0.59	0	Calculated					
Link-75		CHANNEL	0	01:55	0.12	1.00	55.24	2088.96
0.03	0.65	0	Calculated					
Link-77		CHANNEL	0	01:55	0.31	1.00	54.61	1394.08
0.04	0.39	0	Calculated					
Link-80		CHANNEL	0	01:55	0.17	1.00	69.90	1224.27
0.06	0.53	0	Calculated					
Link-82		CHANNEL	0	01:55	0.20	1.00	69.24	2012.43
0.03	0.48	0	Calculated					
Link-85		CHANNEL	0	01:55	0.12	1.00	73.35	1540.30
0.05	0.64	0	Calculated					
Link-86		CHANNEL	0	01:55	0.45	1.00	72.70	2147.91
0.03	0.35	0	Calculated					
Link-91		CHANNEL	0	01:55	0.35	1.00	16.36	1476.16
0.01	0.18	0	Calculated					
Link-93		CHANNEL	0	01:55	0.35	1.00	26.54	1205.28
0.02	0.23	0	Calculated					
Link-96		CHANNEL	0	01:51	0.27	1.00	22.29	852.26
0.03	0.23	0	Calculated					
Link-97		CHANNEL	0	00:00	0.00	1.00	0.00	2976.83
0.00	0.00	0	Calculated					
Link-99		CHANNEL	0	01:55	1.13	1.00	21.74	852.26
0.03	0.23	0	Calculated					
{STM}.CBL109	(STM)	ORIFICE	0	01:54			84.04	
1.00								
{STM}.CBL111	(STM)	ORIFICE	0	01:54			60.59	
1.00								
{STM}.CBL113	(STM)	ORIFICE	0	02:01			57.96	
1.00								
{STM}.CBL115	(STM)	ORIFICE	0	01:54			35.09	

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1.00						
{STM}.CBL117	(STM)	ORIFICE	0	01:54		101.49
1.00						
{STM}.CBL119	(STM)	ORIFICE	0	01:56		80.89
1.00						
{STM}.CBL123	(STM)	ORIFICE	0	01:57		54.90
1.00						
{STM}.CBL125	(STM)	ORIFICE	0	01:54		100.39
1.00						
{STM}.CBL128	(STM)	ORIFICE	0	01:56		78.96
1.00						
{STM}.CBL130	(STM)	ORIFICE	0	01:54		84.54
1.00						
{STM}.CBL85	(STM)	ORIFICE	0	02:00		48.82
1.00						
{STM}.CBL87	(STM)	ORIFICE	0	01:54		74.14
1.00						
{STM}.CBL91	(STM)	ORIFICE	0	01:58		75.23
1.00						
{STM}.CBL93	(STM)	ORIFICE	0	01:57		106.97
1.00						
{STM}.CBL97	(STM)	ORIFICE	0	01:56		22.95
1.00						
{STM}.STM Pipe - (182)	(STM)	ORIFICE	0	01:42		169.12
1.00						
{STM}.STM Pipe - (183)	(STM)	ORIFICE	0	01:41		148.87
1.00						
{STM}.STM Pipe - (389)	(STM)	ORIFICE	0	01:50		69.60
1.00						
{STM}.STM Pipe - (391)	(STM)	ORIFICE	0	01:54		97.13
1.00						
{STM}.STM Pipe - (392)	(STM)	ORIFICE	0	01:50		67.55
1.00						
{STM}.STM Pipe - (393)	(STM)	ORIFICE	0	01:51		88.17
1.00						
{STM}.STM Pipe - (397)	(STM)	ORIFICE	0	01:55		27.05
1.00						
{STM}.STM Pipe - (400)	(STM)	ORIFICE	0	01:55		62.40
1.00						
{STM}.STM Pipe - (403)	(STM)	ORIFICE	0	01:55		63.53
1.00						
{STM}.STM Pipe - (406)	(STM)	ORIFICE	0	01:55		64.87
1.00						
{STM}.STM Pipe - (409)	(STM)	ORIFICE	0	01:55		50.81
1.00						
{STM}.STM Pipe - (412)	(STM)	ORIFICE	0	01:55		58.83
1.00						
{STM}.STM Pipe - (414)	(STM)	ORIFICE	0	01:55		50.74
1.00						
{STM}.STM Pipe - (417)	(STM)	ORIFICE	0	01:55		35.43
1.00						
{STM}.STM Pipe - (419)	(STM)	ORIFICE	0	01:55		15.78
1.00						
{STM}.STM Pipe - (421)	(STM)	ORIFICE	0	01:55		24.76
1.00						
{STM}.STM Pipe - (425)	(STM)	ORIFICE	0	01:51		21.97
1.00						
{STM}.STM Pipe - (427)	(STM)	ORIFICE	0	01:51		24.76
1.00						
{STM}.STM Pipe - (429)	(STM)	ORIFICE	0	01:55		18.46
1.00						
{STM}.STM Pipe - (433)	(STM)	ORIFICE	0	01:52		37.00
1.00						
{STM}.STM Pipe - (435)	(STM)	ORIFICE	0	01:55		17.94
1.00						
Link-01		ORIFICE	0	02:18		448.44
1.00						
Link-102		ORIFICE	0	01:52		17.72
1.00						
O-111		ORIFICE	0	01:50		22.08

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1.00

Flow Classification Summary

Link	--- Fraction of Time in Flow Class ---						Avg. Froude Number	Avg. Flow Change			
	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit					Down Crit
{STM}.STM Pipe - (190) (STM)	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.94	0.45	0.0001
{STM}.STM Pipe - (199) (STM)	0.00	0.00	0.00	0.02	0.00	0.97	0.01	0.00	0.00	0.12	0.0000
{STM}.STM Pipe - (390) (STM)	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.26	0.0001
{STM}.STM Pipe - (69) (1) (STM)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
0.0003 {STM}.STM Pipe - (69) (1) (STM)	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
0.0002 {STM}.STM Pipe - (70) (1) (STM)	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
0.0002 {STM}.STM Pipe - (70) (STM)	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.0002
{STM}.STM Pipe - (71) (STM)	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.0003
{STM}.STM Pipe - (72) (1) (STM)	0.00	0.84	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.01	
0.0000 {STM}.STM Pipe - (72) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.03	0.0002
{STM}.STM Pipe - (75) (2) (1) (STM)	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.01
0.0001 {STM}.STM Pipe - (75) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.01	0.0001
{STM}.STM Pipe - (76) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.01	0.0001
{STM}.STM Pipe - (77) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.02	0.0001
{STM}.STM Pipe - (78) (1) (STM)	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.97	0.00	
0.0000 {STM}.STM Pipe - (78) (STM)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.58	0.0001
{STM}.STM Pipe - (79) (1) (STM)	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.96	0.00	
0.0000 {STM}.STM Pipe - (79) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.01	0.0002
{STM}.STM Pipe - (80) (1) (STM)	0.88	0.03	0.00	0.04	0.00	0.00	0.00	0.00	0.06	0.00	
0.0000 {STM}.STM Pipe - (80) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.03	0.0001
{STM}.STM Pipe - (81) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.03	0.0001
{STM}.STM Pipe - (82) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.04	0.0001
{STM}.STM Pipe - (83) (1) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.12	
0.0001 {STM}.STM Pipe - (83) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.08	0.0001
{STM}.STM Pipe - (84) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.12	0.0001
{STM}.STM Pipe - (85) (STM)	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.17	0.0001
{STM}.STM Pipe - (86) (STM)	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.96	0.34	0.0001
{STM}.STM Pipe - (87) (STM)	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.98	0.31	0.0000
{STM}.STM Pipe - (88) (STM)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.54	0.0001
Link-02	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.23	0.0002	
Link-07	0.98	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.0000	
Link-09	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-10	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-101	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.07	0.0000	
Link-106	0.99	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-11	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-112	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-113	0.00	0.98	0.00	0.00	0.01	0.00	0.00	0.00	0.03	0.0000	
Link-114	0.00	0.98	0.00	0.01	0.01	0.00	0.00	0.00	0.02	0.0000	
Link-115	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-116	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-117	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-118	0.99	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.0000	
Link-119	0.00	0.99	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-12	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-120	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.19	0.0000	
Link-13	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000	
Link-14	0.98	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.0000	
Link-16	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.06	0.0000	

100 Year Output Summary.txt

Link-17	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.13	0.0000
Link-18	0.98	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.0000
Link-19	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.00	0.0000
Link-22	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.52	0.0000
Link-23	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.36	0.0000
Link-25	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.36	0.0000
Link-26	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.42	0.0000
Link-30	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-31	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-32	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.24	0.0000
Link-33	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-34	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.09	0.0000
Link-35	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.12	0.0000
Link-38	0.00	0.00	0.00	0.07	0.00	0.00	0.93	0.37	0.0000
Link-40	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-44	0.93	0.05	0.00	0.02	0.00	0.00	0.00	0.00	0.0000
Link-45	0.00	0.00	0.00	0.06	0.00	0.00	0.94	1.11	0.0000
Link-47	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-48	0.99	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-49	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-51	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.25	0.0000
Link-52	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.12	0.0000
Link-53	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.12	0.0000
Link-54	0.98	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-55	0.97	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-57	0.98	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-59	0.98	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-60	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.15	0.0000
Link-61	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-64	0.00	0.98	0.00	0.02	0.00	0.00	0.00	0.01	0.0000
Link-70	0.99	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.0000
Link-71	0.99	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.0000
Link-72	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.10	0.0000
Link-74	0.00	0.00	0.00	0.03	0.00	0.00	0.97	0.05	0.0000
Link-75	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.09	0.0000
Link-77	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.06	0.0000
Link-80	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.06	0.0000
Link-82	0.00	0.00	0.00	0.07	0.00	0.00	0.93	0.09	0.0000
Link-85	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.05	0.0000
Link-86	0.00	0.00	0.00	0.02	0.00	0.00	0.98	0.09	0.0000
Link-91	0.99	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0000
Link-93	0.98	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.0000
Link-96	0.99	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.0000
Link-97	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0000
Link-99	0.00	0.99	0.00	0.01	0.00	0.00	0.00	0.00	0.0000

Highest Continuity Errors

Node 4+568 (-3.17%)
Node CB87-88 (STM) (-1.97%)
Node CB93-94 (STM) (-1.66%)
Node Jun-51 (1.22%)
Node CB91-92 (STM) (1.19%)

Highest Flow Instability Indexes

Link {STM}.STM Pipe - (182) (STM) (20)
Link Link-01 (15)
Link {STM}.STM Pipe - (75) (2) (1) (STM) (9)
Link {STM}.STM Pipe - (76) (STM) (6)
Link {STM}.STM Pipe - (75) (STM) (3)

Routing Time Step Summary

100 Year Output Summary.txt

Minimum Time Step : 5.00 sec
Average Time Step : 5.00 sec
Maximum Time Step : 5.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 7.26

WARNING 107 : Initial water surface elevation defined for Junction 379A (STM) is below junction invert elevation.

Assumed initial water surface elevation equal to invert elevation.

WARNING 108 : Surcharge elevation defined for Junction 4+420 is below junction maximum elevation. Assumed surcharge elevation equal to maximum elevation.

WARNING 118 : Orifice crest elevation defined for Orifice 0-111 is below upstream node invert elevation.

Assumed orifice crest elevation equal to upstream node invert elevation.

WARNING 116 : Conduit inlet invert elevation defined for Conduit {STM}.STM Pipe - (199) (STM) is below upstream node invert elevation.

Assumed conduit inlet invert elevation equal to upstream node invert

elevation.

WARNING 116 : Conduit inlet invert elevation defined for Conduit {STM}.STM Pipe - (71) (STM) is below upstream node invert elevation.

Assumed conduit inlet invert elevation equal to upstream node invert

elevation.

WARNING 116 : Conduit inlet invert elevation defined for Conduit {STM}.STM Pipe - (72) (STM) is below upstream node invert elevation.

Assumed conduit inlet invert elevation equal to upstream node invert

elevation.

WARNING 004 : Minimum elevation drop used for Conduit Link-02.

WARNING 117 : Conduit outlet invert elevation defined for Conduit Link-113 is below downstream node invert elevation.

Assumed conduit outlet invert elevation equal to downstream node invert

elevation.

100 Year Output Summary.txt

WARNING 117 : Conduit outlet invert elevation defined for Conduit Link-114 is below downstream node invert elevation.

Assumed conduit outlet invert elevation equal to downstream node invert

elevation.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 10+053.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 11+001.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+001.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+185.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+228.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+254.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 12+309.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 373A (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 379A (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+345.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+420.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+510.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+568.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+665.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+750.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 4+828.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 6+088.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 6+102.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 7+096.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 8+128.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node 8+150.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB101-102 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB111-112.

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB113-114 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB115-116 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB117-118 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB119-120 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB121-122 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB123-124 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB125-126 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB127-128 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB129-130 (STM).

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB131-132 (STM).

100 Year Output Summary.txt

WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB133-134 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB85-86 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB87-88 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB89-90 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB91-92 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB93-94 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB95-96 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node CB97-98 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node E-34.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-35.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-37.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-40.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-43.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node Jun-51.
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-21 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-22 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-23 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-24 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-25 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-27 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-28 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-30 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-31 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-32 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-33 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-34 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-38 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCB-39 (STM).
WARNING 002 : Max/rim elevation (depth) increased to account for connecting conduit height dimensions for Node RYCBMH-2 (STM).

Analysis began on: Tue Jul 14 09:13:37 2015
Analysis ended on: Tue Jul 14 09:13:43 2015
Total elapsed time: 00:00:06

Appendix D Drawings

<i>Draft Plan of Subdivision</i>	<i>(Annis, O'Sullivan, Vollebekk)</i>
<i>Storm Drainage Area Plans</i>	<i>108180-15-STM</i>
<i>Erosion and Sediment Control Plan</i>	<i>108180-15-ESC</i>

REGISTERED PLAN 4M-1491
BLOCK 213

BLOCK 222
0.30 RESERVE
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060

BLOCK 226
0.30 RESERVE
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060

BLOCK 142
0.30 RESERVE
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060

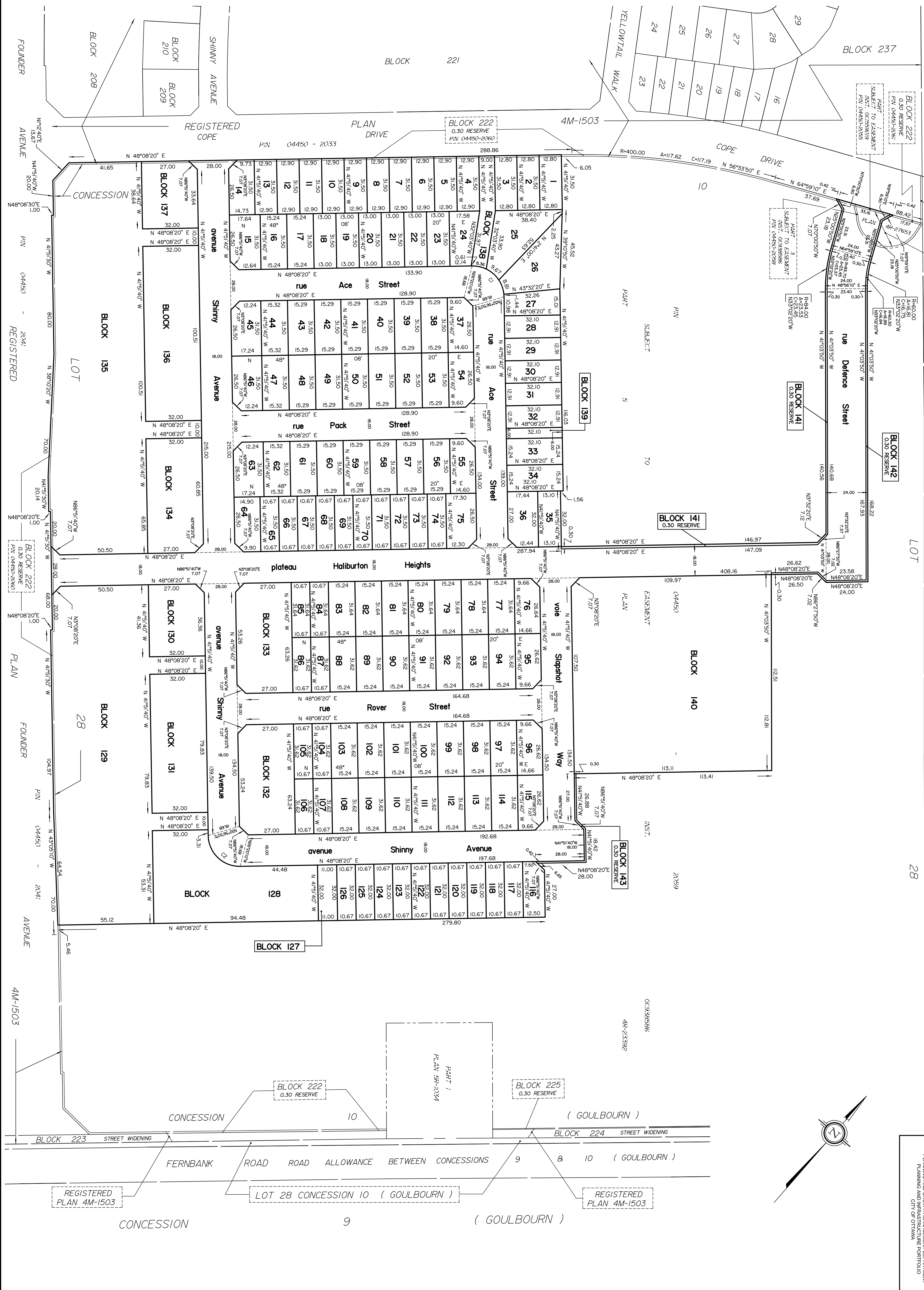
BLOCK 141
0.30 RESERVE
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060

BLOCK 140
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060

BLOCK 139
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060

BLOCK 138
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060

BLOCK 137
PART TO EASEMENT
P.L.N. 04450-2060
P.V. 04450-2060



CURVE SCHEDULE

NUM.	LOCATION	RADIUS	ARC	CHORD	BEARING
C1					
C2					

APPROVED UNDER SECTION 51 OF THE PLANNING ACT
BY THE CITY OF OTTAWA
THIS DAY OF _____

JOHN L. MOSEY, GENERAL MANAGER
PLANNING AND GROWTH MANAGEMENT DEPARTMENT
CITY OF OTTAWA

PLAN 4M-
I CERTIFY THAT THIS PLAN IS REGISTERED IN THE LAND REGISTRY OFFICE OF THE LAND TITLES DIVISION OF OTTAWA-COULETOWN NO. 4 AT _____ O'CLOCK ON THE _____ DAY OF _____ AND ENTERED IN THE PARCEL REGISTER FOR PROPERTY IDENTIFIERS _____ AND THE REQUIRED CONSENTS ARE REGISTERED AS PLAN DOCUMENT NO. _____

LAND REGISTRAR

**PLAN OF SUBDIVISION OF
PART OF LOT 28
CONCESSION 10**
Geographic Township of Goulbourn
And
PART OF BLOCK 222
REGISTERED PLAN 4M-1503
CITY OF OTTAWA

Surveyed by Annis, O'Sullivan, Vollebakk Ltd.

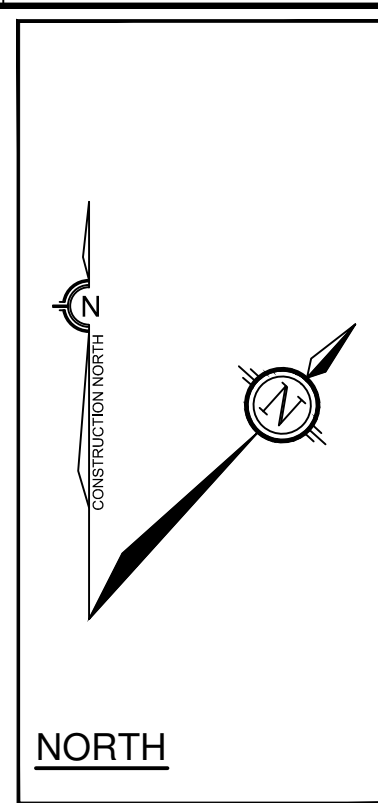
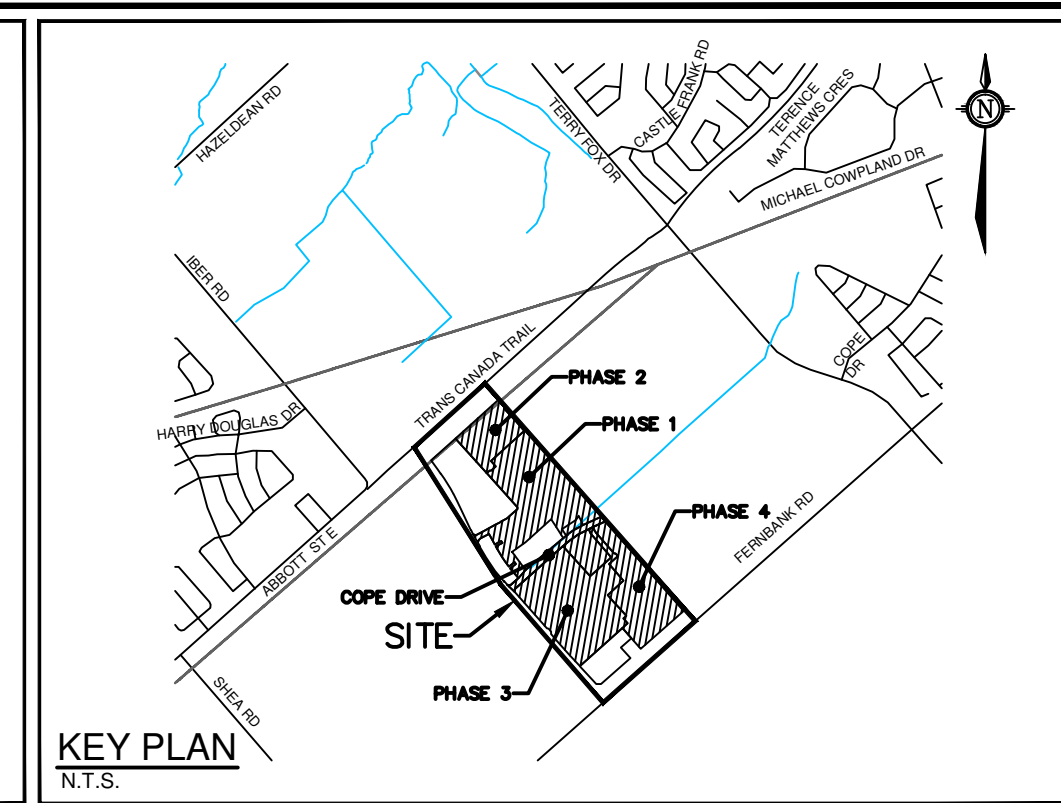
Scale 1 : 1000
Metric
DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METERS AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

SURVEYORS CERTIFICATE
I CERTIFY THAT:
1. This survey and plan are correct and in accordance with the Surveys Act, the Surveyors Act and the Land Titles Act and the regulations made under them.
2. The Survey was completed on the _____ day of _____, 2015.

OWNERS CERTIFICATE
This is to certify that:
1. Lots 1 to 126, both inclusive, blocks 127 to 140, both inclusive, the streets, namely, Ace Street, rue Defence Street, plateau Shiny Heights, rue Pack Street, rue Rover Street, avenue Shiny and rue Sagspot Street, and the parcels of land therein, lots 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, have been laid out in accordance with my instructions.
2. The streets are dedicated as public highways.

NOTES AND LEGEND
-D- denotes Survey Monument Planted.
-S- Survey Monument Found.
-SIB- Standard Iron Bar.
-CC- Short Standard Iron Bar.
-C- Cur. Cross.
-IB- Iron Bar.
-CF- Chain Link Fence.
-BF- Board Fence.
-AOG- Amnis, O'Sullivan, Vollebakk Ltd.
-P- Plan.
-F1- Plan.
-F2- Plan.

ANNIS, O'SULLIVAN, VOLLEBAKK LTD.
14 Concordia Gate, Suite 500
Ottawa, Ontario K1K 0P6
Phone: (613) 737-7079
Fax: (613) 737-7079
www.aosvl.com
LAND SURVEYORS (S.O. Reg. No. 52724-2, Reg. No. P.L. 1, 28, 010, 00, 036, 03)



LEGEND

- SILT FENCE PER OPSD 219.110
- STRAW BALE FLOW CHECK PER OPSD 219.180
- DEBRIS AND RUBBLE FROM DEMOLISHED STRUCTURE
- CLEARING, GRUBBING & TOPSOIL STRIPPING
- REMOVALS

EROSION AND SEDIMENT CONTROL NOTES :

1. ALL EROSION AND SEDIMENT CONTROLS ARE TO BE INSTALLED TO THE SATISFACTION OF THE ENGINEER, THE MUNICIPALITY AND THE CONSERVATION AUTHORITY. THEY ARE TO BE APPROPRIATE TO THE SITE CONDITIONS. PRIOR TO UNDERTAKING ANY SITE ALTERATIONS (FILLING, GRADING, REMOVAL OF VEGETATION, ETC.) AND DURING ALL PHASES OF SITE PREPARATION AND CONSTRUCTION THESE PRACTICES ARE TO BE IMPLEMENTED IN ACCORDANCE WITH THE CURRENT BEST MANAGEMENT PRACTICES FOR EROSION AND SEDIMENT CONTROL AND SHOULD INCLUDE AS A MINIMUM THOSE MEASURES INDICATED ON THE PLAN.
2. TO PREVENT SURFACE EROSION FROM ENTERING THE DITCH OR STORM SYSTEM DURING CONSTRUCTION, FILTER CLOTH WILL BE PLACED UNDER GRATES OF ALL PROPOSED AND EXISTING CATCHBASINS AND STRUCTURES. A LIGHT DUTY SILT FENCE BARRIER WILL ALSO BE INSTALLED IN SELECTED LOCATIONS SHOWN ON THIS PLAN AND STRAW BALE BARRIERS WILL BE INSTALLED WITHIN THE OUTLET DITCHES. THESE CONTROL MEASURES WILL REMAIN IN PLACE UNTIL VEGETATION HAS BEEN ESTABLISHED AND CONSTRUCTION COMPLETE.
3. THE SEDIMENT CONTROL MEASURES SHALL ONLY BE REMOVED WHEN, IN THE OPINION OF THE ENGINEER, THE MEASURES ARE NO LONGER REQUIRED. NO CONTROL MEASURES MAY BE PERMANENTLY REMOVED WITHOUT PRIOR AUTHORIZATION FROM THE ENGINEER.
4. THE CONTRACTOR SHALL IMMEDIATELY REPORT TO THE ENGINEER ANY ACCIDENTAL DISCHARGES OF SEDIMENT MATERIAL INTO ANY DITCH OR STORM SEWER SYSTEM. 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.
5. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.
6. THE CONTRACTOR SHALL ENSURE PROPER DUST CONTROL IS PROVIDED WITH THE APPLICATION OF WATER (AND IF REQUIRED, CALCIUM CHLORIDE) DURING DRY PERIODS.

REMOVALS NOTES :

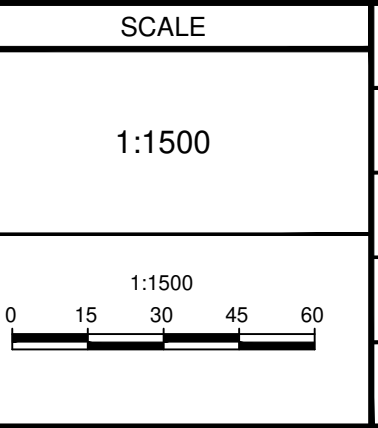
1. ALL HYDRANTS, VALVES AND OTHER APPURTENANCES TO BE REMOVED SHALL BE SALVAGED AND DELIVERED TO CITY OF OTTAWA MAINTENANCE YARD AT CLYDE AVENUE.
2. THE CONTRACTOR SHALL PROTECT ALL SURVEY MONUMENTS.
3. REMOVAL OF ALL ABOVE GROUND TRAFFIC PLANT AND STREETLIGHTING TO BE DONE BY OTHERS. CONTRACTOR SHALL PROTECT AND MAINTAIN EXISTING STREETLIGHTING, HYDRO POLES AND OVERHEAD LINES DURING CONSTRUCTION.
4. ALL BELL AND HYDRO OTTAWA MAINTENANCE HOLE ADJUSTMENTS SHALL BE PERFORMED BY AN APPROVED CONTRACTOR ONLY.
5. ALL TOPSOIL AND ANY SOFT, WET OR DELETERIOUS MATERIAL SHALL BE REMOVED FROM IMPROVED AREAS UNLESS OTHERWISE DIRECTED BY THE ENGINEER.
6. FORESTRY TO BE CONTACTED PRIOR TO ANY SELECTIVE PRUNING OR REMOVALS WITHIN THE AREAS OF TREES SURROUNDING THE TRANS CANADA TRAIL AND TREES THAT ARE TO REMAIN ARE TO HAVE PROPER TREE PROTECTION FENCING.



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



No.	REVISION	DATE	BY
5.	ISSUED FOR MOE	JUL 13/15	MAB
4.	REVISED PER CITY COMMENTS	JUN 23/15	MAB
3.	ISSUED FOR APPROVAL	MAY 3/15	MAB
2.	ISSUED FOR APPROVAL	MAR 10/15	MAB
1.	ISSUED FOR APPROVAL	DEC 19/14	MAB



FOR REVIEW ONLY

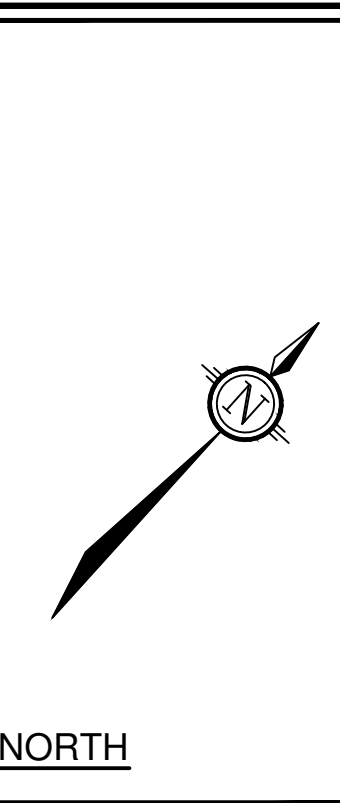
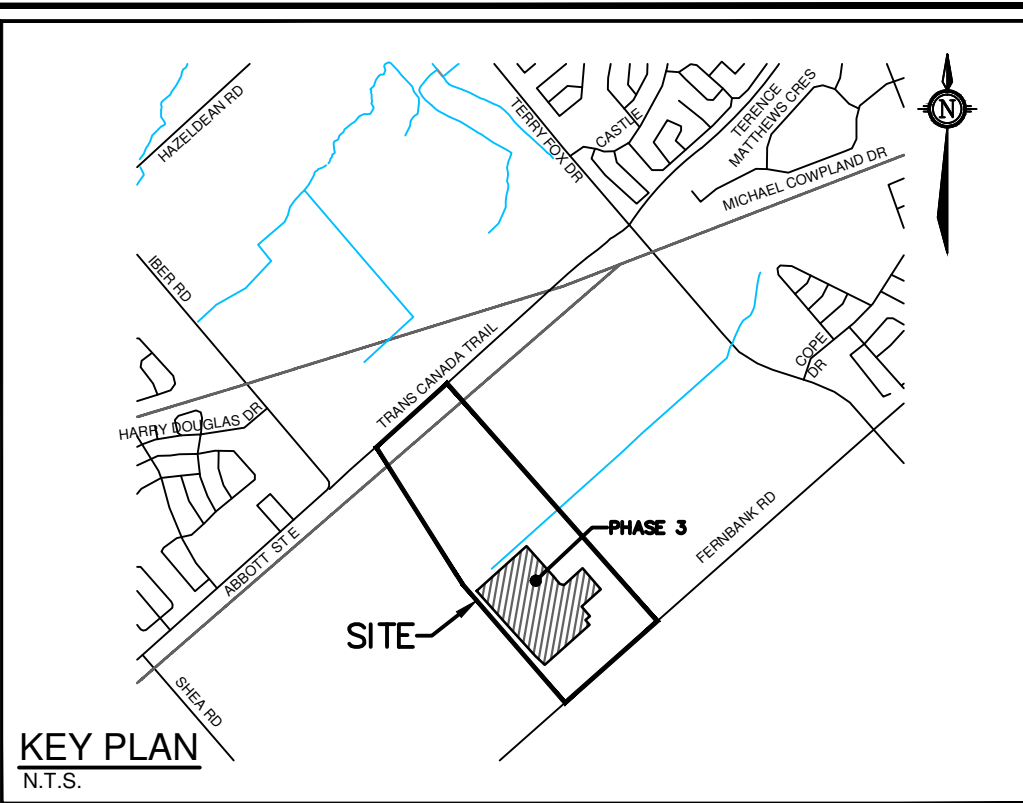
DESIGN: LRW
CHECKED: MAB
DRAWN: DTD
CHECKED: MAB
APPROVED: JGR

NOVATECH
Engineers, Planners & Landscape Architects
Suite 200, 240 Michael Cowland Drive
Ottawa, Ontario, Canada K2M 3P6
Telephone: (613) 254-9643
Facsimile: (613) 254-5867
Website: www.novatech-eng.com

CITY OF OTTAWA
FERNBANK CROSSING

EROSION AND SEDIMENT CONTROL PLAN & REMOVALS

PROJECT No.: 108180-15
REV: REV # 5
DRAWING No.: 108180-15-ESC

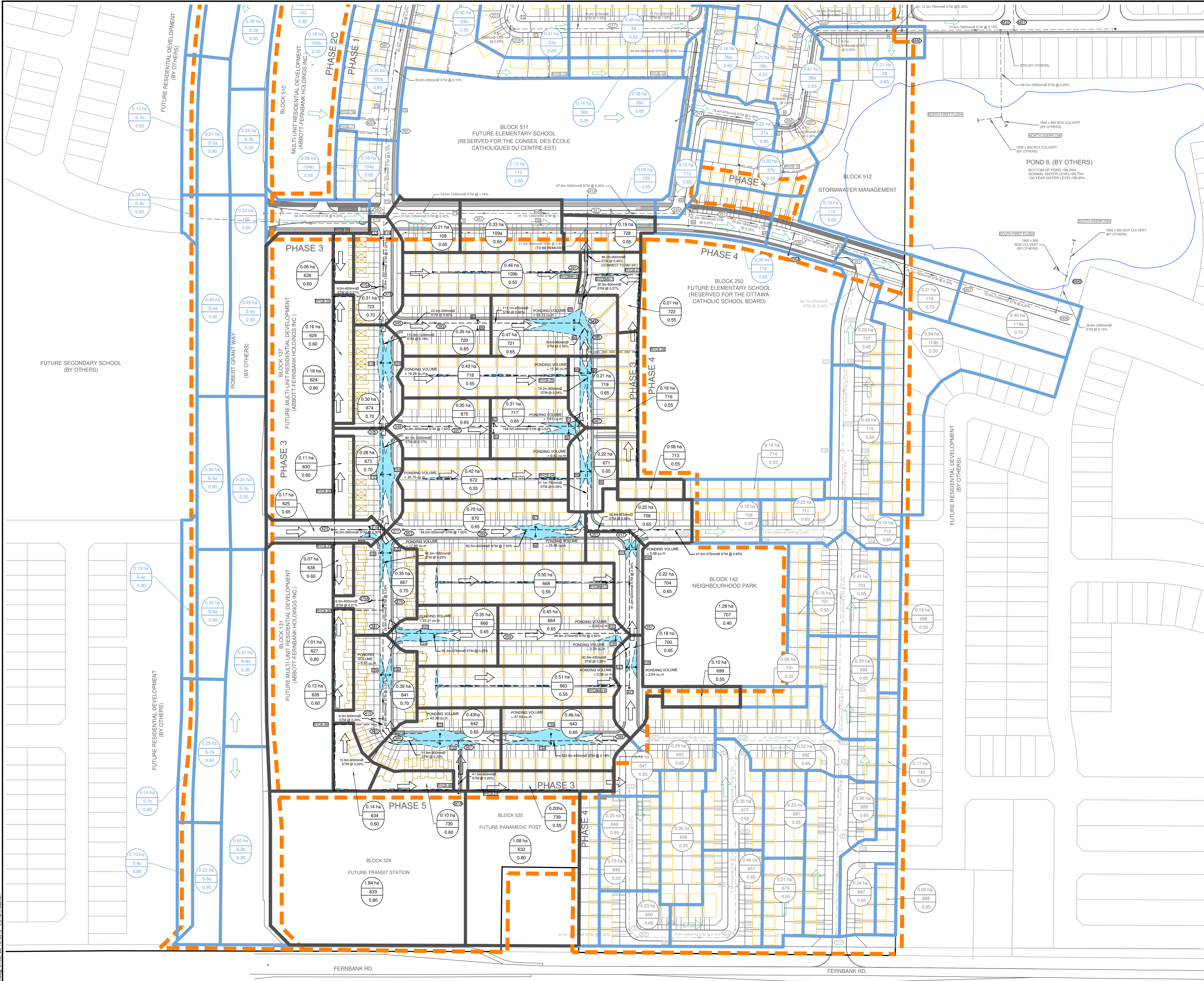


LEGEND

- PHASE 3 AREA (hectares)
- PHASE 3 AREA ID
- PHASE 3 RUN-OFF COEFFICIENT
- FUTURE-EXISTING DRAINAGE AREA (hectares)
- FUTURE-EXISTING AREA ID
- FUTURE-EXISTING RUN-OFF COEFFICIENT
- STORM DRAINAGE AREA BOUNDARY
- EXISTING STORM DRAINAGE AREA BOUNDARY
- PROPOSED STORM MANHOLE & SEWER WITH DIRECTION OF FLOW
- PROPOSED ROAD CATCHBASIN
- MAJOR SYSTEM FLOW ROUTE
- PONDING AREA

STM MANHOLE TABLE (PH3)

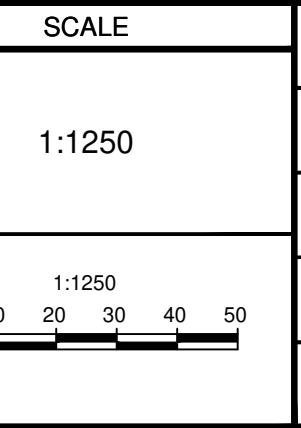
MANHOLE ID	OBVERT
309	NE-101.68 SW-100.79
343	NW-99.61 E-99.64 SW-100.93
345	NE-101.75
347	NW-99.98 SE-99.98 SW-99.98
349	NE-101.06
351	NW-100.28 NE-100.28 SW-100.28
353	NE-101.72
357	NW-102.42 SW-102.42
359	SW-103.00 NE-102.92
373	NW-102.23 SE-102.23 SW-102.23
375	NW-102.43 SE-102.43 SW-102.43
377	NW-102.57 SE-102.57 SW-102.57
379	NW-102.71 SE-102.71 SW-102.71
381	NW-102.77 SE-102.77 NE-102.77
383	NW-102.96 E-102.96
385	W-102.98 NE-102.98
387	SW-103.08 NE-103.08 SE-103.14
389	SW-103.32
391	NW-99.46 SE-99.46
393	NE-101.61 SW-101.61
395	W-99.69 SE-99.72
397	NE-100.54 SW-100.54
399	NE-101.08 SW-101.08
417	SW-100.48 NE-100.48 SE-100.48
419	NW-102.94 SE-102.94 SW-102.94
421	NW-102.57
423	NE-102.97



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1.	ISSUED FOR APPROVAL	DEC 19/14	MAB



FOR REVIEW ONLY

REGISTERED PROFESSIONAL ENGINEER
J.G. RIDDELL
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
M.A. BISSETT
PROVINCE OF ONTARIO



CITY OF OTTAWA
FERNBANK CROSSING - PHASE 3

STORM DRAINAGE AREA PLAN

REVIEWED BY DEVELOPMENT REVIEW BRANCH

Signed _____

Date _____ 2015

Plan Number 16229

PROJECT No. 108180-15

REV # 5

DRAWING No. 108180-15-STM