REPORT
PROJECT: 27970-5.2.2

DESIGN BRIEF
CRT LANDS PHASE 1
FERNBANK COMMUNITY

Prepared for CRT DEVELOPMENT INC.
by IBI GROUP

JULY 2017

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1 INTRODUCTION

1.1 Background

In 2009, the City of Ottawa completed the Fernbank Community Design Plan (FCDP).The FCDP covers approximately 675 gross hectares of land between the established communities of Stittsville, Kanata West and Kanata South. The community extends from Hazeldean Road to the north, the Carp River and Terry Fox Drive to the east, Fernbank Road to the south and the existing Urban Area of Stittsville to the west.

In conjunction with preparation of the Community Design Plan, several Class Environmental Assessment Studies/Master Plans were also prepared. Two of those were the Master Servicing Study (MSS) for water and sanitary and an Environmental Management Plan (EMP) for the natural environment and stormwater management. Those reports identify planning level solutions for on-site storm drainage, wastewater collection and water supply and distribution to the community. Those reports recommended a Preliminary Demonstration Plan on which the recommended major infrastructure servicing will be based. A copy of the Preliminary Demonstration Plan is included in **Figure 1.1**.

1.2 Objective

The purpose of this Design Brief is to provide stakeholder regulators with the project background together with the design philosophy and criteria incorporated in the subdivision design. This report will provide a logical framework to assist reviewers with evaluation of the design of the development.

Land is now being assembled in the Fernbank Community and development applications are being brought forward for approvals. This report is being prepared in support of development approval for the CRT Lands. This report will provide a recommended servicing plan for the major municipal infrastructure needed to support development of the subject property. The review will be a macro level detail study with further details to be confirmed and provided during the design process in the form of detail designs and design briefs. This report will demonstrate how proposed municipal servicing is in conformance with the MSS recommendations. Any deviation from the MSS documents will also be identified with rationalization for the change.

This report was prepared in accordance with the November 2009 Servicing Study Guidelines for Development Applications in the City of Ottawa. **Appendix A** contains a customized copy of those guidelines which can be used as a quick reference for the location of each of the guideline items within the study report.

1.3 Subject Property

The current draft plan for the subject property, which is located in the Fernbank Community, is identified on **Figure 1.2**, which is located in **Appendix A**. The property covers a total area of about 53 ha and is bounded by Fernbank Road to the south, Abbott Street and the Trans Canada Trail to the north, future CRT lands to the west and Robert Grant Avenue to the east. The upper reaches of the Flewellyn Drain also extend north of Fernbank Road into the property.

The proposed land use for the subject property, which is in general conformance with the FCDP, will include a residential mix of single family units, townhouses and stacked townhouses. The draft plan also provides land for both an elementary and secondary school and both a neighbourhood and community park. Also as per the FCDP, an east-west collector road (Cope Drive) is proposed to bisect the property.

1.4 Phasing

The total land holdings purchased by the CRT group cover about 165 ha. The proposed draft plan shown in **Figure 1.2** includes about 53 ha. However, the owners are proposing to develop the lands covered by the draft plan in at least two phases. **Figure 1.3** identifies the current phasing plan as envisioned by the Owners.

Phase 1, which includes construction of the first phase of the stormwater management facility covers about 53 ha. It includes the northern portion of the property including two school sites, one park and Cope Drive, the east-west collector street. Phase 1A, within Phase 1, is also identified in **Figure 1.3**. That area, covering about 7 ha, is the only portion of the draft plan with stormwater runoff tributary to Pond 6 which is located on the Fernbank Crossing lands east of Robert Grant Avenue.

It is the Owner's intent to develop Phase 1, including 1A, immediately upon receipt of approvals. The timing of development of Phase 2 will be market determined.

1.5 Previous Studies

The Fernbank Community development process included a number of background studies that are pertinent to the subject site. Three integrated Class Environmental Assessment Studies/Master Plans were prepared in support of the FCDP which include:

- Transportation Master Plan;
- Environmental Management Plan (EMP);
- Master Servicing Study (MSS).

In 2011, IBI Group completed a Conceptual Site Servicing Plan for the CRT Lands. That report was designed to assist the City in preparation of draft conditions for development of the subject property.

In January 2012, Novatech Engineering Consultants Ltd. completed the Fernbank Community Sanitary Trunk Sewer Design Report of the Fernbank Trunk Sewer. That sewer was identified in the 2009 MSS report. The 2012 report built upon previous design elements and included some changes to the proposed sewer design originally identified in the 2009 document. It is the latter report that will provide the design framework for the sanitary sewer design for the subject site.

Subsequent development applications under the Planning Act will be supported by these studies/plans. These studies were prepared and followed integration with the Planning Act provision of the Municipal Engineers Association Class Environmental Assessment Process

The subject property will follow closely the recommendations of those three reports. With respect to the provision of water supply, wastewater disposal and treatment of stormwater runoff, the recommendations of the EMP, MSS and the 2012 Fernbank Sewer Report will provide the development criteria on which the subject property will develop. Any deviations from the previous report criteria will be identified in later sections of this report.

1.6 Environmental Issues

The total property purchased by the CRT group includes some natural environment features as shown on Figure 3.2 in the EMP report which is included in **Appendix B** for reference. These include remnant higher quality trees, deciduous hedgerows, meadow habitat and wooded areas. The upper reaches of the Flewellyn Drain also extend about 950 meters into the property from Fernbank Road. In August 2011, under By-Law No. 2011-311, the City of Ottawa formally closed that portion of the Drain and it is no longer recognized as a Municipal Drain as per the provincial Drainage Act. A copy of the By-Law is attached in **Appendix B**.

A permit from the Rideau Valley Conservation Authority is required to fill the former Municipal Drains located north of Fernbank Road within the subject property. Two previously acquired permits have both expired. The owners have recently applied for an amendment to the expired permits.

It is also proposed to lower about 650 m of the existing Flewellyn Drain south of Fernbank Road. That work is required to achieve the herein recommended operating levels of the SWM Facility Pond 5. Additionally, the City of Ottawa has requested that the balance of Flewellyn Drain to Flewellyn Road also be upgraded. Therefore, an additional 800 m of existing drain will also be improved as part of the development of the CRT lands.

1.7 Pre-Consultation

There have been several consultations with City officials including project planners, engineers and municipal drain staff. Although no formal notes of these meetings were recorded, some of the issues reviewed include:

- Phasing;
- Wood lots;
- EIS and Tree Preservation Plan;
- Geotechnical Report;
- Traffic Impact Study;
- Park & Ride;
- Municipal Drain Closure.

During the recent City review of this report, the City advised that the City's 2013 Wastewater IMP and subsequent 2016 Update were completed. In accordance with the recommendations from these reports, the City requested that future flows through the CRT property be updated to include the following external flows:

• Liard Street Pump Station	108 l/s
• OPA 76 Area 6 Pump Station	84 l/s
• Future Developments	100 l/s
	292 l/s

IBI advised that the proposed sub-trunk sanitary sewer through the CRT lands could not accept the 100 l/s for future developments without significantly impacting the development of the CRT property. The City subsequently dropped the requirement for capacity provision for the 100 l/s for future developments. Therefore, the proposed sub-trunk sewer through the CRT property will be sized to provide capacity for external flow from both the existing Liard Street Pump Station and the Area 6 Pump Station. A copy of a relevant e-mail dated January 31, 2017 is included in **Appendix B**.

There also has been some previous correspondence with the provincial Ministry of Environment (MOE) and the Rideau Valley Conservation Authority (RVCA) regarding the development of Phase 1. Copies of e-mail correspondence from 2013 from those agents is also included in **Appendix B**.

1.8 Geotechnical Considerations

A Geotechnical Investigative Report entitled "Geotechnical Investigation Proposed Residential Development CRT Lands – Phase 1, Fernbank Road Ottawa, Ontario", number PG2236-2R, and dated July 23, 2014, was prepared by Paterson Group Inc. The objectives of the investigation include:

- Determination of the subsoil and groundwater conditions;
- Provision of preliminary geotechnical recommendations pertaining to the design and development of the subject site including construction considerations.

Among other items, the report will comment on the following:

- Site grading;
- Foundation design;
- Pavement structure;
- Infrastructure construction;
- Groundwater control;
- Grading;
- Tree planting.

Among other considerations, the report confirmed that there are limited locations where a maximum grade raise limit of 2.5 m is recommended. These limitations exist only in areas where silty clays are located below proposed footing elevations. **Figure 1.4** indicates these areas. The proposed maximum grade raises in the limitation areas are in the 2.2 m range. There are no grade raise limitations for the balance of the subject site.

The Owners have also obtained a Permit To Take Water for Phase 1. The PTTW No. 3238-9TLP82, which covers water taking for the subdivision, Pond 5 and the Flewellyn Drain improvements is included in **Appendix B**.

2 WATER SUPPLY

2.1 Existing Condition

The Fernbank Community is located within the City's 3W Pressure Zone which includes most of Kanata and Stittsville and is one of the most rapidly growing areas in the City. Potable water to this area is pressurized at the Glen Cairn Pump Station where a major water storage reservoir (Glen Cairn Reservoir) is located. Two of the major watermains in this pressure zone from the pump station are located along Hazeldean Road and Terry Fox Drive. As part of the development to the east of the site a 300 mm watermain has been extended from the Trans Canada Trail watermain along Livery Street and Bobolink Ridge crossing Robert Crescent Avenue to the limit of Phase 1. Another main adjacent to the subject site is located in Abbott Street and the Trans Canada Trail. **Figure 2.1** indicates the limits of existing watermains in the vicinity of the subject property.

2.2 Master Servicing Study

The Master Servicing Study recommended a conceptual water plan for the FCDP. A copy of the recommended plan, Watermain Layout Drawing No. 101108-WM, Revision 3, is included in **Appendix C**. For the subject property to be properly serviced with a reliable water supply, two connections to an existing 400 mm diameter main are recommended: one at Abbott Street west of Iber Road and the second along the Trans Canada Trail east of Iber Road. To complete a loop, an additional main is proposed along Bobolink Ridge. The 2009 MSS report recommended that all these mains be 300 mm diameter.

The connection to the existing 400 mm diameter main in the Trans Canada Trail has been completed by the adjacent Fernbank Crossing development which is located immediately east of Robert Grant Avenue and extended westward to Bobolink Ridge.

2.3 Design Criteria

2.3.1 Water Demands

Water demands have been calculated for the Phase 1. Per unit population density and consumption rates are taken from Tables 4.1 and 4.2 at the Ottawa Design Guidelines – Water Distribution and are summarized as follows:

- Single Family 3.4 person per unit
- Townhouse and Semi-Detached 2.7 person per unit
- Average Apartment 1.8 person per unit
- Residential Average Day Demand 350 l/cap/day
- Residential Peak Daily Demand 875 l/cap/day
- Residential Peak Hour Demand 1,925 l/cap/day
- ICI Average Day Demand 50,000 l/gross ha/day
- ICI Peak Daily Demand 75,000 l/gross ha/day
- ICI Peak Hour Demand 135,000 l/gross ha/day

Residential units in Phase 1 consist of single family and street townhouses. There are two school sites, Blocks 325 and 357, which are included in the hydraulic analysis and three future high density residential sites, Blocks 336, 355 and 356. A population of 90 persons per hectare is used to calculate the water demands for the future high density sites. A watermain demand calculation sheet is included in **Appendix C** and the total water demands are summarized as follows:

- Average Day 13.39 l/s
- Maximum Day 28.04 l/s
- Peak Hour 58.41 l/s

2.3.2 System Pressure

The Ottawa Design Guidelines – Water Distribution (WDG001), July 2010, City of Ottawa, Clause 4.2.2 states that the preferred practice for design of a new distribution system is to have normal operating pressures range between 345 kPa (50 psi) and 552 kPa (80 psi) under maximum daily flow conditions. Other pressure criteria identified in Clause 4.2.2 of the guidelines are as follows:

Minimum Pressure	Minimum system pressure under peak hour demand conditions shall not be less than 276 kPa (40 psi)
Fire Flow	During the period of maximum day demand, the system pressure shall not be less than 140 kPa (20 psi) during a fire flow event.
Maximum Pressure	Maximum pressure at any point in the distribution system shall not exceed 689 kPa (100 psi). In accordance with the Ontario Building/Plumbing Code, the maximum pressure should not exceed 552 kPa (80 psi). Pressure reduction controls will be required for buildings where it is not possible/feasible to maintain the system pressure below 552 kPa.

2.3.3 Fire Flow Rates

In the recent Technical Bulletin 'ISDTB-2014-02, Revisions to Ottawa Design Guidelines – Water', the fire flow requirements for single detached dwellings and traditional town and row houses can be capped at 10,000 l/min providing that there is a minimum separation of 10 meters between the backs of adjacent units and that the town and row house blocks are limited to 600 square meters of building areas and seven dwelling units. As the residential units in the Phase 1 meet the requirements of ISDTB-2014-02, the fire flow rate of 10,000 l/min (166.7 l/s) is used in the fire flow analysis.

As there are no details for the institutional land, a fire flow rate of 13,500 l/min (225 l/s) will be used in the fire flow analysis. This value should be considered conservative for a school with a sprinkler system.

2.3.4 Boundary Conditions

The City of Ottawa has provided hydraulic boundary conditions at two locations along the Trans Canada Trail 400 mm watermain. Two separate boundary conditions are given for the max day + fire scenario, one for a fire flow rate of 204 l/s which is used to calculate the residential units and one for a fire flow of 262 l/s which is used in the institutional lands analysis. A copy of the boundary condition is included in **Appendix C** and summarized as follows:

	CONNECTION 1	CONNECTION 2
Max HGL (Basic Day)	161.1 m	161.4 m
Peak Hour	154.7 m	154.8 m
Max Day + Fire (204 l/s Fire Flow)	152.8 m	153.0 m
Max Day + Fire (262 l/s Fire Flow)	150.6 m	150.9 m

2.3.5 Hydraulic Model

A computer model Phase 1 has been developed using the H20 MAP Version 6.0 program produced by MWH Soft Inc. The model includes the existing watermains and boundary conditions identified in Section 2.3.4.

2.4 Proposed Water Plan

2.4.1 Modeling Results

The hydraulic model was run under basic day, maximum day with fire flows and under peak hour conditions for Phase 1. Water pipes are sized to provide sufficient pressure and to deliver the required fire flows.

Results of the hydraulic model are include in **Appendix C** and summarized as follows:

Scenario	
Basic Day (Max HGL) Pressure Range	508.7 to 544.5 kPa
Peak Hour Pressure Range	441.4 to 477.1 kPa
Max Day + 204 l/s Fire Flow Minimum Flow	184.7 l/s
Max Day + 262 l/s Fire Flow Minimum Flow	243.4 l/s

A comparison of the results and design criteria is summarized as follows:

Maximum Pressure	All notes have basic day pressures under 552 kPa, therefore pressure reducing control is not required for this development.
Minimum Pressure	All nodes in the model exceed the minimum value of 276 kPa (40 psi).
Fire Flow	The lowest fire flow for the residential lands is 184.4 l/s which exceeds the requirement of 166.7 l/s while the lowest fire flow for the institutional blocks is 243.4 l/s which exceeds the requirement of 225 l/s.

2.4.2 Watermain Layout

The proposed watermain layout for Phase 1 is shown on Figure 2.2. In accordance with the Master Servicing Study, a 300 mm watermain is extended on Bobolink Ridge connecting to the existing 300 mm main. A 300 mm watermain is also installed on Goldhawk Drive and Angel Heights extending across the Hydro One corridor and Trans Canada Trail to connect to the existing 400 mm watermain providing two connections to the Phase 1 development. All other mains are 150 mm and 200 mm.

3 WASTEWATER DISPOSAL

3.1 Existing Conditions

The Hazeldean Pump Station (HPS) is the recommended wastewater outlet for all lands in the FCDP, including the subject site. Among other areas in Kanata, including Bridlewood, Kanata South Business Park and the Glen Cairn Community, the HPS also serves most developed lands in Stittsville west of Terry Fox Drive and south of Hazeldean Road. Flows are directed towards the station via the existing 750 mm diameter Stittsville Trunk Sewer which is located in Abbott Street and the Trans Canada Trail.

The 900Ø South Glen Cairn Trunk and 750Ø Glamorgan Trunk Sewer also contribute wastewater flows to the HPS. A 525Ø sub-trunk sewer in Cope Drive near the south west section of the FCDP, west of Terry Fox Drive, also directs flows to the South Glen Cairn Trunk sewer.

The design of the station did not consider the Fernbank Community. Recognizing the need to complete upgrades to the HPS in order to accommodate new growth from the Fernbank Community, the City, in 2014, completed upgrades to the HPS and increased its capacity to 1225 l/s. The Fernbank Trunk Sewer was subsequently completed and is terminated at MH FT24 which is located in the Hydro One easement within the subject site.

Figure 2.1 shows the location of the existing sanitary sewer system in the vicinity of the subject site.

3.2 Master Servicing Studies

The June 24, 2009 Master Servicing Study was completed in support of the FCDP. The MSS Report recommended a wastewater collection and disposal system for the FCDP, including the subject site. Subsequent to completion of the 2009 MSS report, Novatech Consulting Engineers Ltd completed the Fernbank Community Sanitary Trunk Sewer Design Report in 2012. The latter report recommended construction of the Fernbank Trunk Sewer in the Hydro One easement adjacent to the Trans Canada Trail. The upper reach of the Trunk Sewer is designed as a 600 mm dia pipe at 0.39% slope and is proposed to be constructed immediately north of the subject site and will provide an outlet capacity at MH-FT24. Copies of the Drainage Area Plan and design sheet from the 2012 Fernbank Trunk Sewer report are included in **Appendix D**.

The following is a comparison of the proposed tributary areas and population projections from the 2012 report and the CRT Phase 2 design.

Table 3.1 Elements Tributary to MH-FT24

DESIGN	AREA (HA)	POPULATION
2012	200.11	10436
CRT Phase 1*	203.44	10400

** The areas and populations for the MH-FT24 outlet have been adjusted to account for OPA Expansion Area 6.*

Table 3.2 Elements Tributary to MH-FT18

DESIGN	AREA (HA)	POPULATION
2012	13.19	538
CRT Phase 1*	12.21	524

** The areas and populations for the MH-FT24 outlet have been adjusted to account for OP Expansion Area 6.*

As is evident from these tables, the areas and population estimates for each outlet are relatively consistent. There are to be some minor differences expected between final design, when final lotting is known, and the more macro focused master study estimates. Therefore, the sanitary design is in general conformance with the 2012 Trunk Sewer Report.

There are some changes now recommended to the sanitary drainage area boundaries, especially along the west side of Robert Grant Avenue and the drainage divide along the Phase 1A limits. The changes are identified in **Figure 3.1**. The significant change is that the school site, Block 361, adjacent to Robert Grant Avenue is now proposed to be serviced from Cope Drive and be tributary to the proposed 600 mm Ø sub-trunk sewer in Goldhawk Drive. The MSS report recommended that the school site be tributary eastward to the Fernbank Crossing development. The change is recommended because of ownership boundaries.

Upstream of MH-FT24 on the Fernbank Trunk Sewer, the 2009 MSS document recommended construction of a 525 mm diameter sub-trunk sewer along Goldhawk Drive and a 450 mm diameter sewer oversized for external lands west of Shea Road. A copy of the 2009 MSS Sanitary Drainage Area Plan (Drawing 101108-SAN) is included in **Appendix D**. Since the 2009 MSS report was completed, the City of Ottawa has requested that the CRT sanitary sewer be oversized to account for wastewater flows to the existing Laird Street Pump Station and also expected flow from the 2012 OPA Area 6 expansion lands. The latter areas were brought into the urban envelope in 2012 as part of the last Official Plan review by the City.

In accordance with recent instructions from the City of Ottawa, an allowance for external flows of 192 l/s has been provided in the proposed 600 mm Ø sub-trunk sewer in the subject property, 108 l/s for the Liard Street Pump Station and 84 l/s for the OPA 76 Area 6 lands. Refer to an e-mail string last dated January 31, 2017 from the City located in **Appendix B**.

Therefore, the recommended sanitary sewer extension through the CRT Phase 1 site to accommodate the revised design criteria is now a 600 mm diameter pipe as opposed to the 450/525 pipe recommended in the MSS report.

As recently agreed with the City, the proposed 600 mm diameter sanitary sub-trunk sewer through the CRT property has been sized to accommodate the following external flows:

• Liard Street Pump Station	108 l/s
• OPA 76 Area 6 Pump Station	84 l/s
	192 l/s

Those flows are in addition to other upstream flows from future developments within the Fernbank CDP area.

3.3 Design Criteria

The sanitary sewers for the subject site will be based on the recommendations of the 2009 MSS and the standards of both the City of Ottawa and the provincial Ministry of the Environment. Some of the key criteria will include the following:

Average Day Residential Flow	350 l/cap/day
Residential Peaking Factor	Harmon Formula: (min. -2.0, max, -4.0)
Industrial Flow Rate	50,000 l/day/ha
Commercial & Institutional Flow Rate	35,000 l/day/ha
ICI Peaking Factor	1.5
Infiltration Rate	0.28 l/s/ha
Single Unit Population Density	3.3 ppu
Townhouse Unit Population Density	2.5 ppu
Mixed Use Residential Area Density	1.8 ppu
Velocities	Min 0.6 m/s Max 3.0 m/s

Table 3.3 Minimum Allowable Slopes

DIAMETER (MM)	SLOPE (%)
200	0.320
250	0.240
300	0.816
375	0.140
450	0.111
525 and larger	0.100

Where practical and where there are less than 10 residential connections, the first lengths of sanitary sewers are designed as 200 mm diameter pipes with a minimum slope of 0.65%. The population densities used for the wastewater design for the subject lands are those recommended in the 2009 MSS document which are:

Low Density	3.3 pers/unit
Medium Density	2.5 pers/unit
High Density	1.8 pers/unit

For the purpose of this Design Brief document, single family units are considered low density and townhouse units are considered medium density.

3.4 Recommended Wastewater Plan

The recommended wastewater plan for the CRT Lands is shown in **Figure 3.2**. Sanitary sewer sizes are included only for the sewers 250 mm Ø and larger. To accommodate the expanded external wastewater drainage limits, construction of a 600Ø sub-trunk sewer is now proposed in Goldhawk Drive south to Cope Drive. That sub-trunk sewer will be oversized for future developments west of Goldhawk Drive, including the Laird Street Pump Station sewer shed and OPA Expansion Area 6. With the exception of Area 1A identified on **Figure 1.3**, all wastewater flows for the draft plan area will be directed to the proposed Goldhawk Drive 600Ø sub-trunk sewer. Drainage from Area 1A will outlet directly to the Fernbank Trunk Sewer at MHFT18 near Robert Grant Avenue.

The balance of Goldhawk Drive within the draft plan will include 375Ø and 300Ø sewers. Most of the remaining sanitary sewers within the subject site will be 250Ø and 200Ø.

3.5 Wastewater Outlet

The recommended wastewater plan for the FCDP includes construction of a new Fernbank Trunk Sewer to be located in the Trans Canada Trail and hydro easement adjacent to the existing developments in Stittsville. The new trunk sewer, which is now installed up to MHFT24, outlets directly to the HPS. With the exception of about 25 ha in the extreme south-east of the FCDP, the new Fernbank Trunk Sewer will provide an outlet for the FCDP lands located south of the Trans Canada Trail.

The 2009 MSS Report also completed a sanitary hydraulic gradient analysis (HGL). The recommended Hazeldean Pump Station overflow system included a diversion to the Monahan Constructed Wetlands Stormwater Management Facility. The predicted HGL at the station was 95.0 meters. The overflow will protect all development lands in the FCDP and most of the existing sewershed. A copy of Figure 6.1 Hydraulic Grade Line Analysis and the Sanitary Sewer Hydraulic Grade line Analysis (2031) from the 2009 MSS report is attached in **Appendix D**.

The City recently advised that the current sanitary hydraulic grade line (HGL) at the Hazeldean Pump Station is now 95.30 m as opposed to the 95.0 m HGL predicted in the 2009 MSS review. Because the proposed sanitary sewer system through the subject property, as well as the new completed Fernbank Trunk Sewer, are to carry the 192 l/s external flow (Liard Street Pump Station and Area 6 Expansion Lands) recently requested by the City, we have completed another review of the sanitary HGL along the Fernbank Trunk Sewer as well as into the CRT development. The detailed analysis is included in **Appendix D**.

The static analysis is based on the Darcy–Weisbach formula. Table 3.4 shows a comparison of the current analysis based on the sewer as-built design, and the MSS analysis.

Table 3.4 Sanitary HGL Analysis along the Fernbank Trunk Sewer

FERNBANK TRUNK SEWER			
AS-BUILT SEWER		MSS DESIGN	
LOCATION	HGL	LOCATION	HGL
MH FT-01	95.39	974	95.09
MH FT-08	95.60	972	95.91
MH FT-18*	97.50	934	97.96
MH FT-24**	99.93	924	100.75

* CRT East connection point
**CRT West connection point

The sewer locations in the above table represent common locations. This analysis indicates that the sanitary HGL along the trunk sewer is lower than previously predicted in the MSS document even though more wastewater is included in the current analysis. This seems to be related to the different hydraulic loss coefficients used in the analysis. The current review used the hydraulic loss coefficients as per Appendix 6-B.1 from the City of Ottawa Sewer Design Guidelines and Section 1.7 from the MOE Guidelines which are both located in **Appendix D**. The difference however appears to be a moot matter. The current analysis indicates that the proposed basements are several meters above either sanitary HGL.

From MH FT-18 (MSS node 934) the hydraulic analysis was carried to MH 146A in Putney Crescent which is the nearest MH in Phase 1A. The estimated sanitary HGL at MH 146A is 100.96 meters and the lowest basement footings at this location are designed to be near 103.66 meters.

There is a similar situation immediately upstream from the Fernbank Trunk Sewer MH FT-24 where the analysis was extended to MH 103A in Goldhawk Drive. The HGL at MH 103A is predicted to be 100.60 meters and the nearest basement footings are designed to be near the 105.75 elevation. Based on this analysis, the logical conclusion is that the Fernbank Trunk Sewer hydraulic gradient will not impact building construction in the CRT development.

3.6 Local Extraneous Flows

All sanitary sewers will be constructed to City of Ottawa standards, including testing prior to being put into service. There are no unusual local conditions within the subject site that are expected to contribute extraneous flows higher than those noted in the City's guidelines.

3.7 Sewer Calculations

Detailed sanitary sewer design sheets, using recommendations from the MSS, and criteria of the City of Ottawa and the provincial Ministry of Environment, and Sanitary Drainage Area Plans (Drawings 27970-501, 501A and 501B) are provided in **Appendix D**.

3.8 Environmental Constraints

There are no significant environmental constraints associated with development of the subject site. The upper reaches of the former Flewellyn Municipal Drain on the Owners property will be filled as part of the Phase 1 development. The wood lot identified in the EMP report is in a future phase and not covered by the current draft plan. The City has the option to purchase the wood lot.

3.9 Emergency Overflow

The wastewater outlet for the CRT Lands will be the Hazeldean Pump Station. Most sanitary pump stations in urban locations include overflows as an additional redundant operational system. The HPS includes an overflow to the Monahan Drain.

4 MINOR STORM SEWER SYSTEM

4.1 Existing Conditions

The subject property is located within the Fernbank Community Development area north of Fernbank Road and south of Abbott Street/Trans Canada Trail and immediately west of Robert Grant Avenue. The approved MSS and EMP recommend construction of nine stormwater management facilities and associated storm sewer services to provide stormwater management for the Fernbank Community. As outlined in the MSS, the majority of the subject property is tributary to Pond 5 and a small portion is tributary to Pond 6. The draft plan covers an area of about 53 ha within the overall development.

The site's topography is generally between the 109 and 105 contours with most of the site draining towards the south into Flewellyn Drain. Although a portion of the plan is farmed, most of it consists of uncultivated grass lands. The north-east corner of the site, about 7 ha, drains to the east and runoff from this area will be tributary to Pond 6 which is located in the neighbouring development east of Robert Grant Avenue. **Figure 4.1** indicates the existing drainage patterns for the subject site.

The geotechnical report indicates that most of the site consists of about 0.2 to 0.3 meters of topsoil over glacial till. Bedrock is generally shallow being about 0.5 to 1.0 m below surface towards the north of the site and between 1.60 m and 3.15 m deep for the remainder of the site. These are also pockets of silty clay at varying depths.

A portion of the Flewellyn Drain is located within the Owner's property. As outlined within **Section 1.6**, about 950 m of the upper reaches of the drain north of Fernbank Road were formally closed as municipal drains in a 2011 City By-Law (No. 2011-311) and a permit to fill those ditches was previously issued by the RVCA. However, because the permit expired in February 2016, the Owners will seek an extension to the permit. This work is to be coordinated with the City of Ottawa and the Rideau Valley Conservation Authority.

4.2 Master Servicing Studies

The 2009 EMP and MSS reports made preliminary recommendations for design of the stormwater management system for the FCDP. These recommendations included preliminary sizing of the stormwater management facilities complete with operating levels.

The MSS report recommended construction of Pond 5 on the subject site with an outlet to the existing Flewellyn Drain. In an effort to limit storm sewer hydraulic gradients and significant grade raising, the MSS report recommend that the 1:100 operating level of Pond 5 be about 104.4 m. To accomplish that elevation, about 375 meters of the Flewellyn Drain south of Fernbank Road was recommended to be lowered.

The 2011 Conceptual Site Servicing Study report completed a further analysis with respect to grade raising and recommended that the 1:100 year operating level of Pond 5 be lowered to about 103.9 m. It was also recommended that the Flewellyn Drain be lowered south of Fernbank Road for a distance of about 600 meters in order to accommodate the proposed operating levels.

It is also proposed to modify the drainage limits between Ponds 5 and 6. **Figure 4.2** shows these adjustments. There is a modest change to the drainage limits towards the north-east of the property as well as along the western limit of Robert Grant Avenue, which are now confirmed based on final lotting and the final design of the arterial road. Also, the secondary school site is recommended to be serviced by Pond 5, the construction of which is in control of the CRT Owners. These changes are fairly minor and will not impact the overall designs of either Pond 5 or 6. Additionally, the drainage split between Pond 5 and 6 at the north east corner of Phase 1 has now been finalized. These drainage limits were originally identified in the "West Park Pond 6

Stormwater Management Report and Design Brief Report" which was completed in support of the Pond 6 design. A copy of Figure 2 from that report is included in **Appendix E** for reference.

The minor storm sewers recommended in the 2009 MSS are now proposed to be larger. This is mostly due to the change in design criteria issued by the City in 2012. A copy of the Storm Drainage Area Plan Minor System Drainage (dwg 101108STM1) from the 2009 MSS report is included in **Appendix E**. A copy of the CRT Phase 1 storm design sheet and drainage area plans **27970-500**, **500A** and **500B** are also included in **Appendix E**. The following **Table 4.1** indicates some of the significant sewers size changes now recommended for Phase 1.

Table 4.1 Minor Storm Sewer Size Changes

LOCATION		SEWER SIZES (MM Ø)	
DESIGN	MSS NODE	2009 MSS	CURRENT DESIGN
Bobolink Ridge	(535-529)	975	1500
Goldhawk Drive	(529-523)	1650	2100
Cope Drive	(525-523)	1500	1950
Goldhawk Drive	(523-519)	1950	2700

4.3 Minor Storm Sewer Design Criteria

In keeping with guidelines published by the City of Ottawa for storm sewers in Greenfield developments, the storm drainage system proposed for the CRT Phase 1 lands will follow the principles of dual drainage.

The minor storm flow estimates were reviewed by the rational method. Some of the significant criteria used in the minor storm sewer design are:

- Intensity 1.5 year curve (local and collector roads)
- Initial Time of Concentration 10 min
- Runoff Coefficients:
  Singles/Townhouses Front yards = 0.75
  Rear yards = 0.5
- Velocities 0.80 m/s to 6.0 m/s
- Manning roughness coefficient 0.013 (smooth wall pipes)
- Minimal allowable slopes Refer to below table

Table 4.2 Minimal Allowable Slopes

DIAMETER (MM)	SLOPE (%)
250	0.432
300	0.340
375	0.250
450	0.195
525	0.160
600	0.132
750 and larger	0.100

- Minimum depth of cover of 2.0 m
- Inlet-control rate to capture 5 year peak flows

- 100 year Hydraulic Grade Line (HGL) separation to be greater than 0.30 m from the underside of footing
- HGL analysis calculated with XPSWMM

4.4 Proposed Minor Storm Sewer Plan

The minor storm sewer design sheet and the storm drainage area plans are included in **Appendix E**. The proposed minor storm sewer plan for the CRT Phase 1 lands is indicated on **Figure 4.3**. Only sewer sizes 750 mm diameter and larger are indicated.

All drainage form the subject site will be directed into the proposed SWMF Pond 5 via large storm sewers in Goldhawk Drive. Most of the storm sewers were designed based on the rational method; however, the sewer sections MH 303 to MH 207 on Goldhawk Street and Street No. 26 and MH 207 to MH 300 on Street No. 25 were sized based on stormwater management criteria which are discussed in detail in the “Fernbank Pond 5 Stormwater Management Facility Report and Design Brief, March 2016”. Essentially, the proposed 1500 mm diameter sewer in Street No. 25 is a first flush pipe and the 2100 mm diameter sewer south of MH 207 is a dual purpose pipe serving as a minor storm pipe during most events but as an overflow conveyance during rare events. The overflow pipe provides flow separation, allowing the first flush to be diverted to the sediment forebay via the 1500 diameter first flush pipe, and minor flow in excess of the first flush to be conveyed directly to the wet well. During less frequent events, overflows will bypass the sediment forebay, thus preventing re-suspension of sediment. During these events, the 1500 mm diameter first flush pipe will continue to function concurrently.

4.5 Robert Grant Avenue Drainage

Phase 1 of the CRT lands abuts the arterial road Robert Grant Avenue which is located to the east of the subject site. The natural topography of the CRT property in the vicinity of the arterial road slopes from west to east towards the road. **Figure 4.1** provides an indication of the existing drainage pattern for the subject site.

Since there are two projects that were each designed by different engineers and abut and impact each other, IBI has discussed, reviewed and agreed with the roadway designers, Novatech Engineering, on the limits of runoff that can be accommodated by the arterial roadway drainage design. **Figure 4.4** indicates these limits in terms of location, areas and flows. The significant limitation to development of the CRT lands adjacent to the Robert Grant Avenue is that no minor storm runoff in the 1:5 yr. event can cross the roadway sidewalk. The only minor runoff from the subject site that can be accommodated by the arterial road drainage system is from short sections of three side streets: Bobolink Ridge; Cope Drive and a future street opposite Haliburton.

There will be some major storm runoff from the edges of most developments along Robert Grant Avenue as well as the three side streets.

5 SITE STORMWATER MANAGEMENT

5.1 Synopsis of Previous Reports

The post-development drainage strategy for the Fernbank Community Development, including the subject site, was presented in the 2009 EMP and MSS. The conceptual post-development servicing of the lands tributary to Pond was presented in the 2011 Conceptual Site Servicing Study. In May 2016, IBI completed the “Fernbank Pond 5 Stormwater Management Facility Report and Design Brief”, outlining the design of the Pond 5 SWM Facility to which the majority of the development is tributary. The end-of-pipe SWM facility is designed to provide water quantity and quality control and outlet to the Flewellyn Drain.

This report builds upon the recommendations and findings of the 2009 EMP, 2009 MSS, 2011 Conceptual Site Servicing, and the 2016 Pond 5 Design Brief. It is intended to aid in the review and approval of the servicing for the proposed Phase 1 development.

5.2 Objective

The purpose of this report section is to present the dual drainage design, including the minor and major system, for the CRT Development Inc. Phase 1 development in the Fernbank Community. The design includes the sizing of inlet control devices, maximum depth and velocity of flow on the surface, and hydraulic grade line analysis. The stormwater system concept is discussed in subsequent sections and has been developed based on the October 2012 City of Ottawa Sewer Design Guidelines and February 2014 City of Ottawa Technical Bulletin ISDTB-2014-01.

5.3 Dual Drainage Design

The site was designed with dual drainage features, accommodating minor and major system flow. During frequent storm events, the effective runoff of a catchment area is directly released via catchbasin inlets to the network of storm sewers, called the minor system. During less frequent storm events, the balance of the flow (in excess of the minor flow) is accommodated by a system of rear yard swales and street segments, called the major system.

The streets within Phase 1 feature a mix of sawtooth and continuous grade profiles. The sawtooth profile facilitates surface storage on subdivision streets. In accordance with City of Ottawa guidelines, rear yard storage has not been accounted for. Inlet control devices (ICDs) are proposed across the site to maximize the use of available on-site storage and control surcharge of the minor system during infrequent storm events. The dual drainage system has been evaluated using the DDSWMM hydrological model, which offers single storm event flow generation and routing. The minor system hydraulic grade line analysis has been evaluated using the XPSWMM dynamic model.

There are two minor system outlets from Phase 1. The majority of the site is tributary to proposed Pond 5 to the south. The northern corner of the site, referred to as Phase 1A, is tributary to the existing Pond 6 to the east. Subsequently in this section, ‘Phase 1’ refers to those lands tributary to Pond 5.

ICDs were initially sized based on the 5 year 3 hour Chicago design storm event. In some instances, the proposed ICD release rates and minor system sewer sizing were optimized to protect lots from surface flooding. This was accomplished by increasing ICD release rates above the 5 year storm event. For Phase 1A, the minor system restriction was set to respect the allowable release rate of the existing outlet. DDSWMM input parameters, including ICD restrictions, are summarized in **Table 5.1**.

The major system flow pattern includes the following outlet locations: future Phase 2 to the south via Dagenham Street and via Goldhawk Drive; the existing Dry Pond 3 located southwest of the corner of Abbott Street and Robert Grant Avenue.

The DDSWMM drainage area plan is presented on **Drawings 27970-750A** and **750B** (enclosed in **Appendix F**).

Model files are enclosed on CD in **Appendix F**. It should be noted that due to the limitation of the modeling software, separate DDSWMM models were created for Phase 1 and Phase 1A. They read into one overall XPSWMM model.

5.4 Stormwater Evaluation

5.4.1 Hydrological Evaluation

Land use, selected modeling routines, and input parameters for the subject site are discussed in the following sections.

Land Use

Phase 1 and 1A will be developed with a mixture of townhouses, single family units, one park and two school sites. Higher density residential is proposed for the eastern portion of the site.

Storms and Drainage Area Parameters

The main hydrology parameters are summarized below and in **Table 5.1**.

- **Design storms:** The site was evaluated using the following storms:
  - 5 and 100 year 3 hour Chicago storm event with a 10 minute time step
  - 100 year 3 hour Chicago storm event + 20% increase in intensity with a 10 minute time step
  - July 1 1979, August 4 1988 and August 8 1996 historical storms with a 5 minute time step

  For consistency with the Pond 5 design, Phase 1 was also simulated with the following storms:
  - 100 year 24 hour SCS Type II storm event with a 12 minute time step, the design storm for the pond
  - 100 year 24 hour SCS design storm event with a 20% increase in intensity, 12 minute time step, stress test
- **Infiltration:** The selected infiltration losses are consistent with the City of Ottawa Sewer Design Guidelines. The Horton values are as follows: f_o = 76.2 mm/h, f_c = 13.2 mm/h, k = 0.00115 s^{-1}.
- **Area:** The catchment areas are based on the rational method spreadsheet, with some minor modifications for modeling purposes.
- **Imperviousness:** The imperviousness values are based on the runoff coefficients, which were determined by obtaining the footprint of the model units intended for the site and placing the maximum footprint on the lots.
- **Catchment Width:** The catchment width was based on the conveyance route length of the drainage area and multiplied by two. The multiplier of two was only used if the drainage area had runoff contribution from both sides of the drainage area.

- **Slope:** The ground slope was based upon the average slope for both impervious and pervious area. Generally, the slope is approximately 2% (0.02 m/m). This assumes a slope of approximately 1% for impervious or road surfaces and 3% for pervious surfaces (lot grading).

- **Initial Abstraction (Depression Storage):** The depression storage used for impervious areas was 1.57 mm and for pervious areas 4.67 mm, which is consistent with the City of Ottawa Sewer Design Guidelines values.
- **Manning's Roughness:** Manning's roughness coefficients of 0.013 and 0.25 were used for impervious and pervious areas, respectively.
- **Baseflow:** No baseflow components were assumed for any of the areas contributing runoff to the minor system.

- **Major system storage and routing:** The subject site is comprised of both continuous grade and sawtooth road profiles. For drainage areas with sawtoothing, available surface storage has been calculated based on the grading plan. Flow is attenuated within low points with potential overflow cascading to the next segment downstream. The total volume at each low point, up to the overflow depth, is the maximum static storage. Rear yard segments have a sawtooth pattern with some storage available, but the storage is not accounted for as part of the analysis.

  For street segments with ponding, minor system capture is set to fully utilize storage during the 100 year design storm, while minimizing ponding during the 5 year event. Cascading overflow from a low point to a downstream segment utilizes the static storage available plus an additional amount of storage equivalent to the depth required for the flow to cascade over the downstream high point. The attenuation in street sags was evaluated to account for static storage and, if overflow occurs, dynamic storage. Within this report it is referred to as double routing.

  DDSWMM does not have a direct way of coding double routing since it does not allow the user to code dynamic storage over the high point. For this analysis, the method employed is that recommended in the February 2014 City of Ottawa Technical Bulletin ISDTB-2014-01. It accounts for overflow from a street segment (regular static storage at a sag) being conveyed to a downstream dummy segment. In other words, a regular low point segment is provided with a downstream dummy segment for further flow attenuation to account for the dynamic ponding during overflow.

  There are no drainage area attributes associated with the dummy segment since it is a segment solely for routing. In addition, there is no inflow to the minor system from these dummy segments. The overflow hydrograph from the upstream catchment is routed in the dummy segment to the next "real" downstream segment. The dummy segments have the following specific characteristics:

  - Segment Length: Equivalent to the length of the maximum static storage from the street segment contributing to it.

  - Road Type: Equivalent to the right-of-way characteristics from the segment contributing to it, but with a longitudinal slope of 0.01% (0.0001 m/m).

The dummy segments for major system routing have been applied to the analysis of the subject site. The segments are referenced as D1, D2, D3, etc. within the DDSWMM modeling file. The drainage area plan presented in **Drawing 27970-750A** and **750B** does not show the dummy segments, but the DDSWMM output file shows the dummy segments immediately following the corresponding major segment which cascades into that dummy segment.

For street segments with continuous grade, simulations were based on the approach-capture characteristics of the catchbasin with the constraint that during the 100 year design storm the maximum cascading flow does not exceed 0.3 m.

For street segments with sawtoothing, simulations were based on the constraint that during the 100 year design storm the maximum depth of ponding (including cascading flow where applicable) does not exceed 0.3 m. Where surface storage is available, the storage-outflow characteristics for each low point were taken into consideration. The evaluation was undertaken assuming static conditions. The ponding plan for the subject site is presented on **Drawings 27970-751A and 751B** (enclosed in **Appendix F**).

Rear yards were considered independently of street segments and rear yard catch basins were incorporated in the DDSWMM model. Simulations were based on the total interception of runoff by the storm inlets. This was done by specifying a one-to-one relationship between approach flow and capture flow. Storage volume in rear yards was not accounted for as available on-site storage. Overflow from the rear yards cascades to a major system road segment via swales.

The two schools and higher density residential at the eastern edge of the site have been simulated with sufficient storage to contain the 100 year 3 hour Chicago storm event, with a provision for emergency overflow as indicated on **Drawings 27970-750A** and **750B**. For the higher density residential blocks, the required storage could consist of roof top storage, parking lot storage and/or underground storage. As discussed in **Section 4.5**, some major flow from the eastern edge of the residential blocks will cascade to the Robert Grant Way right-of-way. The information is illustrated on **Figure 4.4** and has been coordinated with the designers of the arterial road. The development of these blocks will be in accordance with the relevant constraints.

- **Minor system capture:** The minor system capture is based on the 5 year 3 hour Chicago storm event for maximum ponding conditions. ICDs are incorporated into the design to protect the minor system from surcharge during infrequent storm events and to utilize the available on-site storage. The size of the inlet control devices (ICDs) was optimized using DDSWMM.

  The minor system inflow rate was optimized to account for continuous grade. Specifically, the model incorporates the actual flow entering the minor system on continuous grade based on approach-capture curves derived from the 1984 MTO Drainage Manual (specifically, Charts E4-7D and Chart E4-7H). Minor system capture was set to correspond to either the 5 year simulated flow, or the maximum capture during unrestricted 100 year flow conditions, whichever was less. This is due to the fact that based on the approach-capture curve, the actual capture may be less than the 5 year simulated flow. This results in there being cascading flow on the surface during both the 5 and 100 year events. Therefore, at receiving low points, ICDs have been sized to fully capture the cascading flow from upstream street segments on continuous grade during the 5 year event, while minimizing ponding at the low point.

  The exception to this is the downstream low point within Phase 1A (S145B). The minor system restriction at this location was restricted to below the 5 year flow to meet the allowable release rate of 1200 l/s to the existing receiving trunk. The engineering consultant for the trunk storm sewer, Novatech Engineering, provided the maximum allowable release rate to the sewer as well as the boundary condition (refer to correspondence in **Appendix F**).

Areas where the capture rates have been revised for site optimization are noted in **Table 5.1**.

The main hydrological parameters used in the DDSWWM model are summarized in the below table. ICD restrictions are also summarized in tabular form on **Drawing DETAILS-1**.

Table 5.1 DDSWMM Parameters

AREA ID	AREA (HA)	MH	D/S SEGMENT	IMP RATIO	LENGTH (M)	WIDTH (M)	AVAIL. STORAGE (CU-M)	5 YEAR SIMULATED FLOW (L/S) *07-PH1-5CH.OUT & 07-PH1A-5CH.OUT*	ICD RESTRICTION (L/S)
Phase 1 Minor system tributary to Pond 5									
S153	0.12	MH153	S149A	0.79	32	64	N/A	25	17.07(1)
S149A	0.08	MH149	S149B	0.79	38	76	N/A	17	17(1)
RES2A	0.66	MH129	S149C	0.86	74.25	148.5	64.6(2)	133	133
S149C	0.09	MH149	S149B	0.79	99	99	1.09(6)	19	21.64(4)
S149B	0.05	MH149	S128A	0.79	46	46	N/A	10	10(1)
RES2B	0.56	MH129	RES1	0.86	63	126	70(2)	113.14	113.14
S128A	0.18	MH128A	S127B	0.79	58	116	9.63	35	107(3)
S127B	0.26	MH127B	S191B	0.79	72	144	37.78	53	59.65(3)
S191B	0.37	MH191	S186	0.79	101	202	0.38 (6)	76	84.73(4)
S128B	0.33	MH128B	S188	0.79	73	146	35.6	67	74.28(3)
R128B	0.08	MH128B	RES3	0.50	48	48	N/A	10.83	10.83
S188	0.33	MH188	S191A	0.79	80	160	N/A	67	37.29(1)
R188A	0.08	MH188	RES3	0.50	43	43	N/A	10.75	10.75
R188B	0.08	MH188	RES3	0.50	51	51	N/A	10.87	10.87
R127B	0.19	MH127B	R127C	0.50	46	92	N/A	25.35	25.35
R127C	0.22	MH127B	R191A	0.50	54	108	N/A	29.37	29.37
R191A	0.19	MH191	S191A	0.50	45	90	N/A	25.31	25.31
R189	0.07	MH189	RES3	0.50	46	46	N/A	9.53	9.53
R177	0.07	MH177	RES3	0.50	45	45	N/A	9.52	9.52
RES3	1.58	MH189	RG	0.86	178	356	185(2)	318.71	318.71
S189	0.3	MH189	S191A	0.79	126	199	4.73	62	69.75(4)
S191A	0.23	MH191	S186	0.79	91	162	14.04	45	186.15(3)
R182A	0.3	MH182	R186	0.50	75	150	N/A	40.11	40.11
R186	0.23	MH186	S186	0.50	62	124	N/A	30.9	30.9
S186	0.23	MH186	S183	0.79	71	142	9.26	48	141.24(3)
R175	0.36	MH175	R183	0.50	73	146	N/A	47.4	47.4
R183	0.22	MH183	S183	0.50	57	114	N/A	29.48	29.48
S152A	0.3	MH152	S151B	0.79	80	160	42.07	61	68.54(4)
S152B	0.1	MH152	S151B	0.79	77	77	0.69(6)	21	23.49(4)
R128A	0.14	MH128A	R127A	0.50	35	70	N/A	18.72	18.72
R127A	0.19	MH127A	R151B	0.50	45	90	N/A	25.31	25.31
R151B	0.20	MH151B	S151B	0.50	49	98	N/A	26.70	26.70
S151B	0.25	MH151B	S182A	0.79	140	217	1.02	52.98	52.98
S127A	0.17	MH127A	S182A	0.79	46	92	N/A	35	23.51(1)
S182A	0.29	MH182	S182B	0.79	76	152	44.83	58	141.61(3)
S182B	0.29	MH182	S183	0.79	75	150	6.67	59	66.27(3)
S183	0.24	MH183	S174	0.79	76	152	66.51	50	132.73(3)
R182B	0.16	MH182	R182C	0.50	55	55	N/A	20.78	20.78
R182C	0.12	MH182	R174	0.50	58	58	N/A	16	16
R174	0.12	MH174	S174	0.50	58	58	N/A	16	16
S190	0.06	MH190	S176	0.79	71	71	0.55(6)	13	14.48(4)

AREA ID	AREA (HA)	MH	D/S SEGMENT	IMP RATIO	LENGTH (M)	WIDTH (M)	AVAIL. STORAGE (CU-M)	5 YEAR SIMULATED FLOW (L/S) *07-PH1-5CH.OUT & 07-PH1A-5CH.OUT*	ICD RESTRICTION (L/S)
S177	0.14	MH177	RG	0.79	49	98	N/A	29	9.4(1)
S176	0.14	MH176	S175	0.79	96	96	N/A	29	7.62(1)
INST2	6.57	MH176	S175	0.50	739	1478	618(2)	822	801.37
S175	0.42	MH175	S174	0.79	109	218	9.23	82	118.66(4)
S174	0.25	MH174	S173	0.79	68	136	14.44	51	57.18(4)
S173	0.75	MH173	S172	0.79	80	160	14.78	140	156.12(4)
INST1	2.88	MH172	S172	0.86	324	648	326(2)	582	579.45
S172	0.23	MH172	PH2	0.79	65	130	18.32	47	52.88(4)
S135A	0.14	MH135	S135B	0.79	75	75	N/A	29	16.77(1)
S135B	0.12	MH135	S134A	0.79	81	81	0.95(6)	23	46.36(4)
S134C	0.06	MH134	S134A	0.79	60	60	N/A	13	9.26(1)
S136A	0.11	MH136A	S134B	0.79	82	82	N/A	23	14.42(1)
S134B	0.14	MH134	S134A	0.79	77	77	N/A	27	22.21(1)
R151A	0.18	MH151A	R134	0.50	48	96	N/A	24.17	24.17
R134	0.21	MH134	S134A	0.50	56	112	N/A	28.2	28.2
S134A	0.19	MH134	S140	0.79	58	116	5.87	35	75.86(4)
S151A	0.1	MH151A	S150A	0.79	80	80	N/A	21	13.53(1)
S150A	0.28	MH150	S140	0.79	74	148	N/A	54	35.75(1)
S150B	0.04	MH150	S140	0.79	22	22	0.40(6)	8	9.17(4)
R125B	0.19	MH125	R140	0.50	47	94	N/A	25.39	25.39
R140	0.21	MH140	S140	0.50	50	100	N/A	27.98	27.98
S140	0.25	MH140	S124	0.79	78	156	17.74	50	104.9(4)
S125	0.39	MH125	S124	0.79	103	206	19.83	80	88.89(4)
R131	0.2	MH131	R130A	0.50	51	102	N/A	26.78	26.78
R130A	0.16	MH130	R130B	0.50	39	78	N/A	21.36	21.36
R130B	0.17	MH130	S130	0.50	38	76	N/A	22.55	22.55
S124	0.26	MH124	S180A	0.79	69	138	15.52	53	59.47(4)
S130	0.35	MH130	S180A	0.79	100	200	15.27	72	80.28(4)
R125A	0.16	MH125	R124B	0.50	78	78	N/A	21.33	21.33
R124B	0.16	MH124	S180A	0.50	86	86	N/A	21.47	21.47
R180A	0.09	MH180	R181	0.50	43	43	N/A	12	12
S180A	0.19	MH180	S180B	0.79	65	65	9.97	37	103.71(3)
R181	0.09	MH181	S181	0.50	43	43	N/A	12	12
S180B	0.18	MH180	S181	0.79	65	65	10.67	36	101.83(3)
S181	0.14	MH181	PH2	0.79	69	138	30.43	30	93.49(3)
S170A	0.27	MH170	S171	0.79	75	150	17.58	55	61.9(3)
RES3A	3.26	MH170	S171	0.66	367	734	81.50(7)	522	583
S171	0.26	MH171	PH2	0.79	74	148	29.26	54	259.83(3)
PARK1	1.27	MH132	S132	0.00	143	286	N/A	29.66	29.66
R112A	0.12	MH112	R112B	0.50	62	62	N/A	16.07	16.07
R112B	0.06	MH112	S132	0.50	28	28	N/A	7.99	7.99
S132	0.24	MH132	S113	0.79	32.5	65	44.45	54	116.8(3)
S112	0.27	MH112	S113	0.79	70	140	10.79	55	61.57(4)
S113	0.27	MH113	S114	0.79	70	140	4.29	55	61.57(4)
S114	0.24	MH114	S120	0.79	70	140	19.69	50	55.33(4)
R114A	0.32	MH114	R114B	0.50	65	130	N/A	42.14	42.14
R114B	0.18	MH114	S114	0.50	30	60	N/A	23.33	23.33
S122	0.31	MH122	S120	0.79	82	164	34.71	63	70.84(4)
R102	0.21	MH102	R103B	0.50	56	112	N/A	28.2	28.2
R103B	0.16	MH103	R104B	0.50	36	72	N/A	21.24	21.24
R104B	0.19	MH104	R104C	0.50	38	76	N/A	24.99	24.99
R104C	0.17	MH104	S104	0.50	39	78	N/A	21.36	21.36
S120	0.28	MH120	S105A	0.79	85	170	41.25	58	111.71(3)
S110	0.09	MH110C	S103	0.79	80	80	2.96	19	19(1)
S102	0.09	MH102	S103	0.79	80	80	3.02	19	21.31(4)

AREA ID	AREA (HA)	MH	D/S SEGMENT	IMP RATIO	LENGTH (M)	WIDTH (M)	AVAIL. STORAGE (CU-M)	5 YEAR SIMULATED FLOW (L/S) *07-PH1-5CH.OUT & 07-PH1A-5CH.OUT*	ICD RESTRICTION (L/S)
R103A	0.34	MH103	R104A	0.50	77	154	N/A	45.14	45.14
S103	0.34	MH103	S104	0.79	81	162	55.49	69	77.01(4)
R104A	0.23	MH104	S105A	0.50	57	114	N/A	30.73	30.73
S104	0.30	MH104	S105A	0.79	80	160	11.06	61	68.60(4)
R122	0.07	MH122	R121	0.50	35	35	N/A	9.36	9.36
R121	0.13	MH121	R105	0.50	60	60	N/A	17.27	17.27
R105	0.13	MH105	S105A	0.50	65	65	N/A	17.37	17.37
S105A	0.4	MH105	S105B	0.79	65	65	16	72	110.18(4)
S105B	0.51	MH105	S107	0.79	70	70	15.71	89	129.60(4)
S107	0.61	MH107	S109	0.79	80	80	29.42	106	141.24(3)
S109	0.52	MH109	EXT110	0.79	79	79	4.18	92	103.19(4)
S170B	0.06	MH170	EXT110	0.79	40	40	0.3(6)	13	13.99(4)
EXT110	0.47	MH110	PH1OVF	0.79	53	106	9.6	88	98.49(4)
Phase 1A Minor system tributary to Pond 6									
R142B	0.19	MH142	R143	0.50	75	150	N/A	26.13	26.13
R136A	0.27	MH136	S136E	0.50	128	256	N/A	37.39	37.39
S143	0.32	MH143	S136E	0.79	93	186	N/A	66	41.87(1)
S136E	0.17	MH136C	S144	0.79	55	55	N/A	30.48	30.48(1)
S136B	0.27	MH136C	S144	0.79	80	160	N/A	56	36.99(1)
S144	0.25	MH144	S145A	0.79	80	80	N/A	49	45.32(1)
R137A	0.11	MH137A	R144C	0.50	28	56	N/A	14.73	14.73
R144C	0.26	MH144	S160B	0.50	65	130	N/A	34.74	34.74
S160B	0.13	MH160	S145A	0.79	50	50	N/A	26	14.77(1)
S136D	0.07	MH136B	S160A	0.79	48	48	N/A	15	9.58(1)
S160A	0.3	MH160	S145A	0.79	86	172	N/A	62	36.92(1)
S145A	0.27	MH145	S145B	0.79	80	80	N/A	51	51(1)
S136C	0.11	MH136B	S137A	0.79	77	77	N/A	23	13.42(1)
R136B	0.23	MH136B	R137B	0.50	52	104	N/A	30.53	30.53
R137B	0.3	MH137A	S137A	0.50	72	144	N/A	39.97	39.97
S137A	0.14	MH137A	S137B	0.79	67	67	N/A	28	22.8(1)
S137B	0.13	MH137A	S138	0.79	90	90	1.1	27	61.15(4)
S138	0.15	MH138	S148	0.79	120	120	N/A	32	18.01(1)
S148	0.22	MH148	S145B	0.79	72	144	N/A	45	35.33(1)
R138	0.14	MH138	R145	0.50	35	70	N/A	18.72	18.72
R145	0.3	MH145	S145B	0.50	75	150	N/A	40.09	40.09
S145B	0.28	MH145	BLK335	0.79	60	120	35.13	55	90(5)
R142A	0.14	MH142	R143A	0.50	70	70	N/A	18.7	18.7
R143A	0.16	MH143	R144A	0.50	75	75	N/A	21.27	21.27
R144A	0.15	MH144	R146	0.50	63	63	N/A	19.79	19.79
R146	0.14	MH146	BLK335	0.50	63	63	N/A	18.57	18.57
RES1	1.89	MH162	DP	0.86	212.5	425	233(2)	381.83	381.83
HYD2	5.12	N/A	DP	0.00	576	1152	N/A	N/A	N/A

(1) Continuous grade, ICD set to correspond to lower of the 5 year simulated flow and the maximum capture during unrestricted 100 year flow conditions
(2) Assumed ponding volume. Assumes that on-site storage will be provided up to the 100 year 3 hour Chicago event
(3) Minor flow restrictions have been increased based on optimization of the system
(4) The minor flow restriction has been increased in sags to allow full capture of overflow from upstream segments on continuous grade during the 5 year storm event without ponding and/or to maintain ponding depths within the maximum depth during the 100 year storm event.
(5) Over-controlled to meet allowable release rate to existing receiving storm trunk
(6) Due to the limitation of the DDSWMM modeling software (specifically the allowable number of storage-release curves) the ponding was either discounted or merged to that of an adjacent drainage area.
(7) Assumed ponding volume.

5.4.2 Results of Hydrological Modeling

Minor system hydrographs generated by DDSWMM were exported to XPSWMM for the hydraulic grade line analysis (refer to **Section 5.4.3**). The results of the DDSWMM major system evaluation are summarized in the following sections.

5.4.2.1 Cascading Flow

The cascading flow across the site was evaluated to confirm that depth and velocity were in accordance with City guidelines. To determine velocity of cascading overflow at critical locations, SWMHYMO was used. The applicable right-of-way (ROW) sections were entered into the model with the corresponding longitudinal slopes to obtain the maximum velocity of flow using the Route Channel routine. The resulting depths were also applied for street segments with continuous grade. To determine depth of the cascading overflow for street segments with ponding, the calculation sheet from the February 2014 City of Ottawa Technical Bulletin ISDTB-2014-01 was employed. The major system flow results are summarized in **Table 5.2** and **Table 5.3** and presented in full in **Appendix F**, along with supporting model files.

At one location, R137B, major flow from rear yards cascades to the street between units, utilizing the side lot. At the City's request, the cross-section of the side lot is enclosed in **Appendix F**, with the resulting water level during the 100 year event indicated, as well as the top of foundation wall. The top of foundation wall is greater than 0.15 m above the 100 year water level. It should be noted that 3H:1V side slopes were applied to the side lot cross-sections, considered a conservative approach.

Major flow from the majority of Phase 1 cascades south to future phases of development via Dagenham Street and Goldhawk Drive. The total major flow at each of these outlets is presented in the below tables. The flow has been accounted for in the overall CRT modeling at MH 207, along with flow from future phases of development.

The major flow outlet from Phase 1A is a walkway block to the existing Dry Pond 3. As previously noted, due to the allowable release rate to the existing storm sewer, minor system flow upstream of the walkway block was over-controlled. This results in the ponding at S145B being fully utilized during the 5 year event, with 185 l/s cascading to the dry pond. The designers of the existing dry pond, Novatech Engineering, were provided the hydrographs to the dry pond and have confirmed the dry pond's performance (refer to correspondence in **Appendix F**).

Table 5.2 Summary of Cascading Flow during the 100 year 3 hour Chicago Storm (Model files: 07-PH1-100CH.OUT, 07-PH1A-100CH.OUT and 27970VXD.OUT)

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
Phase 1							
S153	1.33	29	0.62	0	0.037	0.037	0.02
S149A	0.53	43	0.49	0	0.052	0.052	0.03
S149C	0.53	104	0.90	0.080	0.083	0.163	0.08
S149B	0.55	71	0.66	0	0.081	0.081	0.05
S128A(D1)	0.51	0	N/A	0.140	0	0.140	N/A
S127B(D2)	0.69	0	N/A	0.220	0	0.220	N/A
S191B	0.69	57	0.58	0.060	0.054	0.114	0.03
S128B(D3)	0.53	0	N/A	0.210	0	0.210	N/A
S188	0.53	88	0.58	0	0.067	0.067	0.04
S189(D4)	0.54	36	0.46	0.110	0.061	0.171	0.03
S191A(D5)	0.97	45	0.61	0.150	0.066	0.216	0.04

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
S186(D6)	1.14	58	0.70	0.140	0.072	0.212	0.05
S152A(D7)	0.69	0	N/A	0.220	0	0.220	N/A
S152B	0.52	32	0.54	0.060	0.060	0.120	0.03
S151B(D8)	0.61	113	0.65	0.050	0.094	0.144	0.06
S127A	0.51	41	0.48	0	0.051	0.051	0.02
S182A(D9)	1.04	49	0.64	0.230	0.068	0.298	0.04
S182B(D10)	1.14	42	0.64	0.130	0.064	0.194	0.04
S183(D11)	0.7	0	N/A	0.280	0	0.280	N/A
S190	0.62	10	0.43	0.050	0.038	0.088	0.02
S177	0.52	45	0.57	0	0.067	0.067	0.04
S176	0.52	53	0.61	0	0.072	0.072	0.04
S175(D12)	0.55	141	0.70	0.110	0.102	0.212	0.07
S174(D13)	0.55	98	0.67	0.155	0.089	0.244	0.06
S173(D14)	0.81	143	0.83	0.145	0.102	0.247	0.08
S172(D15)	0.73	134	0.79	0.165	0.101	0.266	0.08
S135A	0.56	37	0.57	0	0.063	0.063	0.04
S135B	0.91	70	0.80	0.070	0.072	0.142	0.06
S134C	0.51	15	0.44	0	0.045	0.045	0.02
S136A	0.56	29	0.54	0	0.057	0.057	0.03
S134B	0.56	57	0.64	0	0.073	0.073	0.05
S134A(D16)	1	123	0.80	0.115	0.096	0.211	0.08
S151A	0.52	25	0.51	0	0.055	0.055	0.03
S150A	0.79	91	0.68	0	0.063	0.063	0.04
S150B	1	12	0.53	0.060	0.036	0.096	0.02
S140(D17)	0.86	188	0.84	0.180	0.113	0.293	0.09
S125(D18)	0.55	8	0.32	0.160	0.035	0.195	0.01
S124(D19)	0.66	185	0.76	0.160	0.113	0.273	0.09
S130(D20)	0.66	71	0.60	0.170	0.079	0.249	0.05
S180A(D21)	1.17	186	0.95	0.140	0.112	0.252	0.11
S180B(D22)	1.12	97	0.79	0.150	0.088	0.238	0.07
S181(D23)	0.73	0	N/A	0.230	0	0.230	N/A
S170A(D24)	0.92	5	0.39	0.155	0.029	0.184	0.01
S171(D25)	0.73	69	0.72	0.205	0.078	0.283	0.06
Total Major Flow to Phase 2 via Dagenham*	0.73	195	0.80	0	0.085	0.085	0.07
S132(D26)	0.67	0	N/A	0.240	0	0.240	N/A
S112(D27)	0.67	21	0.44	0.140	0.050	0.190	0.02
S113(D28)	0.99	36	0.58	0.095	0.061	0.156	0.04
S114(D29)	0.83	101	0.71	0.180	0.089	0.269	0.06
S122(D30)	0.83	0	N/A	0.200	0	0.200	N/A
S120(D31)	0.7	36	0.51	0.220	0.061	0.281	0.03
S110(D32)	0.55	20	0.49	0.120	0.049	0.169	0.02
S102(D33)	0.55	14	0.45	0.120	0.043	0.163	0.02
S103(D34)	0.71	0	N/A	0.230	0	0.230	N/A
S104(D35)	0.7	114	0.69	0.140	0.095	0.235	0.06
S105A(D36)	0.55	203	0.73	0.160	0.117	0.277	0.09

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
S105B(D37)	0.6	164	0.71	0.160	0.108	0.268	0.08
S107(D38)	0.6	122	0.66	0.200	0.097	0.297	0.06
S109(D39)	0.68	106	0.67	0.110	0.092	0.202	0.06
S170B	0.68	9	0.36	0.050	0.026	0.076	0.01
Total Major Flow to Phase 2 via Goldhawk*	0.65	168	0.74	0.200	0.082	0.282	0.06
Phase 1A Major flow tributary to existing Dry Pond 3							
S143	1.65	82	0.88	0	0.053	0.053	0.05
S136E	0.83	143	0.78	0	0.074	0.074	0.06
S136B	2.58	67	0.97	0	0.045	0.045	0.04
S144	0.83	392	1.00	0	0.108	0.108	0.11
S160B	0.89	82	0.69	0	0.059	0.059	0.04
S136D	0.78	18	0.53	0	0.044	0.044	0.02
S160A	1.25	96	0.82	0	0.059	0.059	0.05
S145A	2.75	547	1.12	0	0.121	0.121	0.14
S136C	0.78	30	0.61	0	0.055	0.055	0.03
S137A	0.51	125	0.75	0	0.100	0.100	0.07
S137B(D1)	1.61	99	1.08	0.070	0.088	0.158	0.09
S138	1.61	128	1.15	0	0.082	0.082	0.09
S148	1.43	160	0.98	0	0.069	0.069	0.07
S145B	3.30	688	1.48	0.190	0.107	0.297	0.16
Total Major Flow to Dry Pond 3 via BLK335	2.00	741	1.50	0	0.111	0.111	0.17

** Street cross-section and profile assumed, to be confirmed at detailed design*

Table 5.3 Summary of Cascading Flow during the 100 year 3 hour Chicago Storm + 20% (Model file: 07-PH1-120CH.OUT, 07-PH1A-120CH.OUT and 27970VXD.OUT)

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
Phase 1							
S153	1.33	40	0.67	0	0.042	0.042	0.03
S149A	0.53	62	0.53	0	0.059	0.059	0.03
S149C	0.53	182	1.04	0.080	0.103	0.183	0.11
S149B	0.55	118	0.75	0	0.097	0.097	0.07
S128A(D1)	0.51	55	0.51	0.140	0.072	0.212	0.04
S127B(D2)	0.69	44	0.54	0.220	0.066	0.286	0.04
S191B	0.69	93	0.65	0.060	0.065	0.125	0.04
S128B(D3)	0.53	16	0.37	0.210	0.045	0.255	0.02
S188	0.53	119	0.63	0.000	0.075	0.075	0.05
S189(D4)	0.54	63	0.53	0.110	0.076	0.186	0.04
S191A(D5)	0.97	164	0.85	0.150	0.107	0.257	0.09
S186(D6)	1.14	241	0.99	0.140	0.124	0.264	0.12
S152A(D7)	0.69	13	0.39	0.220	0.042	0.262	0.02
S152B	0.52	50	0.60	0.060	0.070	0.130	0.04
S151B(D8)	0.61	189	0.74	0.050	0.114	0.164	0.08
S127A	0.51	58	0.51	0	0.057	0.057	0.03
S182A(D9)	1.04	156	0.86	0.230	0.105	0.335	0.09
S182B (D10)	1.14	158	0.89	0.130	0.106	0.236	0.09
S183(D11)	0.7	357	0.91	0.280	0.145	0.425	0.13
S190	0.62	16	0.48	0.050	0.045	0.095	0.02
S177	0.52	59	0.61	0	0.075	0.075	0.05
S176	0.52	72	0.65	0	0.081	0.081	0.05
S175(D12)	0.55	362	0.86	0.110	0.146	0.256	0.13
S174(D13)	0.55	531	0.94	0.155	0.168	0.323	0.16
S173(D14)	0.81	483	1.06	0.145	0.161	0.306	0.17
S172(D15)	0.73	812	1.16	0.165	0.192	0.357	0.22
S135A	0.56	50	0.61	0	0.070	0.070	0.04
S135B	0.91	118	0.91	0.070	0.088	0.158	0.08
S134C	0.51	21	0.48	0	0.051	0.051	0.02
S136A	0.56	39	0.58	0	0.064	0.064	0.04
S134B	0.56	80	0.69	0	0.083	0.083	0.06
S134A (D16)	1	214	0.92	0.115	0.118	0.233	0.11
S151A	0.52	35	0.55	0	0.062	0.062	0.03
S150A	0.79	125	0.73	0	0.070	0.070	0.05
S150B	1	20	0.61	0.060	0.044	0.104	0.03
S140(D17)	0.86	332	0.97	0.180	0.140	0.320	0.14
S125(D18)	0.55	65	0.55	0.160	0.077	0.237	0.04
S124(D19)	0.66	388	0.92	0.160	0.146	0.306	0.13
S130(D20)	0.66	119	0.68	0.170	0.096	0.266	0.07
S180A (D21)	1.17	453	1.18	0.140	0.153	0.293	0.18
S180B (D22)	1.12	355	1.09	0.150	0.141	0.291	0.15

AREA ID (DUMMY SEGMENT IF APPLICABLE)	LONGITUDINAL SLOPE (%)	OVERFLOW (L/S)	VELOCITY (M/S)	MAX. STATIC PONDING DEPTH (WHERE APPLICABLE) (M)	DEPTH (DYNAMIC, WHERE APPLICABLE) (M)	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	VXD (M^2/S)
S181(D23)	0.73	268	0.87	0.230	0.130	0.360	0.11
S170A (D24)	0.92	38	0.69	0.155	0.062	0.217	0.04
S171(D25)	0.73	422	0.99	0.205	0.155	0.360	0.15
Total Major Flow to Phase 2 via Dagenham*	0.73	1346	1.44	0	0.171	0.171	0.25
S132(D26)	0.67	144	0.72	0.240	0.103	0.343	0.07
S112(D27)	0.67	48	0.55	0.140	0.068	0.208	0.04
S113(D28)	0.99	131	0.81	0.095	0.098	0.193	0.08
S114(D29)	0.83	208	0.85	0.180	0.117	0.297	0.10
S122(D30)	0.83	13	0.42	0.200	0.041	0.241	0.02
S120(D31)	0.7	133	0.71	0.220	0.100	0.320	0.07
S110(D32)	0.55	34	0.56	0.120	0.060	0.180	0.03
S102(D33)	0.55	32	0.55	0.120	0.059	0.179	0.03
S103(D34)	0.71	33	0.51	0.230	0.059	0.289	0.03
S104(D35)	0.7	196	0.79	0.140	0.116	0.256	0.09
S105A (D36)	0.55	411	0.87	0.160	0.153	0.313	0.13
S105B (D37)	0.6	367	0.87	0.160	0.147	0.307	0.13
S107(D38)	0.6	330	0.85	0.200	0.141	0.341	0.12
S109(D39)	0.68	327	0.90	0.110	0.140	0.250	0.13
S170B	0.68	15	0.41	0.050	0.032	0.082	0.01
Total Major Flow to Phase 2 via Goldhawk*	0.65	369	0.90	0.200	0.110	0.310	0.10
Phase 1A Major flow tributary to existing Dry Pond 3							
S143	1.65	112	0.94	0	0.059	0.059	0.06
S136E	0.83	210	0.85	0	0.085	0.085	0.07
S136B	2.58	93	1.07	0	0.051	0.051	0.06
S144	0.83	574	1.10	0	0.125	0.125	0.14
S160B	0.89	124	0.77	0	0.069	0.069	0.05
S136D	0.78	25	0.58	0	0.051	0.051	0.03
S160A	1.25	131	0.89	0	0.066	0.066	0.06
S145A	2.75	805	1.27	0	0.138	0.138	0.18
S136C	0.78	40	0.66	0	0.061	0.061	0.04
S137A	0.51	191	0.83	0	0.118	0.118	0.10
S137B(D1)	1.61	172	1.24	0.070	0.108	0.178	0.13
S138	1.61	213	1.31	0	0.099	0.099	0.13
S148	1.43	262	1.11	0	0.084	0.084	0.09
S145B	3.3	1054	1.61	0.190	0.132	0.322	0.21
Total Major Flow to Dry Pond 3 via BLK335	2.00	1147	1.64	0	0.137	0.137	0.22

** Street cross-section and profile assumed, to be confirmed at detailed design*

During the 100 year 3 hour Chicago design storm, the maximum depth of cascading flow on the street is less than the maximum allowable 300 mm, and the velocity by depth product is less than the allowable 0.6 m^2/s.

During the 100 year Chicago design storm event increased by 20%, the maximum depth of cascading flow is less than 0.30 m across the majority of the site. However, there are locations where the total depth exceeds 0.30 m. The following table summarizes the elevation of the cascading flow at these critical locations and compares it to the adjacent property line elevation as well as critical elevations (such as garage opening, rear yard building envelope, or park).

Table 5.4 Critical Ponding Locations during the Stress Test and Adjacent Property Elevations

CRITICAL PONDING LOCATION	MAX. DEPTH (STATIC + DYNAMIC, WHERE APPLICABLE) (M)	(1) CORRESPONDING ELEVATION (M)	(2) ADJACENT PROPERTY LINE ELEVATION (M)	DIFFERENCE (2) – (1)	(3) ADJACENT CRITICAL ELEVATION (M)		DIFFERENCE (3) – (1)
S182A	0.335	108.20	108.16	-0.04	Garage	108.35	0.15
S183	0.425	107.79	107.66	-0.13	Garage	107.88	0.09
S174	0.323	107.70	107.63	-0.07	Garage	107.9	0.20
S173	0.306	107.55	107.5	-0.05	Garage	107.75	0.20
S172	0.357	107.44	107.35	-0.09	Garage	107.55	0.11
S140	0.320	108.06	108.05	-0.01	RY	108.33	0.27
S124	0.306	107.95	107.91	-0.04	Garage	108.16	0.21
S181	0.360	107.38	107.27	-0.11	Park	107.32	-0.06
S171	0.360	107.39	107.31	-0.08	Garage	107.55	0.16
S132	0.343	107.83	107.88	0.05	RY	108.27	0.44
S120	0.320	107.67	107.65	-0.02	Garage	107.85	0.18
S105A	0.313	107.73	107.72	-0.01	RY	107.91	0.18
S105B	0.307	107.67	107.66	-0.01	Park	107.66	-0.01
S107	0.341	107.58	107.54	-0.04	Park	107.54	-0.04
S145B	0.322	105.68	105.60	-0.08	Garage	105.95	0.27

At three locations (S181, S105B, and S107) major flow will cascade to the adjacent park area during the stress test. Otherwise, across the remainder of the site, the maximum depth of flow will encroach the lowest property line but remains below the adjacent garage elevation during the stress test.

5.4.3 Hydraulic Grade Line Analysis

The existing XPSWMM hydraulic model for Pond 5 has been revised to include the detailed design of Phase 1, which is tributary to Pond 5, and Phase 1A, tributary to Pond 6. Minor system hydrographs generated from the DDSWMM model were exported to the XPSWMM model. Minor system losses were accounted for in accordance with Appendix 6-B of the City of Ottawa Sewer Design Guidelines (October 2012).

Simulations were performed for various storms to confirm the hydraulic grade line (HGL) through Phase 1 and Phase 1A of the development. With respect to Phase 1, simulations were also performed to evaluate the impact on the receiving Pond 5.

Phase 1A ties into an existing storm sewer, the design of which was completed by Novatech. Novatech provided IBI the boundary condition for this node, as well as the maximum allowable release rate to the sewer. Correspondence is enclosed in **Appendix F**.

The XPSWMM model schematic is enclosed in **Appendix F**.

5.4.4 Results of Hydraulic Evaluation

The hydraulic grade line was analyzed using the XPSWMM dynamic model for the 100 year 3 hour Chicago storm. A sensitivity analysis was completed with the 100 year 3 hour Chicago storm + 20% increase in intensity, as well as three historical storms (July 1979, August 1988 and August 1996). The results of the 100 year 3 hour Chicago storm, stress test and July 1979 events are presented in the below **Table 5.5**, results of the remaining storm events are enclosed in **Appendix F**, along with model files. For the evaluation of the impact on the downstream Pond 5, the 100 year 24 hour SCS Type II event was also simulated, as it is the design storm for the SWM facility. A comparison of HGL values at locations along the storm trunk for the 100 year 24 hour SCSC Type II storm are presented in **Table 5.6**. The complete results are enclosed in **Appendix F**.

The HGL elevations are presented in the following **Table 5.5**, along with a comparison of under-side of footing (USF) elevations, where available, and proposed ground elevations otherwise. Locations at which there is no surcharge are indicated with 'N/A.' Freeboard is calculated from either USF or proposed ground elevation.

Table 5.5 Summary of Hydraulic Grade Line Elevations

MH	USF *(PROPOSED GROUND)* (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV.OUT*		STRESS TEST *27970PH1O_120CH_2017-07-11_REV.OUT*		JULY 1979 *27970PH1O_JUL79_2017-07-11_REV.OUT*	
		HGL	CLEARANCE (M)	HGL	CLEARANCE (M)	HGL	CLEARANCE (M)
PHASE 1							
MH110	*107.52*	104.69	2.83	104.75	2.77	104.71	2.81
MH109	*107.45*	104.71	2.74	104.77	2.68	104.72	2.73
MH107	*107.41*	104.73	2.68	104.80	2.61	104.75	2.66
MH105	105.65	104.76	0.89	104.83	0.82	104.79	0.86
MH104	105.85	104.80	1.05	104.87	0.98	104.83	1.02
MH103	105.75	104.81	0.94	104.89	0.86	104.85	0.90
MH102	105.95	104.82	1.13	104.89	1.06	104.85	1.10
MH110C	*107.93*	N/A	N/A	N/A	N/A	N/A	N/A
MH170	105.50	104.86	0.64	104.94	0.56	104.87	0.63
MH171	105.35	104.96	0.39	105.04	0.31	104.96	0.39
MH172	105.50	105.03	0.47	105.12	0.38	105.03	0.47
MH173	105.65	105.07	0.58	105.17	0.48	105.08	0.57
MH174	105.80	105.13	0.67	105.24	0.56	105.14	0.66
MH175	106.00	105.18	0.82	105.28	0.72	105.19	0.81
MH176	106.10	105.23	0.87	105.33	0.77	105.24	0.86
MH177	*106.55*	105.28	1.27	105.34	1.21	105.30	1.25
MH181	105.65	105.19	0.46	105.28	0.37	105.06	0.59
MH180	105.85	105.42	0.43	105.52	0.33	105.18	0.67
MH184	105.68	105.19	0.49	105.30	0.38	105.20	0.48
MH183	105.95	105.32	0.63	105.42	0.53	105.34	0.61
MH182	106.19	105.83	0.36	105.96	0.23	105.86	0.33
MH187	105.75	105.37	0.38	105.47	0.28	105.39	0.36
MH186	106.05	105.53	0.52	105.68	0.37	105.57	0.48
MH191	106.02	105.61	0.41	105.78	0.24	105.67	0.35
MH185	106.45	105.66	0.79	105.82	0.63	105.72	0.73
MH127	106.70	105.80	0.90	105.99	0.71	105.87	0.83
MH190	106.35	105.26	1.09	105.36	0.99	105.26	1.09
MH189	106.05	105.31	0.74	105.41	0.64	105.31	0.74
MH188	106.55	105.44	1.11	105.58	0.97	105.46	1.09

MH	USF (*PROPOSED GROUND)* (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV.OUT*		STRESS TEST *27970PH1O_120CH_2017-07-11_REV.OUT*		JULY 1979 *27970PH1O_JUL79_2017-07-11_REV.OUT*	
		HGL	CLEARANCE (M)	HGL	CLEARANCE (M)	HGL	CLEARANCE (M)
MH128	106.65	N/A	N/A	105.78	0.87	N/A	N/A
MH120	105.70	104.87	0.83	104.95	0.75	104.90	0.80
MH121	105.70	104.88	0.82	104.96	0.74	104.92	0.78
MH122	105.90	N/A	N/A	104.98	0.92	104.94	0.96
MH123	106.00	N/A	N/A	105.01	0.99	104.97	1.03
MH124	106.10	N/A	N/A	105.07	1.03	N/A	N/A
MH125	106.20	N/A	N/A	105.13	1.07	N/A	N/A
MH126	106.35	N/A	N/A	105.17	1.18	N/A	N/A
MH129	*109.23*	N/A	N/A	N/A	N/A	N/A	N/A
MH114	106.00	104.97	1.03	105.08	0.92	105.03	0.97
MH113	106.05	105.09	0.96	105.21	0.84	105.17	0.88
MH112	106.10	105.16	0.94	105.28	0.82	105.25	0.85
MH111	*108.19*	N/A	N/A	105.28	2.91	105.25	2.94
MH132	106.15	N/A	N/A	105.34	0.81	105.30	0.85
MH130	106.25	105.02	1.23	105.12	1.13	105.09	1.16
MH131	106.15	N/A	N/A	105.14	1.01	105.13	1.03
MH140	106.25	N/A	N/A	N/A	N/A	N/A	N/A
MH134	106.40	N/A	N/A	N/A	N/A	N/A	N/A
MH141	*108.40*	N/A	N/A	N/A	N/A	N/A	N/A
MH135	106.76	N/A	N/A	N/A	N/A	N/A	N/A
MH150	106.65	N/A	N/A	N/A	N/A	N/A	N/A
MH152	107.40	N/A	N/A	N/A	N/A	N/A	N/A
MH153	107.25	N/A	N/A	N/A	N/A	N/A	N/A
MH151	107.00	N/A	N/A	N/A	N/A	N/A	N/A
MH149	106.71	N/A	N/A	N/A	N/A	N/A	N/A
PHASE 1A							
CRT1	*103.30*	100.89	N/A	100.89	N/A	100.89	N/A
MH162	*N/A*	N/A	N/A	N/A	N/A	N/A	N/A
MH161	*104.20*	N/A	N/A	N/A	N/A	N/A	N/A
MH146	103.61	N/A	N/A	N/A	N/A	N/A	N/A
MH147	104.06	N/A	N/A	N/A	N/A	N/A	N/A
MH148	104.56	N/A	N/A	N/A	N/A	N/A	N/A
MH138	106.01	N/A	N/A	N/A	N/A	N/A	N/A
MH145	103.61	102.75	0.86	102.76	0.85	N/A	N/A
MH160	105.53	N/A	N/A	N/A	N/A	N/A	N/A
MH137	106.61	N/A	N/A	N/A	N/A	N/A	N/A
MH136	106.71	N/A	N/A	N/A	N/A	N/A	N/A
MH144	104.81	N/A	N/A	N/A	N/A	N/A	N/A
MH143	105.11	N/A	N/A	N/A	N/A	N/A	N/A
MH142	106.11	N/A	N/A	N/A	N/A	N/A	N/A

The above table indicates that minimum 0.3 m clearance between the USF and HGL is maintained across the subject site during the 100 year 3 hour Chicago storm event. It should be noted that the above results also indicate that there would be no severe flooding to properties during the 100 year 3 hour Chicago storm with a 20% increase in intensity, nor during the July 1 1979 historical storms. The results indicate that the HGL would be above the 0.3 m freeboard at three locations during the stress test, but below the USF across the site. The results of the remainder of the storm events are presented in **Appendix F**.

Phase 1, tributary to Pond 5, was also simulated with the 100 year 24 hour SCS Type II storm event, the design storm of the SWM facility. A comparison of HGL along the storm trunk is presented in **Table 5.6**. There is negligible impact on the HGL as a result of the revisions related to Phase 1 detailed design.

Table 5.6 100 year 24 hour SCS Type II HGL Comparison: Pond 5 Submission and Phase 1 Detailed Design

LOCATION		HGL (M)			
		100 YEAR 24 HOUR SCS TYPE II		100 YEAR 24 HOUR SCS TYPE II + 20%	
		POND 5 SUBMISSION MAY 2016	PHASE 1 DETAILED DESIGN *27970PH1_100SCS_2017-07-11_REV.OUT*	POND 5 SUBMISSION MAY 2016	PHASE 1 DETAILED DESIGN *27970PH1_120SCS_2017-07-11_REV.OUT*
Pond 5	D/S Cell	104.32	104.26	104.52	104.47
	U/S Cell	104.33	104.26	104.53	104.48
MH300		104.37	104.26	104.58	104.49
MH207		104.45	104.49	104.63	104.67
MH206		104.48	104.53	104.64	104.72
MH205		104.52	104.57	104.67	104.78
MH110 (Phase 1)		104.58	104.64	104.74	104.86

In addition, an evaluation of the hydraulic grade line was undertaken assuming that those storm sewer pipes that are partially permanently submerged have 25% accumulation of sediment. At the request of the City, the evaluation was undertaken using the 100 year 3 hour Chicago storm event. The results of the hydraulic evaluation are presented in **Table 5.7**.

Table 5.7 Hydraulic Grade Line for 25% Sediment Accumulation in Permanently Partially Submerged Storm Sewers (Phase 1)

MH	USF (*PROPOSED GROUND)* (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV_SED.XP*	
		HGL	CLEARANCE (M)
MH110	*107.52*	105.35	2.17
MH109	*107.45*	105.38	2.07
MH107	*107.41*	105.43	1.98
MH105	105.65	105.48	0.17
MH104	105.85	105.54	0.31
MH103	105.75	105.61	0.14
MH102	105.95	105.67	0.28
MH110C	*107.93*	105.82	2.11
MH170	105.50	105.56	-0.06
MH171	105.35	105.67	-0.32
MH172	105.50	105.75	-0.25
MH173	105.65	105.80	-0.15
MH174	105.80	105.87	-0.07
MH175	106.00	105.91	0.09
MH176	106.10	105.96	0.14
MH177	*106.55*	106.04	0.51
MH181	105.65	105.90	-0.25
MH180	105.85	106.14	-0.29
MH184	105.68	105.92	-0.24
MH183	105.95	106.05	-0.10
MH182	106.19	106.55	-0.36

MH	USF (*PROPOSED GROUND)* (M)	100 YEAR 3 HOUR CHICAGO *27970PH1O_100CH_2017-07-11_REV_SED.XP*	
		HGL	CLEARANCE (M)
MH187	105.75	106.10	-0.35
MH186	106.05	106.26	-0.21
MH191	106.02	106.35	-0.33
MH185	106.45	106.44	0.01
MH127	106.70	106.68	0.02
MH190	106.35	105.98	0.37
MH189	106.05	106.04	0.01
MH188	106.55	106.35	0.20
MH120	105.70	105.67	0.03
MH121	105.70	105.71	-0.01
MH122	105.90	105.74	0.16
MH123	106.00	105.79	0.21
MH124	106.10	105.92	0.18
MH125	106.20	106.14	0.06
MH126	106.35	106.31	0.04
MH128	106.65	106.91	-0.26
MH129	*109.23*	106.91	2.32
MH114	106.00	105.79	0.21
MH113	106.05	105.90	0.15
MH112	106.10	106.06	0.04
MH111	*108.19*	106.08	2.11
MH132	106.15	106.06	0.09
MH130	106.25	105.89	0.36
MH131	106.15	106.09	0.06
MH140	106.25	106.00	0.25
MH134	106.40	106.39	0.01
MH141	*108.40*	106.56	1.84
MH135	106.76	106.33	0.43
MH136	106.71	106.39	0.32
MH150	106.65	106.22	0.43
MH152	107.40	106.39	1.01
MH153	107.25	106.59	0.66
MH151	107.00	106.60	0.40
MH149	106.71	106.80	-0.09

The modeling results of the permanently partially submerged storm sewers assuming 25% sediment accumulation indicate that the HGL is below the USF but the clearance between the USF and HGL is less than 0.3 m at 21 locations (indicated in red). At nine locations, the HGL is above the USF but below the basement slab (indicated in yellow). And at three locations, the HGL is above the basement slab. It should be emphasized that the sediment accumulation simulation has been completed under the 100 year storm event, considered a compounding sensitivity analysis. It is recommended that regular sewer clean out be performed prior to 25% accumulation.

5.5 Summary of Model Output Files

The following is a reference list of the model output files including file names and storm event evaluated. The files are included on the CD enclosed in **Appendix F**.

DDSWMM:

- 5 year 3 hour Chicago: 07-PH1-5CH.DAT, 07-PH1A-5CH.DAT
- 100 year 3 hour Chicago: 07-PH1-100CH.DAT, 07-PH1A-100CH.DAT
- 100 year 3 hour Chicago +20%: 07-PH1-120CH.DAT, 07-PH1A-120CH.DAT
- July 1979: 07-PH1-JUL79.DAT, 07-PH1A-JUL79.DAT
- August 1988: 07-PH1-AUG88.DAT, 07-PH1A-AUG88.DAT
- August 1996: 07-PH1-Aug96.DAT, 07-PH1A-Aug96.DAT

SWMHYMO:

- 27970VXD.OUT

XPSWMM:

- 100 year 3 hour Chicago: 27970PH1O_100CH_2017-07-11_REV.xp
- 100 year 3 hour Chicago +20% increase in intensity: 27970PH1O_120CH_2017-07-11_REV.xp
- July 1979: 27970PH1O_JUL79_2017-07-11_REV.xp
- August 1988: 27970PH1O_AUG88_2017-07-11_REV.xp
- August 1996: 27970PH1O_AUG96_2017-07-11_REV.xp
- 100 year 24 hour SCS Type II: 27970PH1_100SCS_2017-07-11.xp
- 100 year 24 hour SCS Type II + 20%: 27970PH1_120SCS_2017-07-11.xp
- 25% Sediment Accumulation: 27970PH1O_100CH_2017-07-11_REV_SED.xp

5.6 Erosion and Sedimentation Control

Development of a subdivision such as CRT Lands Phase 1 can potentially create deleterious material which can enter the natural environment and gain access to fish habitat. In order to prevent site generated sediments from entering the environment, an Erosion and Sedimentation Control Plan will be implemented prior to development.

The erosion and sedimentation strategy for the subject site will include erection of silt fences around the entire perimeter of the subject site. The silt fences will ensure protection of both adjacent developments and the natural environment.

A copy of the Erosion and Sedimentation Control Plan is included in **Appendix G**.

5.7 Miscellaneous Elements

The following section includes brief comments for items indicated in the current Servicing Study Guidelines for which the proposed development will have little or no impact. These include:

- Setbacks
- Drainage catchment diversions
- Municipal Drains
- 100 year flood lands

- Floodplains

There are no watercourses or hazard land setbacks applicable to the development. Mitigation measures of potential impacts to downstream watercourses such as Flewellyn Drain will include implementation of an Erosion and Sedimentation Control Plan.

There are no drainage catchment diversions proposed by the development.

Any runoff from the site, as with all developments in the Fernbank Community, has end-of-pipe quality and quantity treatment. Any impacts to receiving watercourses have been previously addressed.

The only municipal drain in the vicinity of the subject development is Flewellyn Drain. The drain is proposed to be deepened for about 650 m downstream of Fernbank Road and improved for about another 800 m up to Flewellyn Road. Permit No. RV5-11/15T dated July 9, 2015 from the Rideau Valley Conservation Authority has been obtained by the Owners. The drain improvements have been approved by the MOECC.

There are no flood plains in the vicinity of the CRT Lands.

6 APPROVALS AND PERMIT REQUIREMENTS

6.1 City of Ottawa

The City of Ottawa reviews all development documents including this report and working drawings. Upon completion, the City will approve the local watermains, under Permit NO. 008-202, submit the sewer MOE application to the province, and eventually issue a Commence Work Notification.

6.2 Province of Ontario

The Ministry of Environment and Climate Change (MOECC) will approve the local sewers and the stormwater facilities under Section 53 of the Ontario Water Resources Act and issue the Environment Compliance Approvals. A Permit To Take Water will also be required from the MOE.

6.3 Conservation Authority

Flewellyn Drain will be impacted by the proposed development. About 1450 m of the municipal drain is proposed to be improved. The Rideau Valley Conservation Authority has issued a permit (Permit No.RV5-11/15T) for the proposed improvements.

6.4 Federal Government

There are no permits, authorizations or approvals needed expressly for this development from the federal government.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This report and the accompanying working drawings clearly indicate that the proposed development meets the requirements of the stakeholder regulators, including the City of Ottawa, provincial MOECC and RVCA. With minor exceptions, the proposed development is in general conformance with the 2009 Master Servicing Report and current City of Ottawa design standards. Because of the 2012 change in the City of Ottawa's stormwater management criteria, most minor storm sewers are now proposed to be larger than those recommended in the 2009 Master Servicing Studies.

Downstream sanitary sewers were designed with the proposed development area included. There is a reliable water supply available adjacent to the proposed development.

7.2 Recommendations

It is recommended that the regulators review this submission with an aim of providing the requisite approvals to permit the owners to proceed to the development stage of the subject site.

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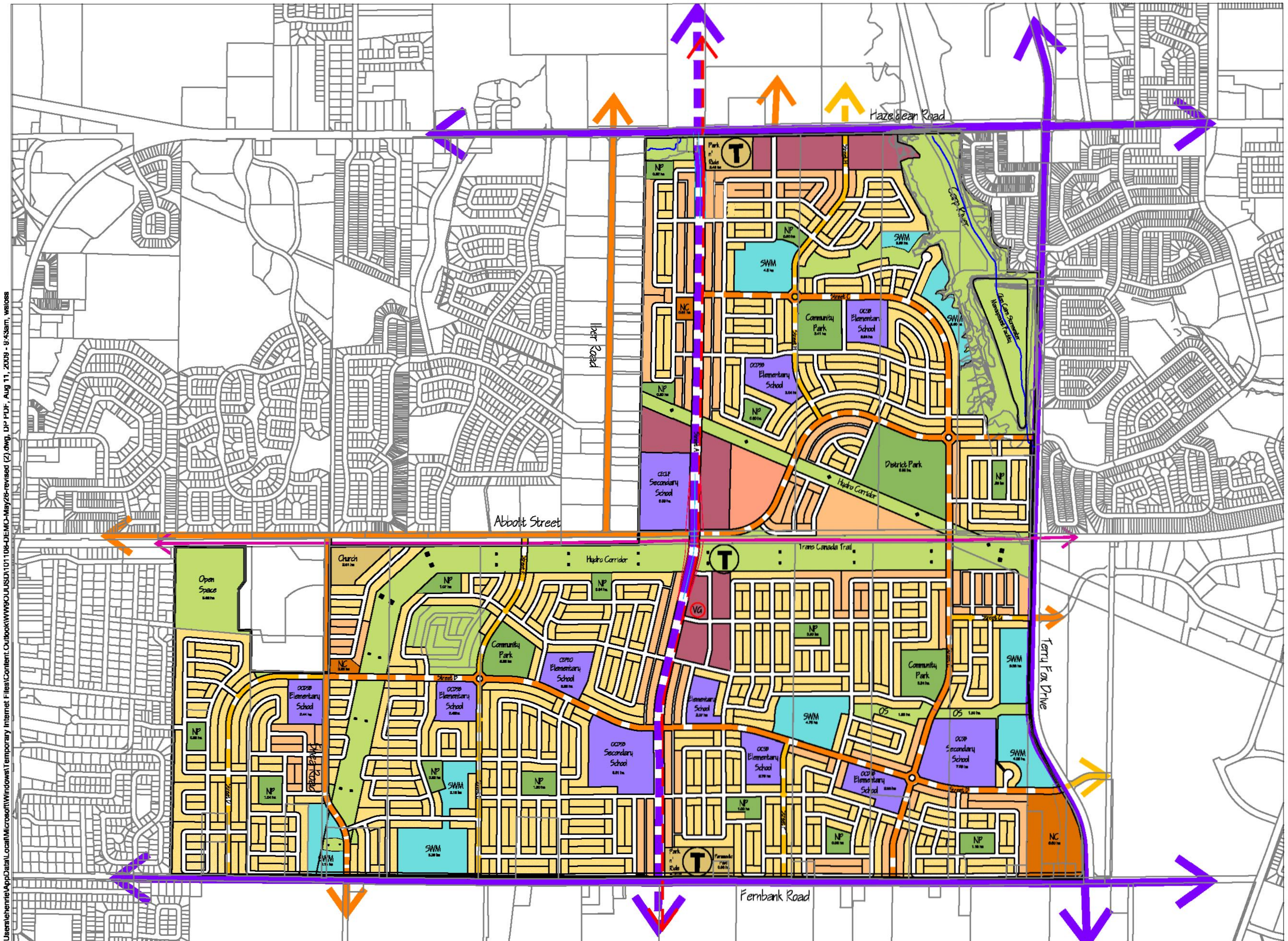


Fernbank Community

City of Ottawa

Preliminary Demonstration Plan B

Legend

EXISTING PROPOSED

- Arterial
- Major Collector
- Minor Collector
- Trans-Canada Trail
- Transit Route
- Transit Station
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Mixed-Use
- Parks
- Schools
- Storm Water Facilities
- Open Space
- Neighbourhood Commercial
- Church/Transit Park n' Ride/Paramedic Post

Scale 1 : 15,000
May 26, 2009
06597

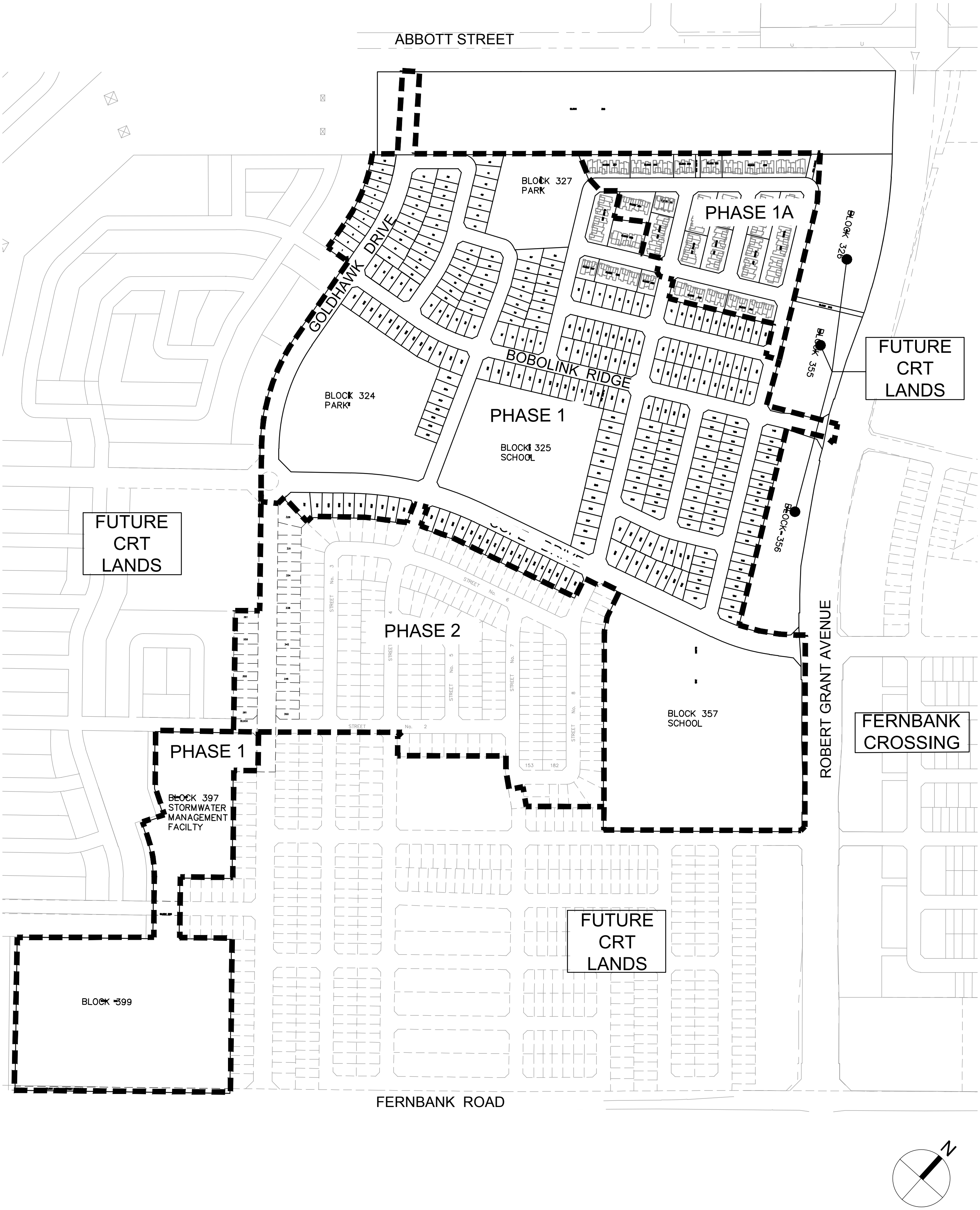
Walker, Nott, Dragicevic Associates Limited
Planning
Urban Design

Scale: N.T.S.

Project Title: DESIGN BRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY

Drawing Title: FERNBANK COMMUNITY PRELIMINARY DEMONSTRATION PLAN

Sheet No.: FIGURE 1.1



J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig1.3 PHASING PLAN.dwg Layout Name: Figure 1.3

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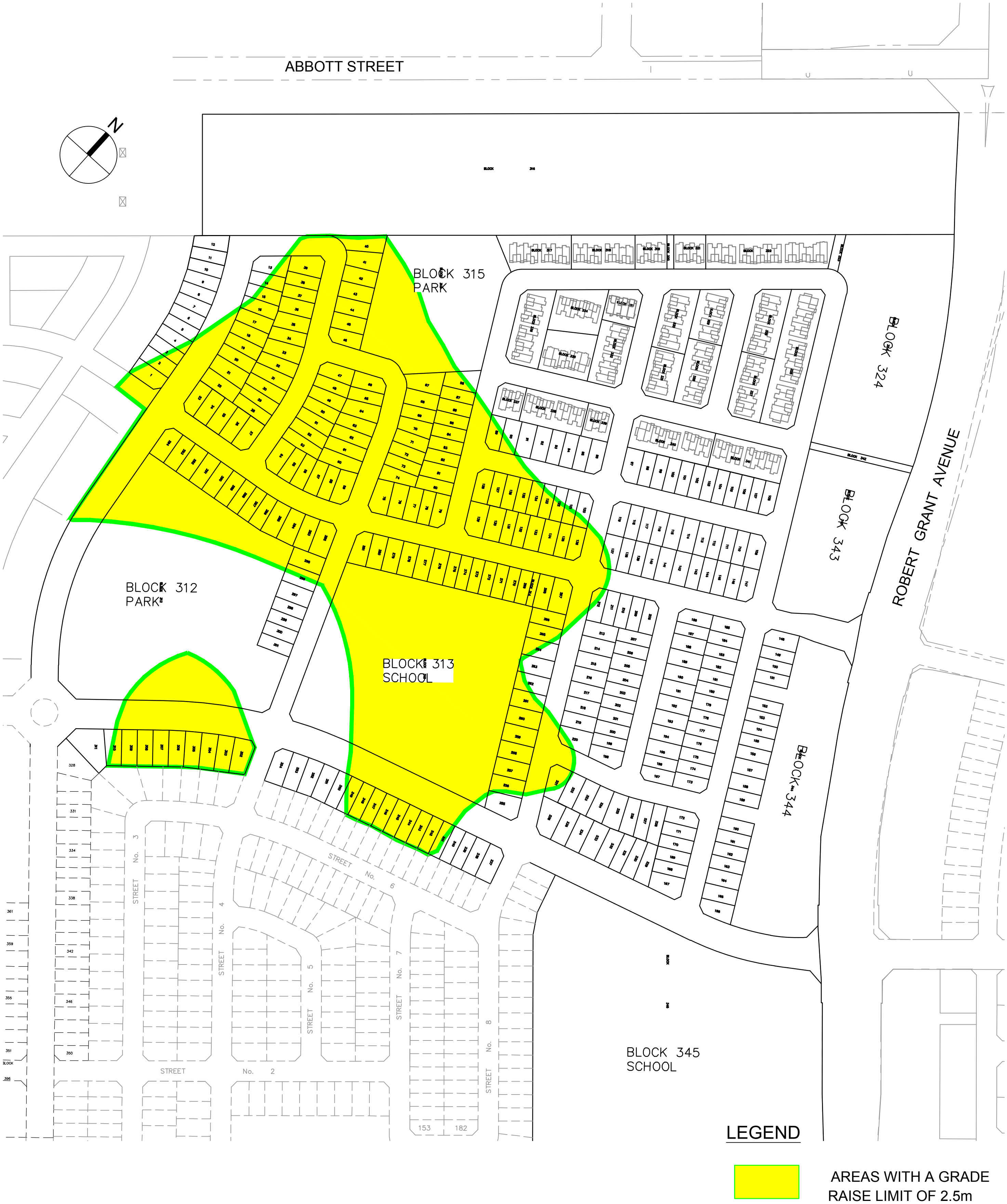
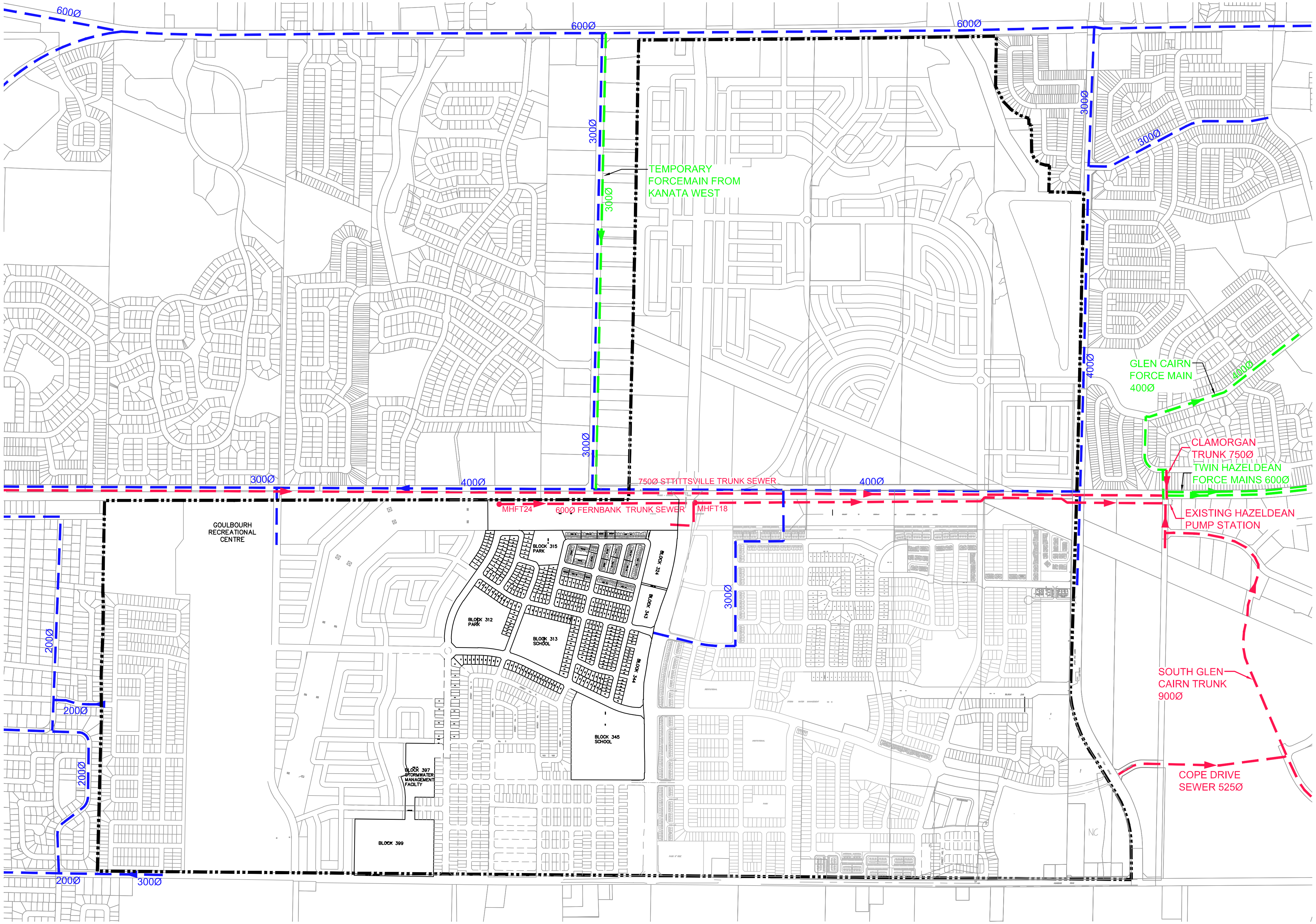
Project Title	Drawing Title	Sheet No.
DESIGN DRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY	PHASING PLAN	FIGURE 1.3

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig1.4 GRADE RAISE LIMITS.dwg Layout Name: Figure 1.4



Project Title	Drawing Title	Sheet No.
DESIGN DRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY	GRADE RAISE LIMITS	FIGURE 1.4



LEGEND:

300Ø EXISTING WATERMAIN AND DIAMETER

300Ø EXISTING SANITARY SEWER, SIZE AND FLOW DIRECTION

300Ø EXISTING FORCEMAINS, SIZE AND FLOW DIRECTION

LIMITS OF FERNBANK COMMUNITY CONCEPT PLAN

Scale

N.T.S.

Project Title

DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

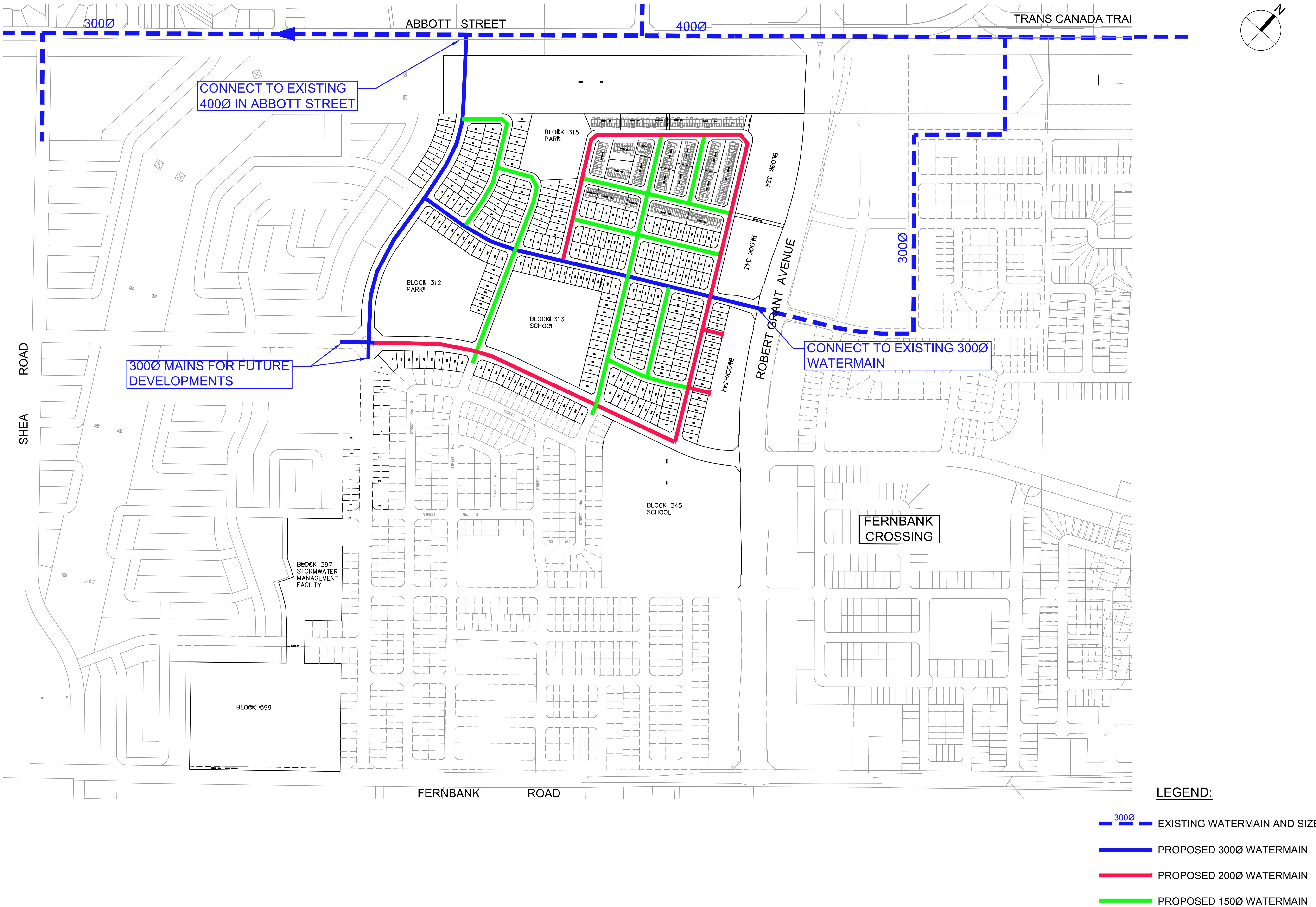
Drawing Title

EXISTING WATERMAINS
AND
SANITARY SEWERS

Sheet No.

FIGURE 2.1

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig2.1 EX.WATER AND SANITARY.dwg Layout Name: Figure 2.1 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 11:32 AM Last Saved By: mmiline
Last Saved At: Jul. 13, 17



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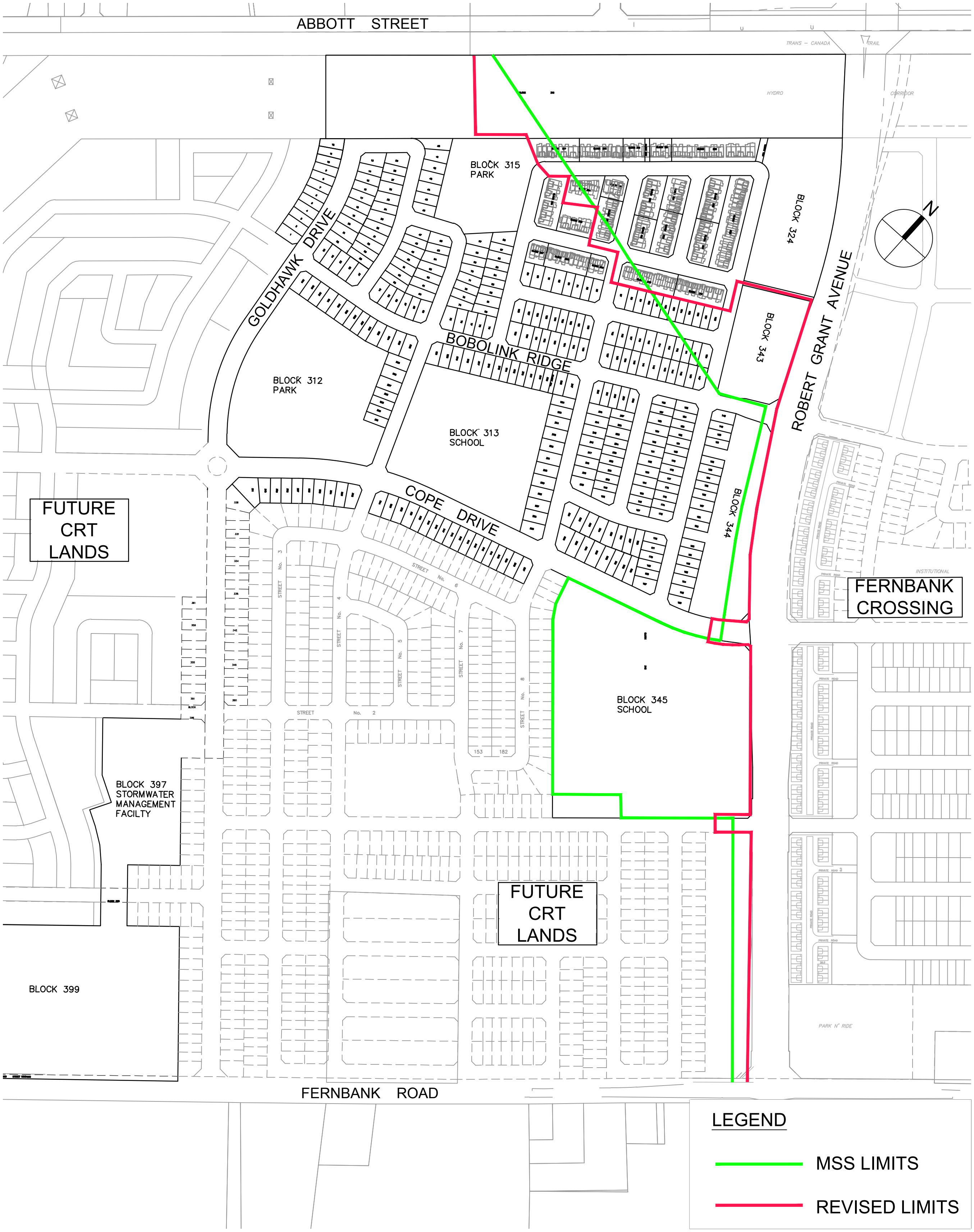
Project Title: DESIGN BRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY

Drawing Title: PROPOSED WATER PLAN

Sheet No.: FIGURE 2.2



J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig3.1 SANITARY DRAINAGE LIMITS.dwg Layout Name: Figure 3.2

IBI

Project Title

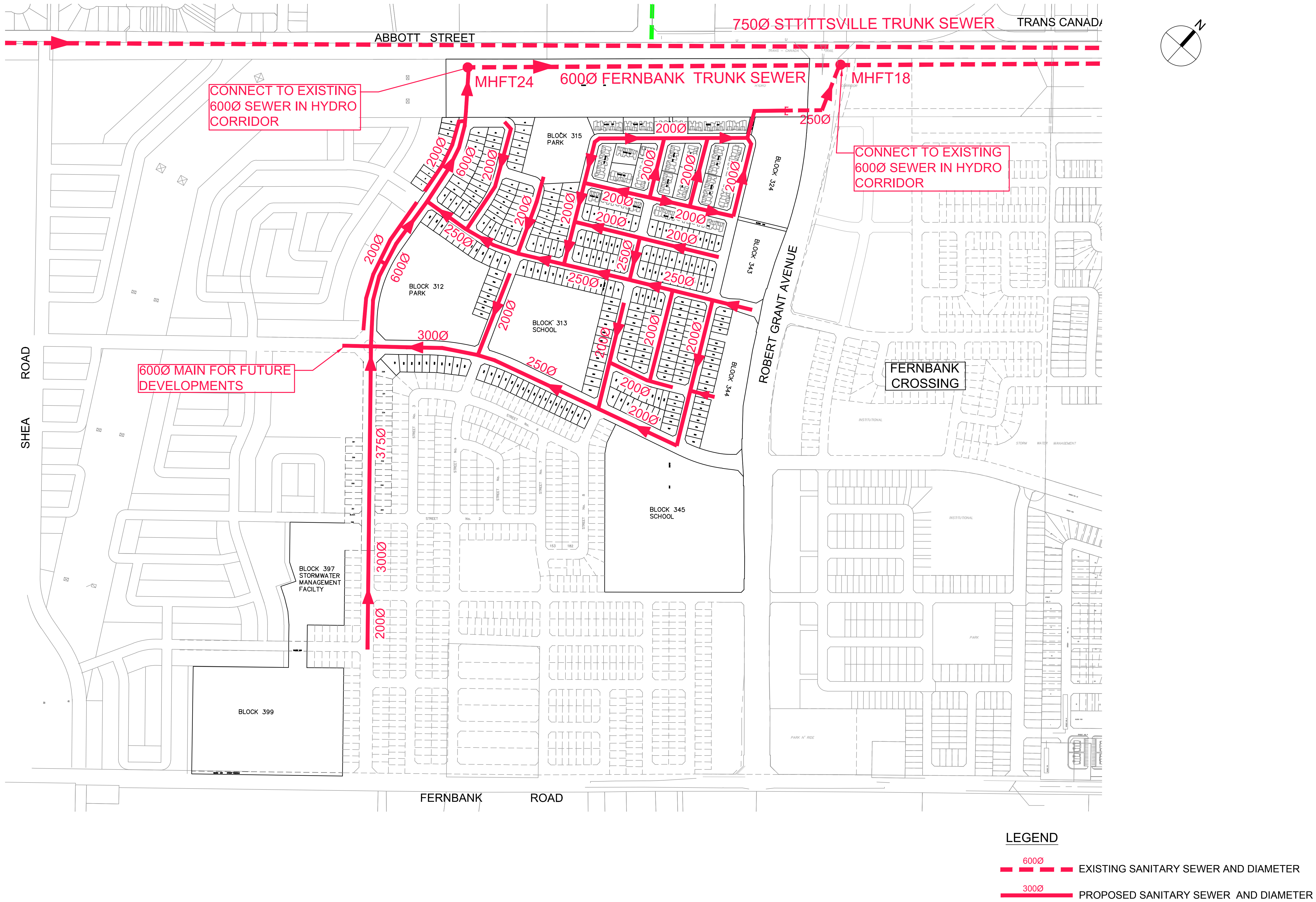
DESIGN DRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title

PROPOSED CHANGES
TO SANITARY DRAINAGE
LIMITS

Sheet No.

FIGURE 3.1



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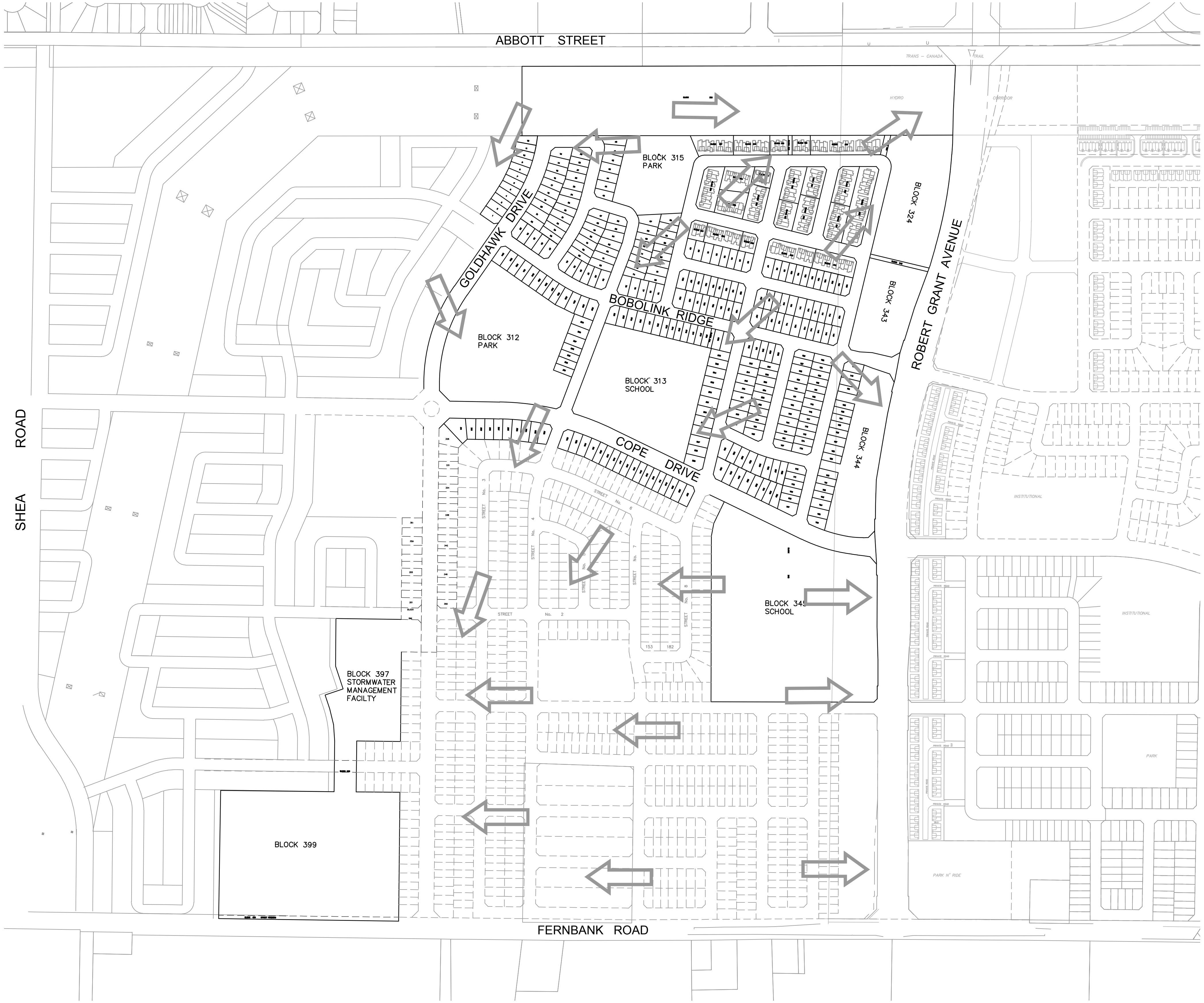
Project Title: DESIGN BRIEF CRT LANDS-PHASE 1 FERNBANK COMMUNITY

Drawing Title: PROPOSED WASTEWATER PLAN

Sheet No.: FIGURE 3.2

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-07-14\27970-Fig3.2 PROPOSED WASTEWATER.dwg Layout Name: Figure 3.2 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 11:54 AM Last Saved By: mmilne Last Saved At: Jul. 13, 17



LEGEND

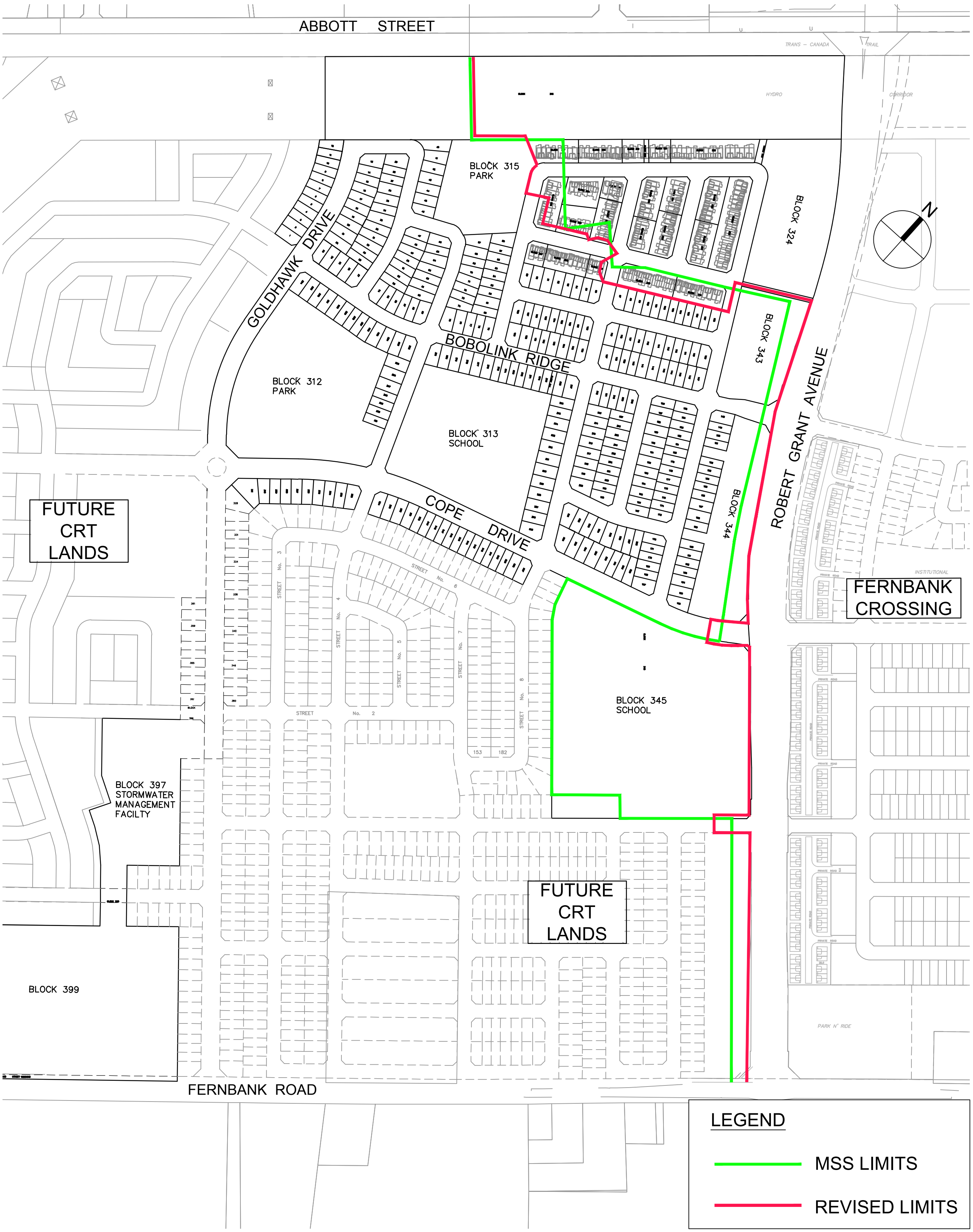
EXISTING SURFACE FLOW DIRECTION

Scale
N.T.S.

Project Title
DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title
EXISTING DRAINAGE
PATTERNS

Sheet No.
FIGURE 4.1



Project Title

DESIGN DRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

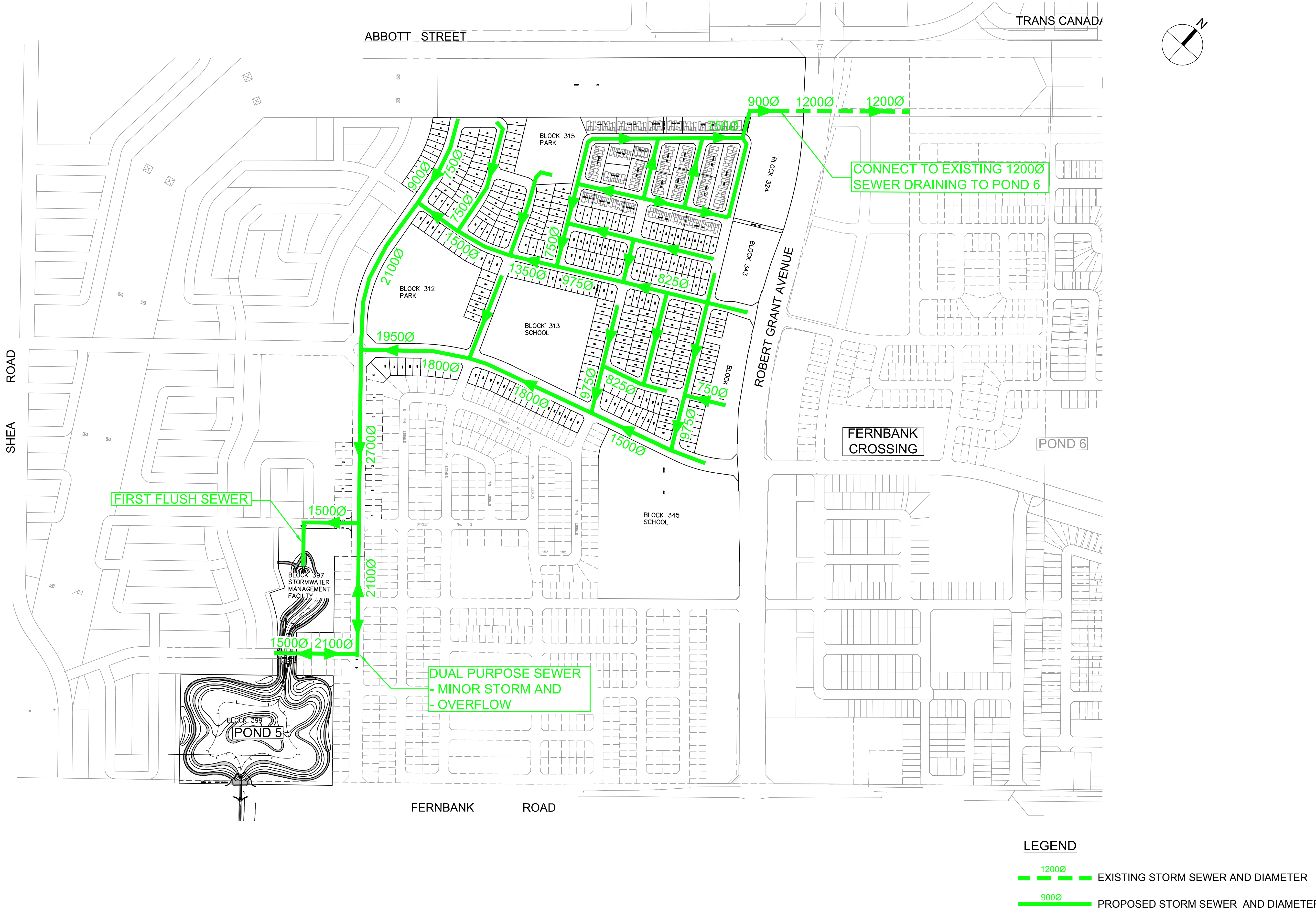
Drawing Title

PROPOSED CHANGES
TO MINOR STORM
DRAINAGE LIMITS

Sheet No.

FIGURE 4.2

J:\27970-FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017-02-10\27970-Fig4.2 MINOR STORM DRAINAGE LIMITS.dwg Layout Name: Figure 4.2



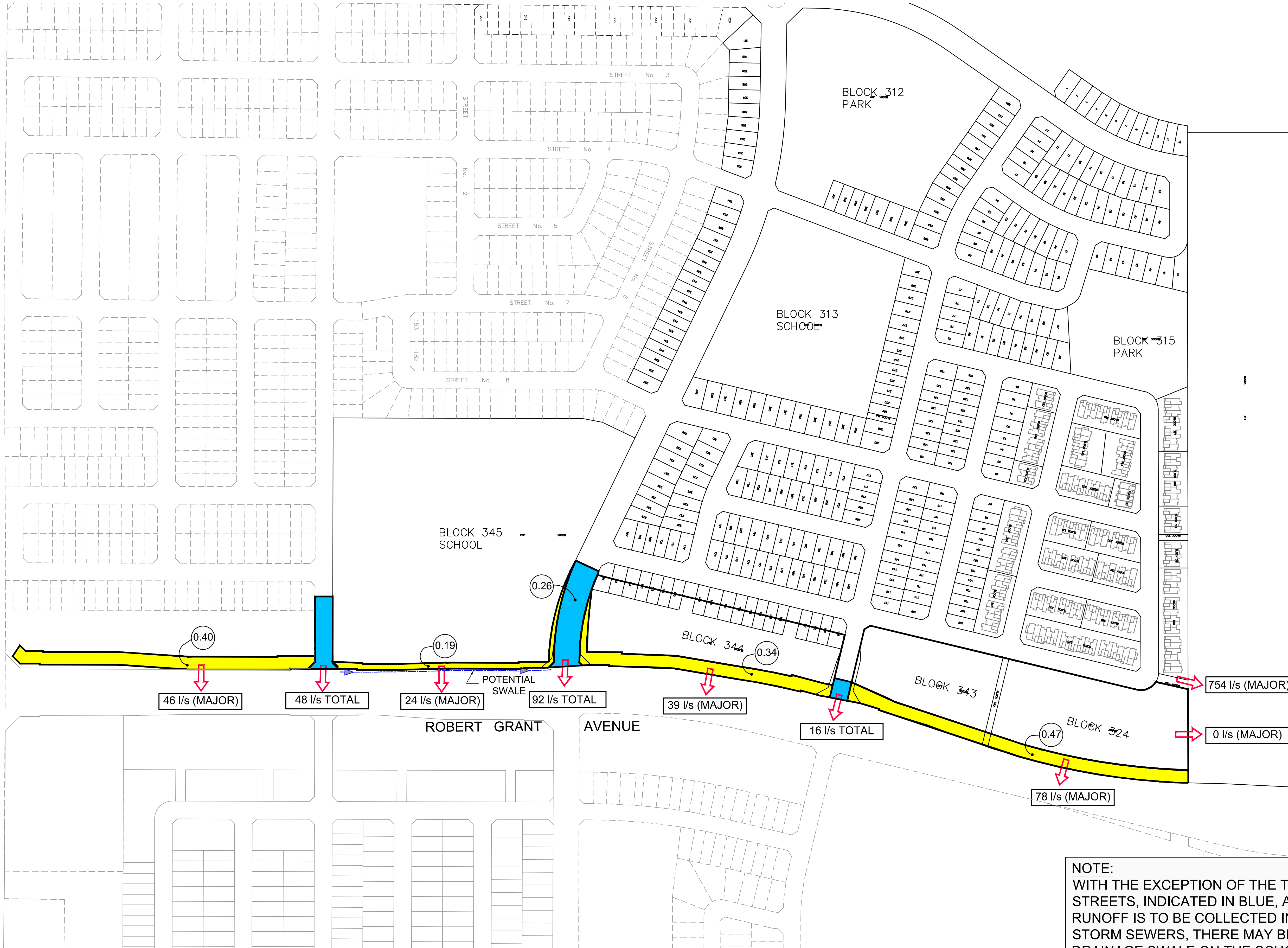
Scale: N.T.S.

Project Title: DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title: PROPOSED MINOR STORM PLAN

Sheet No.: FIGURE 4.3

J:\27970–FernbankPlan\5.9 Drawings\59civil\current\Design Brief\2017–07–14\27970–Fig4.3 PROPOSED MINOR STORM PLAN.dwg Layout Name: Figure 4.3 Plot Style: ---- Plot Scale: 1:2.5849 Plotted At: 7/13/2017 1:06 PM Last Saved By: mmilne Last Saved At: Jul. 13, 17



NOTE:
WITH THE EXCEPTION OF THE THREE SIDE STREETS, INDICATED IN BLUE, ALL MINOR STORM RUNOFF IS TO BE COLLECTED IN THE CRT MINOR STORM SEWERS, THERE MAY BE A FUTURE DRAINAGE SWALE ON THE SCHOOL BLOCK 357 DIRECTED TOWARDS THE ROBERT GRANT AVENUE MINOR SYSTEM. FLOWS CORRESPOND TO THE 100 YEAR 3 HOUR CHICAGO STORM EVENT.

Scale
N.T.S.

Project Title
DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title
DRAINAGE FROM
CRT LANDS TO
ROBERT GRANT AVENUE

Sheet No.
FIGURE 4.4

APPENDIX A

- **Development Servicing Study Checklist**
- **Figure 1.2 – Draft Plan**

General Content

	ITEM DESCRIPTION	LOCATION
	Executive Summary (for larger reports only)	N/A
√	Date and revision number of the report	Front Cover
√	Location Map and plan showing municipal address, boundary, and layout of proposed development.	Figure 1 and 3
√	Plan showing the site and location of all existing services.	Figure 4
√	Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	Section 1.3, 2.3, 3.3 & 4.3
√	Summary of Pre-consultation Meeting with City and other approval agencies.	Appendix B
√	Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.	Section 1.5
√	Statement of objectives and servicing criteria	Section 2.3, 3.3 & 4.3
√	Identification of existing and proposed infrastructure available in the immediate area.	Figure 4
√	Identification of Environmentally Significant Areas, Watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).	Section 1.6
√	Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	Grading Plans
	Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.	N/A
√	Proposed phasing of the development, if applicable.	Figure 3
√	Reference to geotechnical studies and recommendations concerning servicing.	Section 1.8
√	All preliminary and formal site plan submissions should have the following information: • Metric scale • North arrow (including construction North) • Key plan • Name and contact information of applicant and property owner • Property limits including bearings and dimensions • Existing and proposed structures and parking areas • Easements, road widening and rights-of-way • Adjacent street names	Design Drawings

Development Servicing Report: Water

	ITEM DESCRIPTION	LOCATION
√	Confirm consistency with Master Servicing Study, if available	Section 2.2
√	Availability of public infrastructure to service proposed development	Section 2.1, 2.4
√	Identification of system constraints – external water needed	Section 2.1
√	Identify boundary conditions	Section 2.3
√	Confirmation of adequate domestic supply and pressure	Section 2.4
√	Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.	Section 2.3
√	Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.	Section 2.3
√	Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defining phases of the project including the ultimate design.	Section 2.4
√	Address reliability requirements such as appropriate location of shut-off valves.	Design Drawings
	Check on the necessity of a pressure zone boundary modification.	N/A
√	Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range.	Section 2.3 Appendix C
√	Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.	Section 2.4 Figure 5 Appendix C
√	Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities and timing of implementation.	Section 2.1 Figure 5
√	Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Section 2.3
√	Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	Section 2.4 Appendix C

Development Servicing Report: Wastewater

	ITEM DESCRIPTION	LOCATION
√	Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).	Section 3.3
√	Confirm consistency with Master Servicing Study and/or justifications for deviations.	Section 3.2
√	Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age condition of sewers.	Section 3.6
√	Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Section 3.2, 3.4 Figure 4
√	Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)	Section 3.2, 3.4
√	Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix “C”) format.	Section 3.3 & 3.7 Appendix D
√	Description of proposed sewer network including sewers, pumping stations and forcemains.	Section 3.4 Figure 6
√	Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).	Section 1.6, 3.8
√	Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	Section 3.5
	Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N/A
√	Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	Section 3.9
√	Special considerations such as contamination, corrosive environment, check soils, etc.	Section 1.8

Development Servicing Report: Stormwater Checklist

	ITEM DESCRIPTION	LOCATION
√	Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)	Section 1.6, 4.1
	Analysis of available capacity in existing public infrastructure.	Section 4.5
√	A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Figure 2.8 Grading Plans
√	Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.	Section 5.3
√	Water quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Section 5.3
√	Description of the stormwater management concept with facility locations and descriptions with references and supporting information.	Section 5
	Set-back from private sewage disposal systems.	N/A
	Watercourse and hazard lands setbacks.	N/A
√	Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	Section 1.6
√	Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	Section 4.2
√	Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).	Section 5.5
√	Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	Section 1.6, 6.3
√	Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	Section 5.3, 5.5
√	Any proposed diversion of drainage catchment areas from one outlet to another.	Section 4.2
√	Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	Section 4.4 Design Drawings
	If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.	N/A
√	Identification of potential impacts to receiving watercourses	Section 1.6, 6.3
√	Identification of municipal drains and related approval requirements.	Section 1.6, 6.3

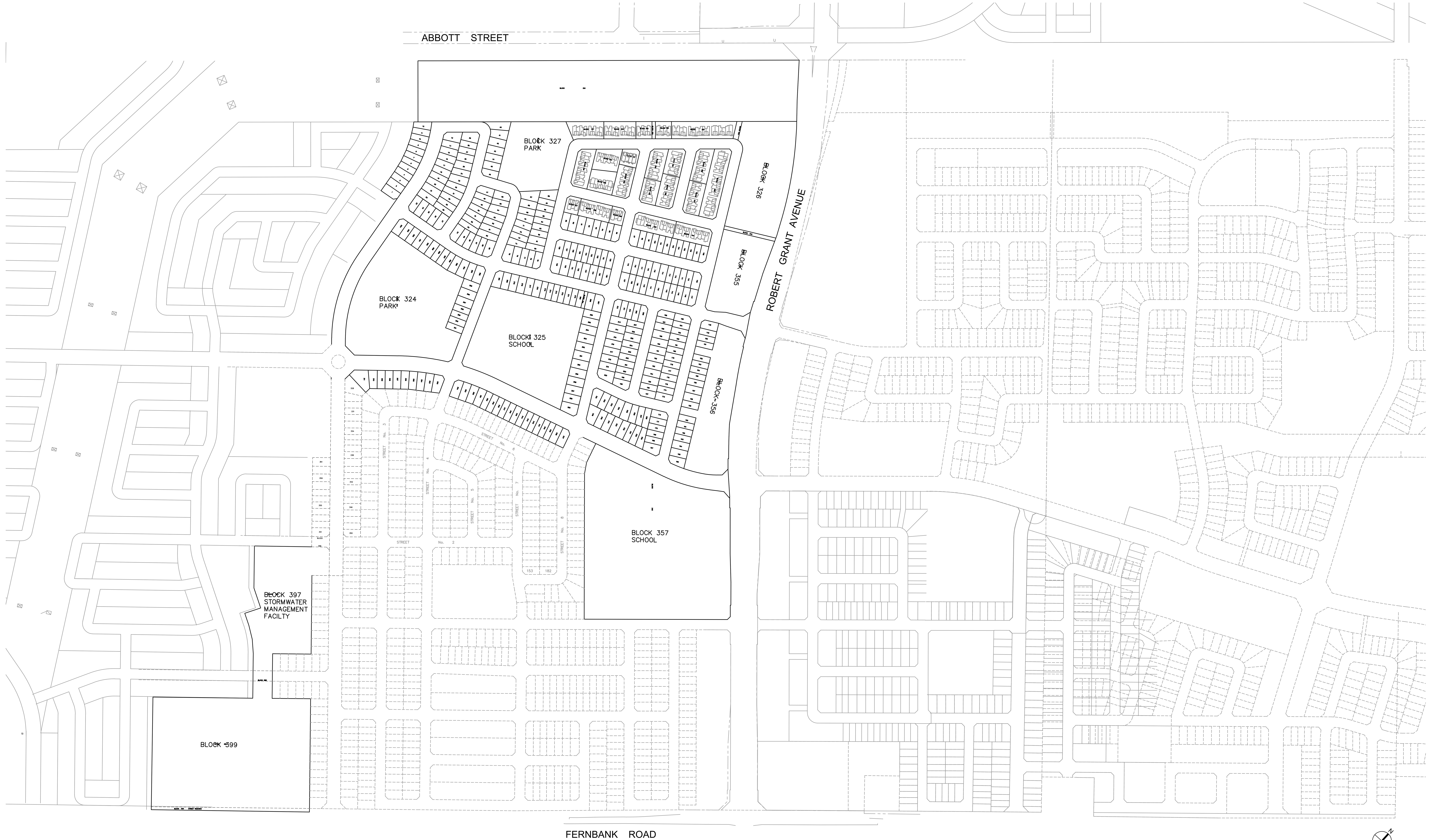
√	Descriptions of how the conveyance and storage capacity will be achieved for the development.	Section 5.4, 5.6
√	100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	Grading Plans
√	Inclusion of hydraulic analysis including hydraulic grade line elevations.	Section 5.6
√	Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Section 5.6
√	Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.	Section 5.7
	Identification of fill constraints related to floodplain and geotechnical investigation.	N/A

Approval and Permit Requirements: Checklist

	ITEM DESCRIPTION	LOCATION
√	Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.	Section 6.3
√	Application for Certification of Approval (CofA) under the Ontario Water resources Act.	Section 6.2
√	Changes to Municipal Drains	Section 1.6
√	Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	Section 6.4

Conclusion Checklist

	ITEM DESCRIPTION	LOCATION
√	Clearly stated conclusions and recommendations	Section 7
	Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.	N/A
√	All draft and final reports shall be signed and stamped by professional Engineer registered in Ontario.	Done



Scale 1:3000

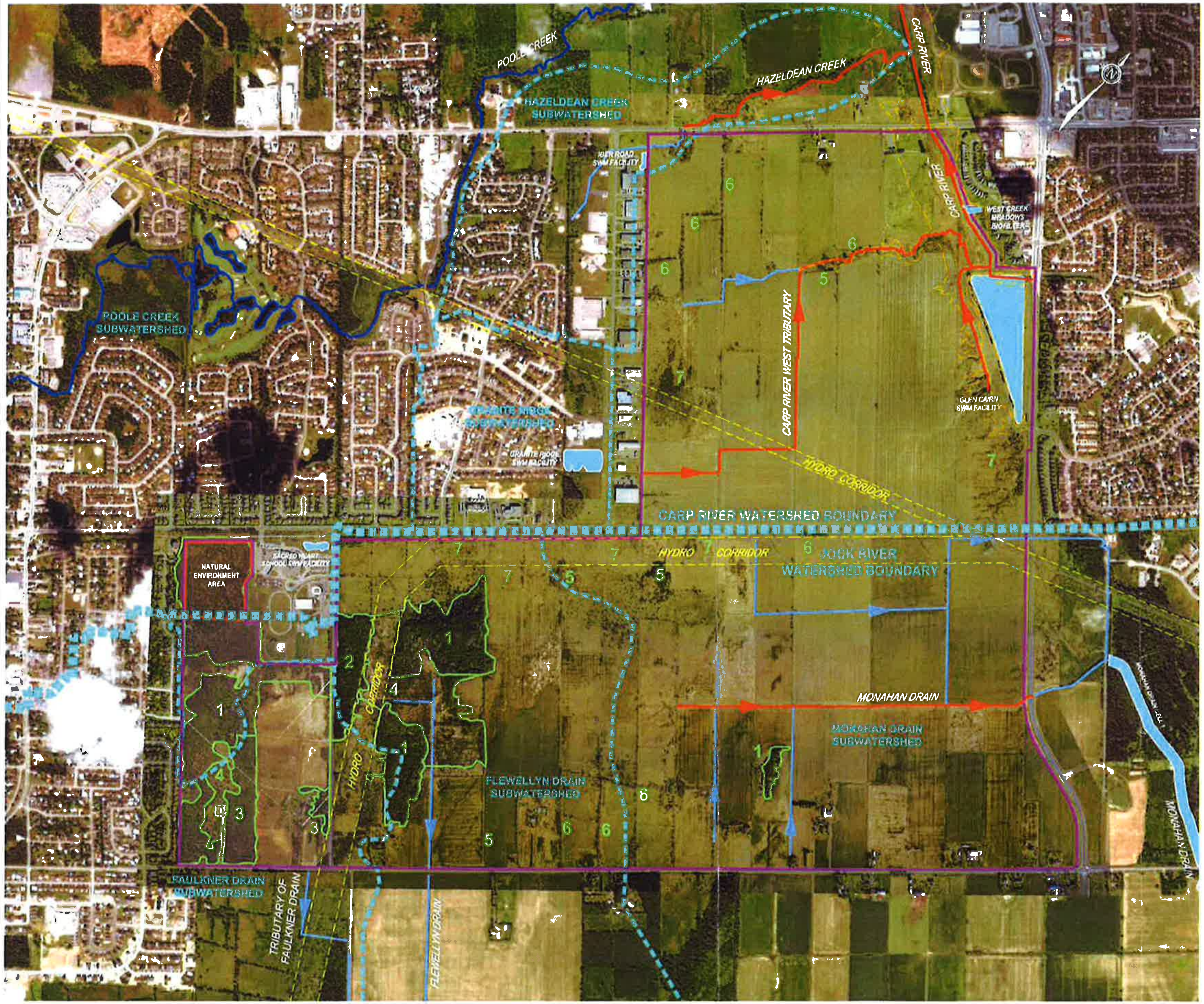
Project Title
DESIGN BRIEF
CRT LANDS-PHASE 1
FERNBANK COMMUNITY

Drawing Title
DRAFT PLAN

Sheet No.
FIGURE 1.2

APPENDIX B

- **Figure 3.2 Existing Conditions – Fernbank Community Design Plan – Environmental Management Plan**
- **Municipal Drain By-Law**
- **January 31, 2017 E-mail from City of Ottawa**
- **December 9, 2013 E-mail from Rideau Valley Conservation Authority**
- **November 28, 2013 E-mail with the provincial Ministry of Environment Ottawa Office**
- **PTTW No. 3238-9TLP82**



FERNBANK COMMUNITY DESIGN PLAN

City of Ottawa

ENVIRONMENTAL MANAGEMENT PLAN

FIGURE 3.2

Existing Conditions

Natural Environment Features

STUDY AREA

AQUATIC FEATURES

WARM WATER FORAGE FISH HABITAT

DRAINAGE CHANNEL

NOTE: OTHER ON-SITE CHANNELS CONTRIBUTE FLOW TO DOWNSTREAM FISH HABITAT

CARP RIVER FLOOD PLAIN

WATERSHED BOUNDARY

TERRESTRIAL FEATURES

NATURAL ENVIRONMENT AREA

AREA OF TERRESTRIAL FEATURE

1 WOODED AREA (CONIFEROUS)
2 WOODED AREA (MIXED SPECIES)
3 PINE PLANTATION
4 SCRUB AND THICKET
5 REMNANT HIGHER QUALITY TREES MAPLE, ASH and BASSWOOD
6 DECIDUOUS HEDGEROWS
7 MEADOW HABITAT USED BY FIELD SPECIES SUCH AS BOBOLINK, SAVANNAH SPARROWS, and UPLAND SANDPIPERS

SOURCE AND DATE OF AERIAL PHOTOS:
a) FERNBANK CDP LANDS: BASE MAPPING CO. (JUNE 2006)
b) BACKGROUND COMMUNITY: GOOGLE EARTH MAP (YEAR VARIES)

SCALE: 1:6000 -B1 Sheet
SCALE: Not to Scale -Report

SEPTEMBER 2008

NOVATECH ENGINEERING CONSULTANTS LTD.
ENGINEERS & PLANNERS

BY-LAW NO. 2011 - 311

A by-law of the City of Ottawa to provide for the partial abandonment of drainage works in the City of Ottawa - Flewellyn Municipal Drain.

WHEREAS the Flewellyn Municipal Drain By-law, being By-law 12-71 of the former Township of Goulbourn was passed pursuant to the *Drainage Act* (now R.S.O. 1990, D.17);

AND WHEREAS the lands of the former Township of Goulbourn are now included in the City of Ottawa by virtue of the *City of Ottawa Act, 1999*, S.O. 1999, c.14, Sch.E;

AND WHEREAS every by-law of the Township of Goulbourn is deemed to be a by-law of the City of Ottawa pursuant to Section 5(6) of the said *City of Ottawa Act, 1999*;

AND WHEREAS the City of Ottawa has received a request under Subsection 84(1) of the *Drainage Act* from not less than three-quarters of the owners of land assessed for benefit and owning not less than three-quarters of the area assessed for benefit, as shown in the Flewellyn Municipal Drain By-law, being By-law 12-71, asking for the abandonment of part of the drainage works, being that part of Branch #1 of the Flewellyn Municipal Drain between Stations 0+00 and 31+00;

AND WHEREAS all of the owners of the land assessed for the drainage works have been notified of the City's intention to abandon part of the drainage works pursuant to Subsection 84(1) of the *Drainage Act*;

AND WHEREAS no request for an engineer's report with respect to the part of the drainage works that is to be abandoned has been received pursuant to Subsections 84(1) and 84(3) of the *Drainage Act*;

AND WHEREAS Subsection 84(5) of the *Drainage Act* states that if no request for an engineer's report on the proposed abandonment is received by the clerk of the municipality, the council may by by-law abandon the drainage works and thereafter the municipality has no further obligation with respect to the abandoned drainage works;

AND WHEREAS there are no costs associated with respect to the part of the drainage works that is to be abandoned;

THEREFORE the Council of the City of Ottawa enacts as follows:

1. Branch #1 of the Flewellyn Municipal Drain from Station 0+00 and 31+00 is hereby abandoned and, pursuant to Subsection 84(5) of the *Drainage Act*, the City of Ottawa has no further obligation with respect thereto.

2. This by-law comes into force on the passing thereof and may be cited as the "Abandonment of Part of the Flewellyn Municipal Drain By-law, 2011".

ENACTED AND PASSED this 25th day of August, 2011.

CITY CLERK MAYOR

BY-LAW NO. 2011 - 311

-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-

A by-law of the City of Ottawa to provide for the partial abandonment of drainage works in the City of Ottawa – Flewellyn Municipal Drain.

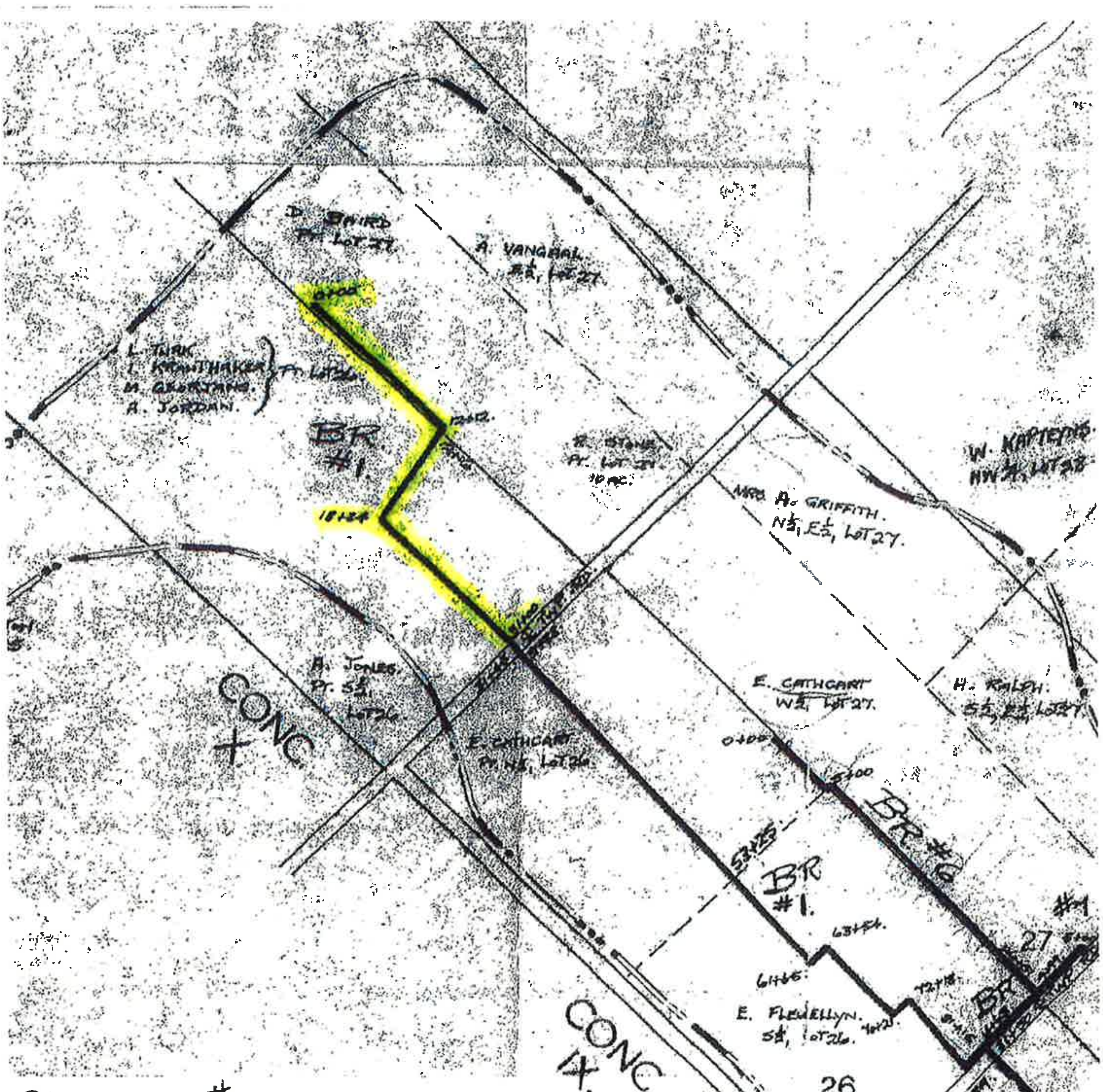
-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-

Enacted by City Council at its meeting of August 25, 2011.

-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-o-

LEGAL SERVICES
CLC/ G04-01 DRAIN

COUNCIL AUTHORITY:
Drainage Act, R.S.O. 1990, c. D.17, s. 84
(as amended by 2010, c.16, Sched.1, s.2)



SKETCH #1

RIDEAU/GOULBOURN WARD/
CITY OF OTTAWA

FLEWELLYN MUNICIPAL DRAIN

FROM: GRAHAM, BERMAN & ASSOCIATES LIMITED
1970

Jim Moffatt

To: Jim Moffatt
Subject: FW: 27970 - PDFs and Design sheet for City

Jim Moffatt

From: Balima, Nadege [mailto:Nadege.Balima@ottawa.ca]
Sent: Tuesday, January 31, 2017 3:39 PM
To: Jim Moffatt <jmoffatt@IBIGroup.com>
Cc: Jim Burghout <jim.burghout@claridgehomes.com>; Shawn Malhotra <shawn.malhotra@claridgehomes.com>; Karlinda Hinds <Karlinda.Hinds@ibigroup.com>; Shepherd, Jennifer <Jennifer.Shepherd@ottawa.ca>; Sweet, Louise <louise.sweet@ottawa.ca>
Subject: RE: 27970 - PDFs and Design sheet for City

Good morning Jim,
Sorry for the delay in responding. Below are the answers following our conversation a couple of weeks ago:

I – Sanitary Flows
The future flow allowance must consider at least 192 l/s (Liard PS rated capacity =108 l/s plus Area 6/Stittsville South Pump station rated capacity of 84 l/s). The total flow that was provided considered future flows beyond the current urban boundary.
CRT may therefore proceed if the future flow allowance is reduced to 192 l/s to alleviate current issues with the design.

Please let me know if you have questions.
Regards,

Nadège Balima, P.Eng., M.P.M., LEED Green Assoc.
Project Manager, Infrastructure Approvals
Development Review Services (West)
✆ 613.580.2424 ext. 13477

Jim Moffatt

From: Jim Moffatt
Sent: Monday, December 09, 2013 1:03 PM
To: 'Hal Stimson'
Cc: Jim Burghout
Subject: RE: CRT Developments

The planner on the file is Louise Sweet-Lindsey and the engineer reviewer is Eris Surprenant.
The City has the stormwater management report which includes the proposed pond 5 and improvements to the Flewellyn Drain. The first submission comments included the one relating to contact with the CA. The drain is a municipal drain and we have started the engineer's update report process. Thanks.
We'll make application for an extension of the current permit.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311
fax 613 225 9868
email jmoffatt@IBIGroup.com
web www.ibigroup.com

From: Hal Stimson [mailto:hal.stimson@rvca.ca]
Sent: Thursday, December 05, 2013 2:22 PM
To: Jim Moffatt
Cc: Jim Burghout
Subject: RE: CRT Developments

Hi Jim,
I have forwarded your e-mail to our Planning department staff in regard to the request from the City for assurance that RVCA has been involved. I'll let you know if there are any outstanding issues. Is there a particular contact person at the City?

In regards to the permits for drainage. The work for the new application would be an Alteration to a Watercourse application (assumes there is an existing watercourse) otherwise drainage & ditching if new and outleting to an existing watercourse. Based on the project description the fee should fall in the Major Project category of our Schedule B fee schedule ($2,185.00) which includes multiple residential units and stormwater management pond/cell. There could be additional technical report review fees depending on the need to review stormwater or other reports (if we haven't already). There is the possibility of breaking projects into multiple applications depending on timing of phasing/construction (pond, downstream channel improvements, etc.) Has the City reviewed the proposal to deepen the channel downstream of Fernbank? Is this still the Flewellyn Municipal Drain downstream? If so, it could require amendment to the engineers drainage report.

To reactive a permit that has expired I will need a new application form and submission of a letter confirming the project has not changed and all design drawings are the same as previously approved. The review fee is half of the current level for that type of project – in this instance $1,092.50.

As the previous permit was for abandonment and/or infill of the drains, one possible option would be to place plugs in the drains prior to the expiry of the permit. We would then consider them abandoned, however, this may not be feasible if outlet drainage is still required as a plug could result in standing water possibly impacting development or on-going agriculture.   Just an option to think about – otherwise we can easily issue a new permit.

I hope this helps.

Regards,

Hal Stimson
Inspector,
Rideau Valley Conservation Authority
Box 599, 3889 Rideau Valley Drive
MANOTICK, Ont K4M 1A5
e-mail: hal.stimson@rvca.ca
613-692-3571 ext 1127 1-800-267-3504

From: Jim Moffatt [mailto:jmoffatt@IBIGroup.com]
Sent: Thursday, December 05, 2013 9:07 AM
To: Hal Stimson
Cc: Jim Burghout
Subject: CRT Developemnts

Hi Hal. As per my voice message, we have submitted our design package to the City for the first phase of the CRT Lands in Fernbank. Among other comments, the City wants insurances that the CA has reviewed the design package and are aware of the development. We are currently revising the drawings in accordance with the city comments and will copy you with the new package. I assume there are some draft conditions that RVCA in time must clear.
The works include a residential development consisting of about 350 units, a stormwater facility (Pond 5 as per the Fernbank MSS documents) and improvements to the outlet watercourse which is the Flewellyn Drain. As per the MSS report, the drain is proposed to be deepened for a distance of about 550m south of Fernbank Road to accommodate the development.
We are completing an application for the drain improvements, and am not sure what box to check in the Description of Works section: Drainage Works and ditching? Alteration to a watercourse? Etc. Also what the review fee might be.
We had earlier obtained a permit (No. RV5-04/12T) to fill existing ditches within the Flewellyn drainage basin north of Fernbank Road. That permit has an expire date of Feb 16, 2014. Since no works have yet started on the development we propose to apply for an extension and would like to confirm that process.
If any questions, just contact me.
Thanks.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311

Jim Moffatt

From: Jim Moffatt
Sent: Thursday, November 28, 2013 2:15 PM
To: 'Larkin, Lance (ENE)'
Subject: RE: CRT Development Fernbank Community Ottawa

Thanks. Appreciated.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311
fax 613 225 9868
email jmoffatt@IBIGroup.com
web www.ibigroup.com

From: Larkin, Lance (ENE) [mailto:Lance.Larkin@ontario.ca]
Sent: Thursday, November 28, 2013 11:22 AM
To: Jim Moffatt
Cc: MacDonald, Tara (ENE)
Subject: RE: CRT Development Fernbank Community Ottawa

Jim,

I believe one of our Drinking Water Inspectors provided some advice to IBI. I will look into to it will have someone call you back within 1 week. As for the PTTW, approval, I will flag the appropriate District Environmental Officer about this application.

Regards,

Lance Larkin | Senior Environmental Officer / Agent principal de l'environnement (#723)

Ontario Ministry of the Environment / Ministère de l'environnement de l'Ontario

Ottawa District Office / Bureau du district d'Ottawa

2430 Don Reid Drive / 2430, promenade Don Reid, Ottawa ON K1H 1E1

☎ 613-521-3450 x229 | 613-521-5437 | Toll free / sans frais: 1-800-860-2195 | Spill or Emergencies/ déversements ou urgences : 1 800 268-6060 | Pollution Hotline/ Ligne-info antipollution : 1 866 MOE-TIPS (1 866 663-8477)

From: Jim Moffatt [mailto:jmoffatt@IBIGroup.com]
Sent: November 26, 2013 8:27 AM
To: Larkin, Lance (ENE)
Cc: Surprenant, Eric; Jim Burghout
Subject: CRT Development Fernbank Community Ottawa

Hi Lance, you were referenced to me as a local MOE contact. IBI Group is assisting CRT Development Inc. (Claridge, Richcraft and Tamarack) with plans to develop its property in the Fernbank Community in Stittsville. Please refer to the attached information. We recently submitted engineering documents in support of the development application seeking approvals for sewers, watermains and a stormwater facility, including improvements to Flewellyn Drain, which is the proposed outlet for the pond. The works are in general accordance with the MSS document completed for the Fernbank Community. The City has asked that IBI contact the local MOE office to confirm what approvals are needed from the MOE for this development. We assume that the pond and Flewellyn Drain will need an ECA as a direct submission and that the sewers will require an ECA through the transfer program and that the watermains can be approved by the City as per Form 1 under MOE authorization 008-202. We are also in the process of submitting an application for a PTTW. If you like we can provide you with relevant background information and can meet with you as needed.
Cheers.

Jim Moffatt
Associate

IBI Group
400-333 Preston Street
Ottawa ON K1S 5N4 Canada

tel 613 225 1311
fax 613 225 9868
email jmoffatt@IBIGroup.com
web www.ibigroup.com

PERMIT TO TAKE WATER
Surface and Ground Water
NUMBER 3238-9TLP82

Pursuant to Section 34.1 of the Ontario Water Resources Act, *R.S.O. 1990 this Permit To Take Water is hereby issued to:*

CRT Development Inc.
Suite 2001 - 210 Gladstone Avenue
Ottawa, Ontario K2P 0Y6
Canada

For the water taking from:
Excavation Sump — Site Servicing — Phase 1,
Stormwater Management Pond,
Excavation Sump — Residential Basement Excavations,
Miscellaneous Site Ponding,
Excavation Sump — Site Servicing — Phase 2,
Excavation Sump — Site Servicing — Phase 3,
Excavation Sump — Site Servicing — Phase 4,
Excavation Sump — Site Servicing — Phase 5,
Excavation Sump — Site Servicing — Phase 6.

Located at: Lot 26 27 and 28, Concession 10 Goulbourn, Geographic Township of Goulbourn Ottawa

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) "Provincial Officer" means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment and Climate Change.

(d) "District Office" means the Ottawa District Office.

(e) "Permit" means this Permit to Take Water No. 3238-9TLP82 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means CRT Development Inc..

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated September 30, 2014 and signed by Subhash Malhotra, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation

2.1 Inspections
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act* , R.S.O. 1990, the *Pesticides Act* , R.S.O. 1990, or the *Safe Drinking Water Act,* S. O. 2002.

2.2 Other Approvals

The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act* , and the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 Expiry

This Permit expires on **February 10, 2025**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	Excavation Sump — Site Servicing — Phase 1	Pond Dugout	Construction	Dewatering Construction	12,000	24	1,500,000	275	18 429650 5013140
2	SWMP	Pond Dugout	Construction	Dewatering Construction	10,000	24	4,500,000	250	18 429800 5012130
3	Excavation Sump — Residential Basement Excavations	Pond Dugout	Construction	Dewatering Construction	2,800	24	150,000	275	18 429650 5013140
4	Misc. Site Ponding	Pond Dugout	Construction	Dewatering Construction	2,800	24	150,000	175	18 429650 5013140
5	Excavation Sump — Site Servicing — Phase 2	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429875 5012805
6	Excavation Sump — Site Servicing — Phase 3	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 430120 5012640
7	Excavation Sump — Site Servicing — Phase 4	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429090 5012965
8	Excavation Sump — Site Servicing — Phase 5	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429320 5012540
9	Excavation Sump — Site Servicing — Phase 6	Pond Dugout	Construction	Dewatering Construction	6,500	24	1,000,000	275	18 429475 5012340
						Total Taking:	7,300,000		

3.3 Notwithstanding Table A above, the Permit Holder shall ensure the total combined rate of water taking for all Phase 1 and the SWMP water takings do not exceed 7,300,000 litres per day.

3.4 Notwithstanding Table A above the Permit Holder shall ensure the total combined rate of water taking for Phase 2, Phase 3, Phase 4, Phase 5 and Phase 6 does not exceed 1,300,000 litres per day.

4. Monitoring

4.1 The Permit Holder shall maintain a record of all water takings. This record shall include the dates and times of water takings, the rates of taking and an estimated calculation of the total amounts of water taken per day for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request.

5. Impacts of the Water Taking

5.1 Notification

The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Surface-Water Takings

The taking of water (including the taking of water into storage and the subsequent or simultaneous withdrawal from storage) shall be carried out in such a manner that streamflow is not stopped and is not reduced to a rate that will cause interference with downstream uses of water or with the natural functions of the stream.

For Groundwater Takings

If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

5.3 Prevention of Adverse Effects:
The Permit Holder shall ensure the taking of water under authority of this Permit does not result in an adverse effect in area waters.

5.4 The taking of water shall be carried out in such a manner as to prevent the disruption or removal of any fish, invertebrates or sediment from the watercourse.

5.5 Prevention of Structural Adverse Effects:
The Permit Holder shall take all measures necessary to prevent damage to buildings, bridges, structures, roads and/or railway lines that may be impacted either directly or indirectly by this taking.

5.6 Discharge Control Measures:
Any discharge of water to the land surface shall use a multi-barrier approach to control erosion and run-off prior to the discharge water entering a watercourse. Siltation control measures shall be installed at the discharge site(s) and shall be sufficient to control the volumes. Continuous care shall be taken to properly maintain the siltation control devices.

5.7 The discharge of water shall be controlled in such a way as to avoid erosion and sedimentation in any receiving stream.

5.8 The Permit Holder shall ensure that any water discharged to the natural environment does not result in scouring, erosion or physical alteration of stream channels or banks and that there is no flooding in the receiving area or water body, downstream water bodies, ditches or properties caused or worsened by this discharge.

5.9 The Permit Holder shall not discharge turbid water to any watercourse. Turbid water shall be defined as any discharge water from the excavation or diverted water with a maximum increase of 8 NTUs above the receiving stream's background levels.

5.10 Discharged Water to the Sanitary or Storm Sewer System:
The Permit Holder shall ensure that any water that is taken for dewatering purposes and discharged to the City of Ottawa sewer system is in accordance with a City of Ottawa Sewer Use Agreement.

6. Director May Amend Permit
The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce

the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

*In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Environmental Commissioner, **Environmental Bill of Rights**, R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary Environmental Review Tribunal 655 Bay Street, 15th Floor Toronto ON M5G 1E5 Fax: (416) 314-4506 Email: ERTTribunalsecretary@ontario.ca	*AND*	*The Environmental Commissioner 1075 Bay Street 6th Floor, Suite 605 Toronto, Ontario M5S 2W5*	*AND*	*The Director, Section 34.1, Ministry of the Environment and Climate Change 1259 Gardiners Rd, PO Box 22032 Kingston, ON K7P 3J6*

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

by telephone at (416) 314-4600 ***by fax at (416) 314-4506*** ***by e-mail at www.ert.gov.on.ca***

*This instrument is subject to Section 38 of the **Environmental Bill of Rights** that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

Dated at Kingston this 13th day of March, 2015.

Greg Faaren
Director, Section 34.1
Ontario Water Resources Act, R.S.O. 1990

Schedule A

This Schedule "A" forms part of Permit To Take Water 3238-9TLP82, dated March 13, 2015.

APPENDIX C

- **MSS Water Plan**
- **Hydraulic Analysis**
- **Boundary Conditions**

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

No.	REVISION	DATE	BY
3	ISSUED WITH MASTER SERVICING STUDY	MAY 25/09	MAB
2	UPDATED WITH DRAFT MASTER SERVICING STUDY	SEP 12/08	MAB
1	ISSUED WITH DRAFT MASTER SERVICING STUDY	MAY 02/08	MAB

LICENSED PROFESSIONAL ENGINEER M.A. BISSETT PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER J.G. RIDDELL PROVINCE OF ONTARIO

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

DESIGN	KJM
CHECKED	MAB
DRAWN	KJM
CHECKED	MAB
APPROVED	JGR

SCALE 1 : 5000

CITY OF OTTAWA
FERNBANK CDP

WATERMAIN LAYOUT

PROJECT No. 101108-00
DATE OCTOBER 2007
DRAWING No. 101108-WM

PLANBLDWG - 1000mmX707mm

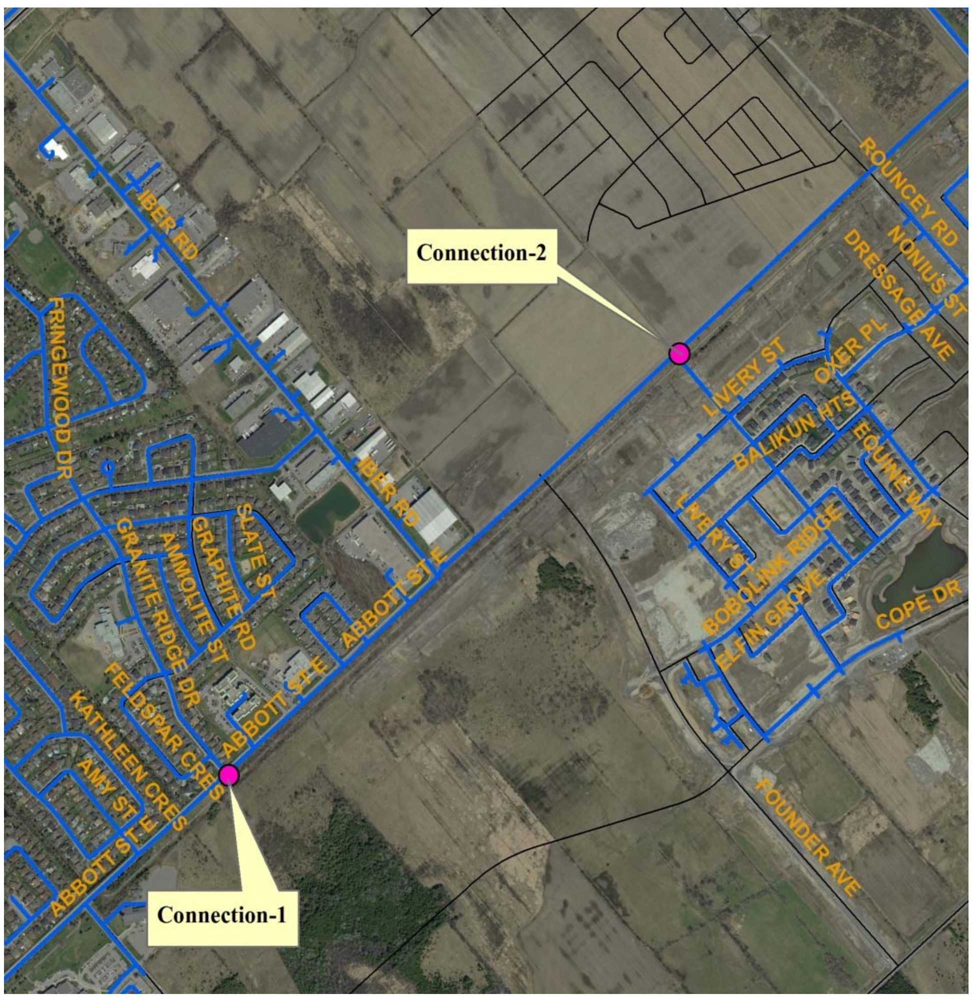
Boundary Conditions at CRT Lands

Information Provided:

Date provided: 16 Nov 2016

Criteria	Demand (L/s)
Average Demand	16.9
Maximum Daily Demand	36.9
Peak Hourly Demand	77.8
Fire Flow Demand	167
Fire Flow Demand	225
Maximum Daily + Fire Flow Demand	204 & 262

Location:



Results

Connection1:

Criteria	Head (m)	Pressure (psi)
Max HGL	161.1	75.8
PKHR	154.7	66.7
MXDY + Fire Flow (204 L/s)	152.8	64
MXDY + Fire Flow (262 L/s)	150.6	60.9

Connection2:

Criteria	Head (m)	Pressure (psi)
Max HGL	161.4	85.4
PKHR	154.8	76.0
MXDY + Fire Flow (204 L/s)	153	73.4
MXDY + Fire Flow (262 L/s)	150.9	70.5

Considerations

1. According to the City of Ottawa Water Design Guidelines as well as the Ontario Building Code, the maximum pressure at any point within a distribution system shall not exceed 80 psi in occupied areas. Measures should be taken to try to reduce the residual pressure below 80 psi without the use of special pressure control equipment. In circumstances where the residual pressure cannot be reduced below 80 psi without the use of pressure control equipment, a pressure reducing valve (**PRV**) should be installed at site.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

IBI GROUP
333 PRESTON STREET
OTTAWA, ON
K1S 5N4

WATERMAIN DEMAND CALCULATION SHEET

PROJECT : CRT LANDS
LOCATION : CITY OF OTTAWA
DEVELOPER : CRT DEVELOPMENT INC.

FILE: 27970.5.7
DATE: 2/9/2017
DESIGN: LME

NODE	RESIDENTIAL			NON-RESIDENTIAL			AVERAGE DAILY DEMAND (l/s)			MAXIMUM DAILY DEMAND (l/s)			MAXIMUM HOURLY DEMAND (l/s)			FIRE DEMAND
	UNITS		POP'N	COM	IND	INS										
	SF	TH		(Ha)	(Ha)	(Ha)	Res.	Non-res.	Total	Res.	Non-res.	Total	Res.	Non-res.	Total	(l/s)
CLA-02	15		51				0.21		0.21	0.52		0.52	1.14		1.14	166.7
CLA-03	14		48				0.19		0.19	0.48		0.48	1.06		1.06	166.7
CLA-04	9		31				0.12		0.12	0.31		0.31	0.68		0.68	166.7
CLA-05	8		27				0.11		0.11	0.28		0.28	0.61		0.61	166.7
CLA-06		17	46				0.19		0.19	0.46		0.46	1.02		1.02	166.7
CLA-07	2	15	47				0.19		0.19	0.48		0.48	1.05		1.05	166.7
CLA-08	17		58				0.23		0.23	0.59		0.59	1.29		1.29	166.7
CLA-09	9		31				0.12		0.12	0.31		0.31	0.68		0.68	166.7
CLA-10	17		58				0.23		0.23	0.59		0.59	1.29		1.29	166.7
CLA-11	16		54				0.22		0.22	0.55		0.55	1.21		1.21	166.7
CLA-12	11		37				0.15		0.15	0.38		0.38	0.83		0.83	166.7
CLA-13	20		68				0.28		0.28	0.69		0.69	1.52		1.52	166.7
CLA-14		28	76				0.31		0.31	0.77		0.77	1.68		1.68	166.7
CLA-15		30	81				0.33		0.33	0.82		0.82	1.80		1.80	166.7
CLA-16			170				0.69		0.69	1.72		1.72	3.79		3.79	166.7
CLA-20		24	65				0.26		0.26	0.66		0.66	1.44		1.44	166.7
CLA-21		13	35				0.14		0.14	0.36		0.36	0.78		0.78	166.7
CLA-22	14		48				0.19		0.19	0.48		0.48	1.06		1.06	166.7
CLA-23		9	24				0.10		0.10	0.25		0.25	0.54		0.54	166.7
CLA-24	13		44				0.18		0.18	0.45		0.45	0.98		0.98	166.7
CLA-25	6		20				0.08		0.08	0.21		0.21	0.45		0.45	166.7
CLA-26			109				0.44		0.44	1.10		1.10	2.43		2.43	166.7
CLA-27	9		31				0.12		0.12	0.31		0.31	0.68		0.68	166.7
CLA-28	18		61				0.25		0.25	0.62		0.62	1.36		1.36	166.7
CLA-28A			68				0.28		0.28	0.69		0.69	1.52		1.52	
CLA-29	7		24				0.10		0.10	0.24		0.24	0.53		0.53	166.7
CLA-30	10		34				0.14		0.14	0.34		0.34	0.76		0.76	166.7
CLA-31	12		41				0.17		0.17	0.41		0.41	0.91		0.91	166.7
CLA-32	15		51				0.21		0.21	0.52		0.52	1.14		1.14	166.7
CLA-32A			68				0.28		0.28	0.69		0.69	1.52		1.52	
CLA-33	12		41				0.17		0.17	0.41		0.41	0.91		0.91	166.7
CLA-34	16		54				0.22		0.22	0.55		0.55	1.21		1.21	166.7
CLA-35	5		17				0.07		0.07	0.17		0.17	0.38		0.38	166.7
CLA-36	13		44			2.88	0.18	1.67	1.85	0.45	2.50	2.95	0.98	4.50	5.48	225.0
CLA-37	16		54				0.22		0.22	0.55		0.55	1.21		1.21	166.7
CLA-38	8		27			6.53	0.11	3.78	3.89	0.28	5.67	5.94	0.61	10.20	10.81	225.0
CLA-54	11		37				0.15		0.15	0.38		0.38	0.83		0.83	166.7
CLA-55		30	81				0.33		0.33	0.82		0.82	1.80		1.80	166.7
TOTALS	**323**	**166**	**1962**			**9.41**			**13.39**			**28.04**			**58.41**	

ASSUMPTIONS

RESIDENTIAL DENSITIES
- SF 3.4 p/p/u
- TH 2.7 p/p/u
- High Density 90.0 p/p/ha

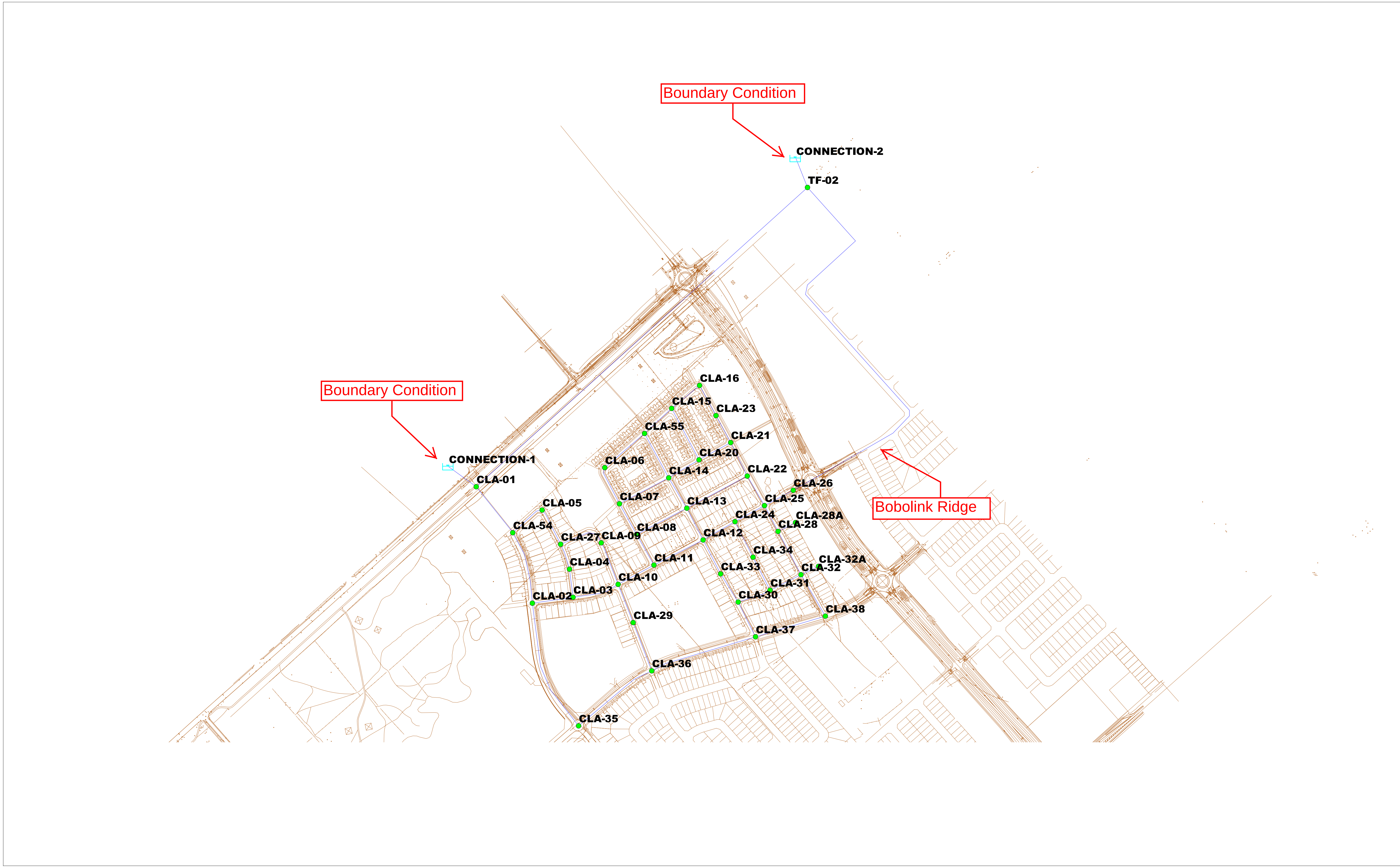
AVERAGE DAILY DEMAND
- Residential 350 l/cap/day
- Commercial 30,000 l/ha/day
- Industrial 35,000 l/ha/day
- Institutional 50,000 l/ha/day

MAXIMUM DAILY DEMAND
- Residential 875 l/cap/day
- Commercial 45,000 l/ha/day
- Industrial 52,500 l/ha/day
- Institutional 75,000 l/ha/day

MAXIMUM HOURLY DEMAND
- Residential 1,925 l/cap/day
- Commercial 81,000 l/ha/day
- Industrial 94,500 l/ha/day
- Institutional 135,000 l/ha/day

FIRE DEMANDS
- SF 166.7 l/s
- TH 166.7 l/s
- ICI 225.0 l/s

Phase 1 Node ID's

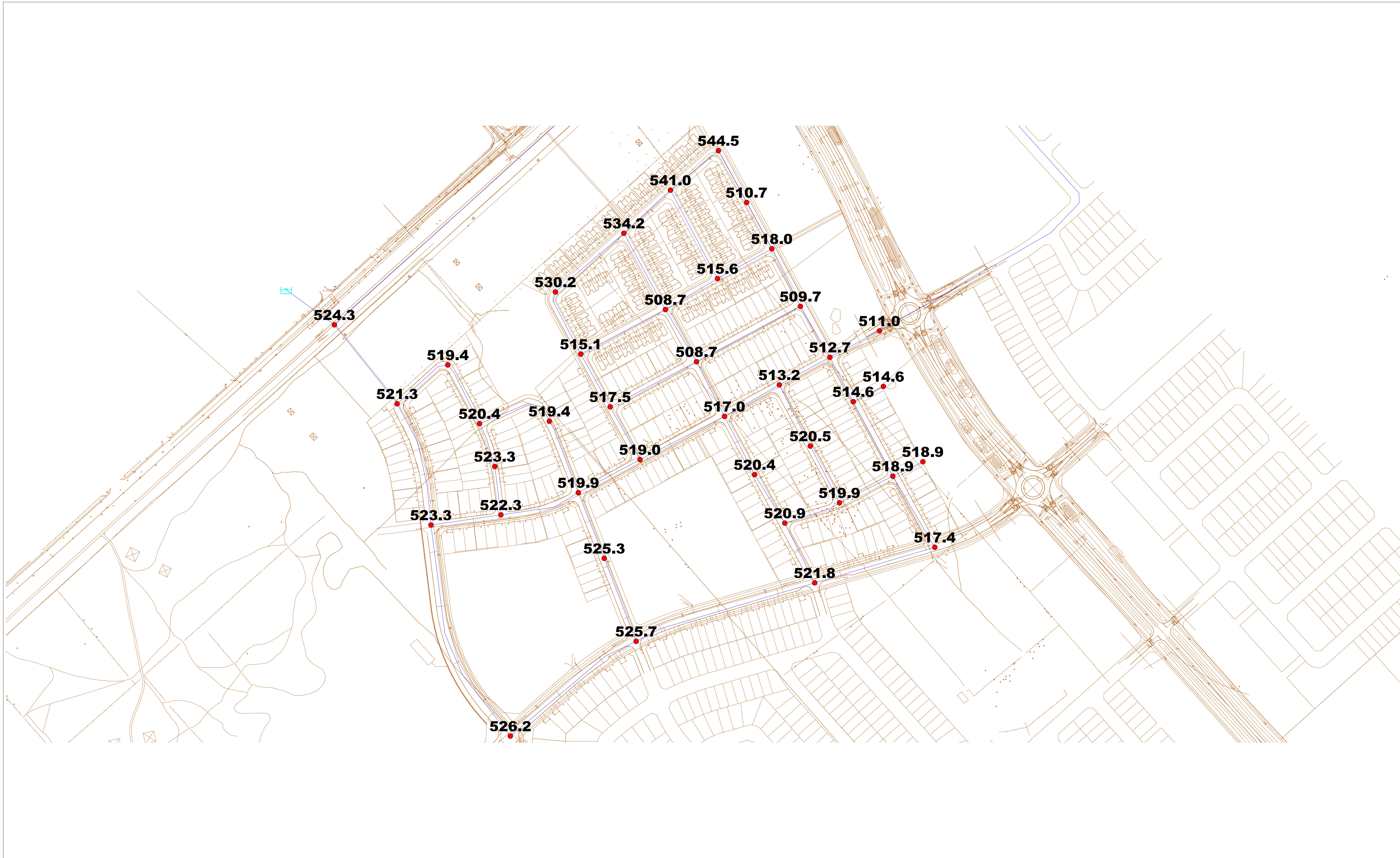


Date: Thursday, February 09, 2017

Phase 1 Pipe Sizes

Date: Thursday, February 09, 2017

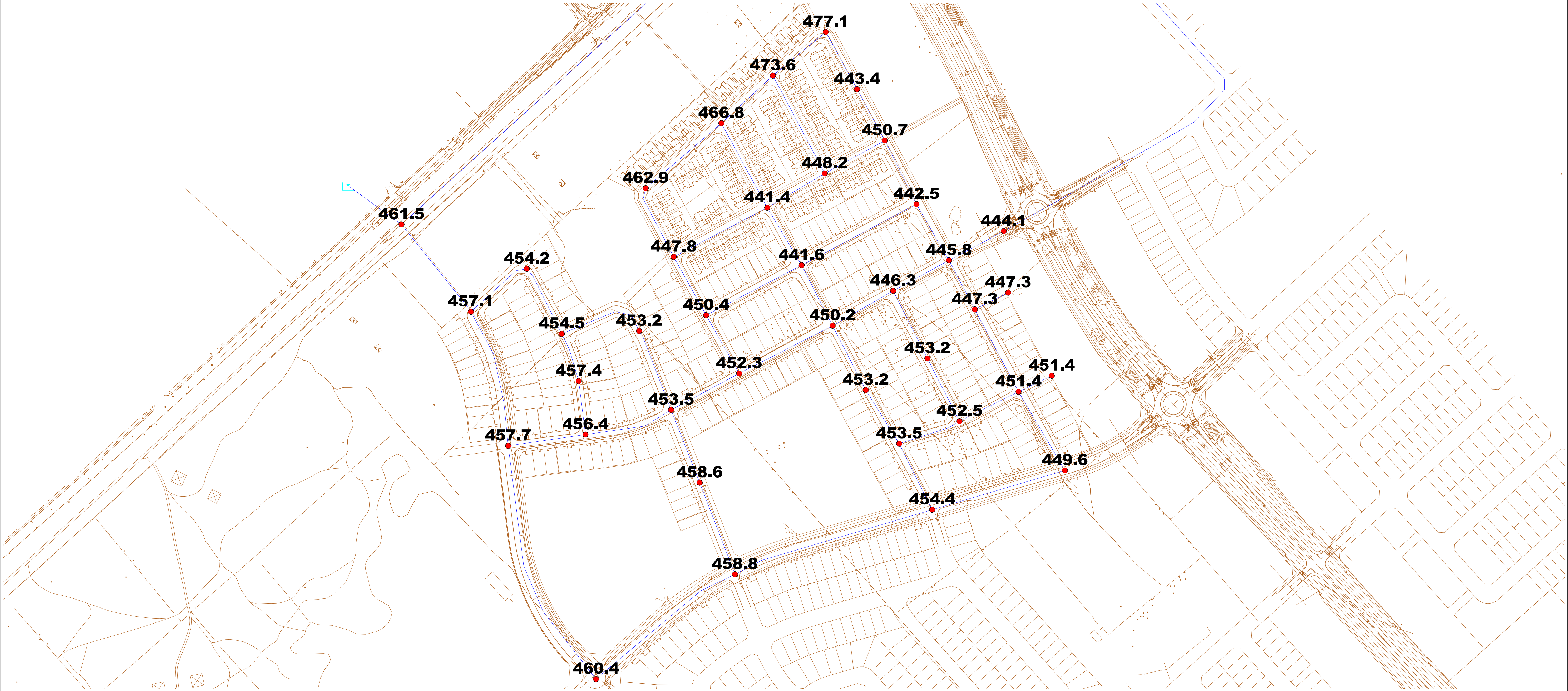
Basic Day (MAX HGL) Pressures (kPa)



Prepared By:

Date: Thursday, February 09, 2017

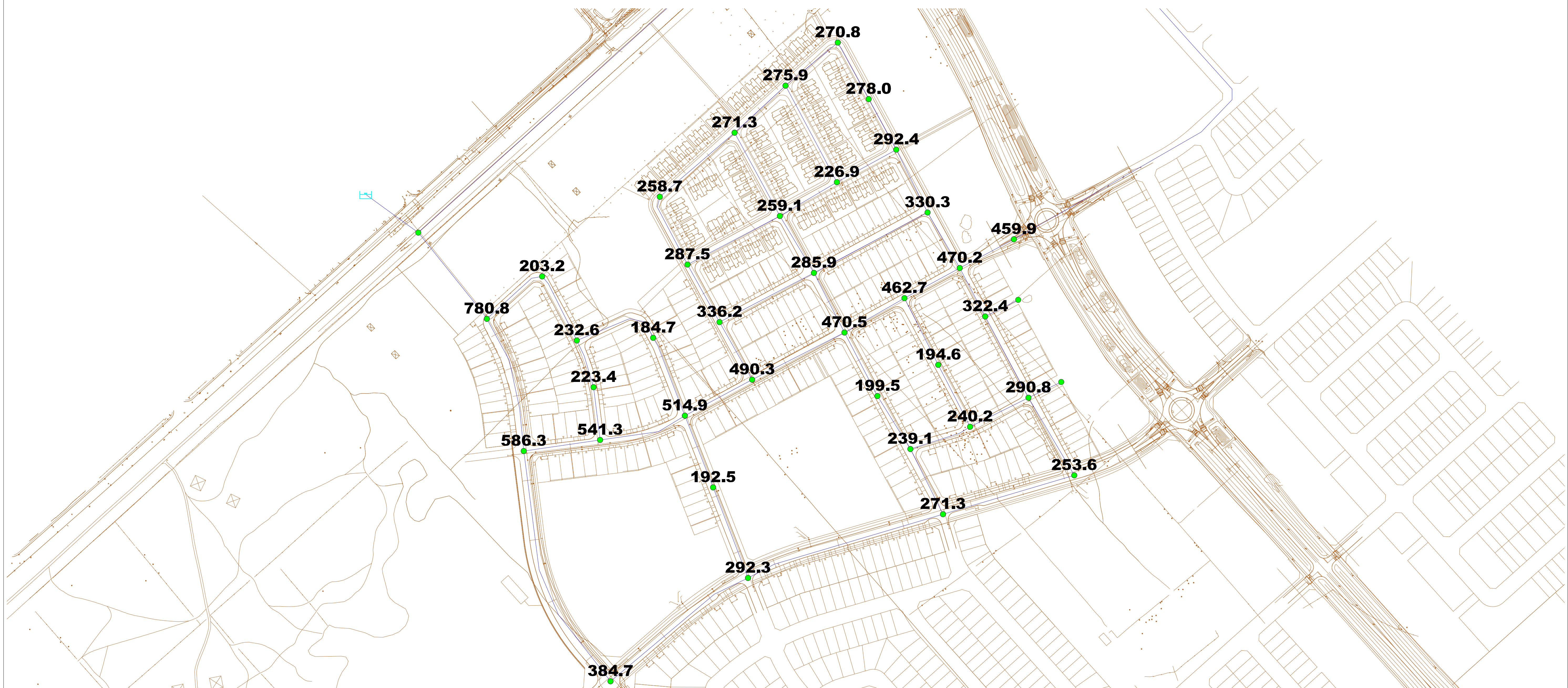
Peak Hour Pressures (kPa)



Prepared By:

Date: Thursday, February 09, 2017

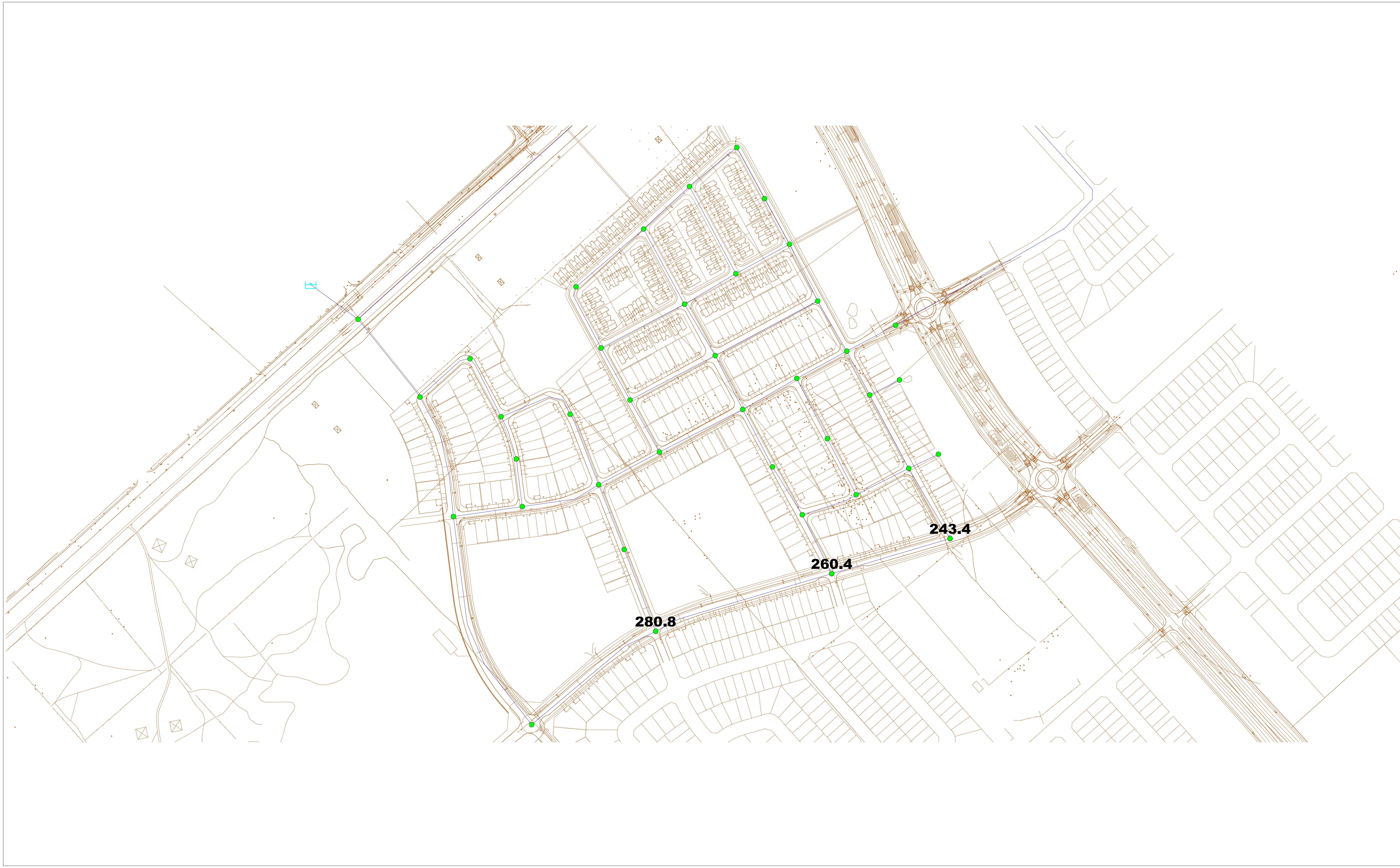
Max Day + Fire - Residential Fire Flows (l/s)



Prepared By:

Date: Thursday, February 09, 2017

Max Day + Fire ICI - Fireflow Design Report (l/s)



Date: Thursday, February 09, 2017

Basic Day (Max HGL) - Junction Report

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
1		CLA-01	0.00	107.60	161.10	524.26
2		CLA-02	0.21	107.70	161.10	523.30
3		CLA-03	0.19	107.80	161.10	522.34
4		CLA-04	0.12	107.70	161.10	523.32
5		CLA-05	0.11	108.10	161.10	519.38
6		CLA-06	0.19	107.00	161.11	530.24
7		CLA-07	0.19	108.55	161.11	515.05
8		CLA-08	0.23	108.30	161.11	517.50
9		CLA-09	0.12	108.10	161.10	519.40
10		CLA-10	0.23	108.05	161.11	519.91
11		CLA-11	0.22	108.15	161.11	518.97
12		CLA-12	0.15	108.35	161.11	517.05
13		CLA-13	0.28	109.20	161.11	508.70
14		CLA-14	0.31	109.20	161.11	508.69
15		CLA-15	0.33	105.90	161.11	541.03
16		CLA-16	0.69	105.55	161.11	544.46
17		CLA-20	0.26	108.50	161.11	515.55
18		CLA-21	0.14	108.25	161.11	518.03
19		CLA-22	0.19	109.10	161.12	509.72
20		CLA-23	0.10	109.00	161.11	510.67
21		CLA-24	0.18	108.75	161.12	513.17
22		CLA-25	0.08	108.80	161.12	512.74
23		CLA-26	0.44	109.00	161.14	510.95
24		CLA-27	0.12	108.00	161.10	520.37
25		CLA-28	0.25	108.60	161.12	514.62
26		CLA-28A	0.28	108.60	161.12	514.62
27		CLA-29	0.10	107.50	161.10	525.27
28		CLA-30	0.14	107.95	161.11	520.89
29		CLA-31	0.17	108.05	161.11	519.92
30		CLA-32	0.21	108.15	161.11	518.94
31		CLA-32A	0.28	108.15	161.11	518.94
32		CLA-33	0.17	108.00	161.11	520.43
33		CLA-34	0.22	108.00	161.11	520.45
34		CLA-35	0.07	107.40	161.10	526.24
35		CLA-36	1.85	107.45	161.10	525.72
36		CLA-37	0.22	107.85	161.10	521.81
37		CLA-38	3.89	108.30	161.10	517.38
38		CLA-54	0.15	107.90	161.10	521.33
39		CLA-55	0.33	106.60	161.11	534.17
40		TF-02	0.00	108.00	161.40	523.27

Peak Hour - Junction Report

		ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (kPa)
1		CLA-01	0.00	107.60	154.70	461.54
2		CLA-02	1.14	107.70	154.41	457.73
3		CLA-03	1.06	107.80	154.37	456.39
4		CLA-04	0.68	107.70	154.38	457.38
5		CLA-05	0.61	108.10	154.46	454.25
6		CLA-06	1.02	107.00	154.24	462.93
7		CLA-07	1.05	108.55	154.25	447.82
8		CLA-08	1.29	108.30	154.27	450.45
9		CLA-09	0.68	108.10	154.35	453.20
10		CLA-10	1.29	108.05	154.33	453.53
11		CLA-11	1.21	108.15	154.30	452.27
12		CLA-12	0.83	108.35	154.29	450.21
13		CLA-13	1.52	109.20	154.26	441.56
14		CLA-14	1.68	109.20	154.24	441.38
15		CLA-15	1.80	105.90	154.24	473.65
16		CLA-16	3.79	105.55	154.24	477.08
17		CLA-20	1.44	108.50	154.24	448.21
18		CLA-21	0.78	108.25	154.25	450.74
19		CLA-22	1.06	109.10	154.26	442.54
20		CLA-23	0.54	109.00	154.24	443.36
21		CLA-24	0.98	108.75	154.29	446.28
22		CLA-25	0.45	108.80	154.29	445.80
23		CLA-26	2.43	109.00	154.32	444.12
24		CLA-27	0.68	108.00	154.38	454.49
25		CLA-28	1.36	108.60	154.25	447.33
26		CLA-28A	1.52	108.60	154.25	447.31
27		CLA-29	0.53	107.50	154.30	458.61
28		CLA-30	0.76	107.95	154.23	453.47
29		CLA-31	0.91	108.05	154.23	452.48
30		CLA-32	1.14	108.15	154.21	451.37
31		CLA-32A	1.52	108.15	154.21	451.36
32		CLA-33	0.91	108.00	154.25	453.20
33		CLA-34	1.21	108.00	154.25	453.17
34		CLA-35	0.38	107.40	154.39	460.42
35		CLA-36	5.48	107.45	154.27	458.83
36		CLA-37	1.21	107.85	154.22	454.38
37		CLA-38	10.81	108.30	154.18	449.60
38		CLA-54	0.83	107.90	154.55	457.11
39		CLA-55	1.80	106.60	154.24	466.80
40		TF-02	0.00	108.00	154.80	458.60

Max Day + Fire - Fireflow Design Report

		ID	Total Demand (L/s)	Critical Node 1 ID	Critical Node 1 Pressure (kPa)	Critical Node 1 Head (m)	Adjusted Fire-Flow (L/s)	Available Flow @Hydrant (L/s)	Critical Node 2 ID	Critical Node 2 Pressure (kPa)	Critcal Node 2 Head (m)	Adjusted Available Flow (L/s)	Design Flow (L/s)
1		CLA-02	167.19	CLA-14	396.31	148.14	630.98	586.28	CLA-02	139.97	121.98	586.28	586.28
2		CLA-03	167.15	CLA-14	392.70	147.87	586.75	541.31	CLA-03	139.97	122.08	541.31	541.31
3		CLA-04	166.98	CLA-04	263.96	134.64	223.39	223.39	CLA-04	139.96	121.98	223.39	223.39
4		CLA-05	166.95	CLA-05	229.91	131.56	203.20	203.20	CLA-05	139.96	122.38	203.20	203.20
5		CLA-06	167.13	CLA-06	306.72	138.30	258.66	258.68	CLA-06	139.96	121.28	258.69	258.66
6		CLA-07	167.15	CLA-07	320.91	141.30	287.47	287.47	CLA-07	139.96	122.83	287.47	287.47
7		CLA-08	167.26	CLA-08	349.21	143.94	336.17	336.17	CLA-08	139.96	122.58	336.17	336.17
8		CLA-09	166.98	CLA-09	190.07	127.50	184.72	184.72	CLA-09	139.96	122.38	184.72	184.72
9		CLA-10	167.26	CLA-14	387.92	147.64	541.97	514.93	CLA-10	139.96	122.33	514.94	514.94
10		CLA-11	167.22	CLA-14	382.73	147.21	500.77	490.29	CLA-11	139.96	122.43	490.29	490.29
11		CLA-12	167.05	CLA-13	381.53	147.28	491.15	470.51	CLA-12	139.96	122.63	470.52	470.52
12		CLA-13	167.36	CLA-13	316.09	141.46	285.92	285.92	CLA-13	139.96	123.48	285.92	285.92
13		CLA-14	167.44	CLA-14	294.92	139.30	259.10	259.13	CLA-14	139.96	123.48	259.13	259.10
14		CLA-15	167.49	CLA-15	327.60	139.33	275.89	275.89	CLA-15	139.96	120.18	275.89	275.89
15		CLA-16	168.39	CLA-16	324.52	138.67	270.80	270.83	CLA-16	139.96	119.83	270.83	270.80
16		CLA-20	167.33	CLA-20	263.36	135.38	226.86	226.86	CLA-20	139.96	122.78	226.87	226.86
17		CLA-21	167.03	CLA-21	325.97	141.51	292.36	292.36	CLA-21	139.96	122.53	292.36	292.36
18		CLA-22	167.15	CLA-22	340.75	143.87	330.26	330.26	CLA-22	139.96	123.38	330.26	330.26
19		CLA-23	166.92	CLA-23	311.50	140.79	278.00	278.00	CLA-23	139.96	123.28	278.00	278.00
20		CLA-24	167.12	CLA-24	381.05	147.64	462.70	462.70	CLA-24	139.96	123.03	462.71	462.70
21		CLA-25	166.88	CLA-22	380.75	147.65	480.81	470.21	CLA-25	139.96	123.08	470.21	470.21
22		CLA-26	167.77	CLA-26	378.99	147.68	459.94	459.94	CLA-26	139.96	123.28	459.95	459.94
23		CLA-27	166.98	CLA-27	275.17	136.08	232.57	232.57	CLA-27	139.96	122.28	232.57	232.57
24		CLA-28	167.29	CLA-28	340.36	143.33	322.37	322.37	CLA-28	139.96	122.88	322.37	322.37
25		CLA-29	166.91	CLA-29	209.30	128.86	192.54	192.54	CLA-29	139.96	121.78	192.54	192.54
26		CLA-30	167.01	CLA-30	281.56	136.68	239.14	239.15	CLA-30	139.96	122.23	239.15	239.14
27		CLA-31	167.08	CLA-31	282.20	136.85	240.23	240.24	CLA-31	139.96	122.33	240.24	240.23
28		CLA-32	167.19	CLA-32	324.59	141.27	290.82	290.82	CLA-32	139.96	122.43	290.82	290.82
29		CLA-33	167.08	CLA-33	221.78	130.63	199.47	199.47	CLA-33	139.96	122.28	199.47	199.47
30		CLA-34	167.22	CLA-34	211.63	129.60	194.61	194.61	CLA-34	139.96	122.28	194.61	194.61
31		CLA-35	166.84	CLA-35	375.23	145.69	384.66	384.65	CLA-35	139.96	121.68	384.66	384.66
32		CLA-36	227.95	CLA-36	249.80	132.94	292.31	292.31	CLA-36	139.96	121.73	292.32	292.31
33		CLA-37	225.55	CLA-37	224.01	130.71	271.34	271.34	CLA-37	139.96	122.13	271.34	271.34
34		CLA-38	230.94	CLA-38	186.04	127.29	253.61	253.61	CLA-38	139.96	122.58	253.61	253.61
35		CLA-54	167.05	CLA-14	408.38	149.57	855.64	780.75	CLA-54	139.97	122.18	780.76	780.76
36		CLA-55	167.49	CLA-55	319.77	139.23	271.31	271.31	CLA-55	139.96	120.88	271.31	271.31

Max Day + Fire ICI Lands - Fireflow Design Report

		ID	Total Demand (L/s)	Critical Node 1 ID	Critical Node 1 Pressure (kPa)	Critical Node 1 Head (m)	Adjusted Fire-Flow (L/s)	Available Flow @Hydrant (L/s)	Critical Node 2 ID	Critical Node 2 Pressure (kPa)	Critcal Node 2 Head (m)	Adjusted Available Flow (L/s)	Design Flow (L/s)
1		CLA-36	227.95	CLA-36	228.55	130.77	280.83	280.83	CLA-36	139.96	121.73	280.83	280.83
2		CLA-37	225.55	CLA-37	202.79	128.54	260.40	260.41	CLA-37	139.96	122.13	260.41	260.40
3		CLA-38	230.94	CLA-38	164.84	125.12	243.39	243.39	CLA-38	139.96	122.58	243.39	243.39

Peak Hour - Pipe Report

		ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
1		11	CLA-01	CLA-54	128.85	297.00	120.00	36.06	0.52	0.15	1.18
2		113	CLA-20	CLA-15	127.90	155.00	100.00	0.77	0.04	0.00	0.03
3		115	CLA-14	CLA-55	110.97	155.00	100.00	0.96	0.05	0.01	0.05
4		117	CLA-15	CLA-16	79.32	204.00	110.00	0.15	0.00	0.0000	0.000
5		125	CLA-21	CLA-23	67.41	204.00	110.00	1.98	0.06	0.00	0.04
6		127	CLA-22	CLA-23	71.93	155.00	100.00	2.20	0.12	0.02	0.22
7		13	CLA-02	CLA-03	90.19	297.00	120.00	20.27	0.29	0.04	0.41
8		131	CLA-28	CLA-32	107.62	204.00	110.00	6.37	0.19	0.04	0.35
9		135	CLA-29	CLA-10	90.22	155.00	100.00	-2.83	0.15	0.03	0.35
10		141	CLA-27	CLA-09	106.28	155.00	100.00	2.58	0.14	0.03	0.30
11		147	CLA-04	CLA-03	62.23	155.00	100.00	0.69	0.04	0.00	0.03
12		149	CLA-04	CLA-27	58.21	155.00	100.00	-1.37	0.07	0.01	0.09
13		15	CLA-03	CLA-10	104.89	297.00	120.00	19.90	0.29	0.04	0.39
14		151	CLA-06	CLA-55	115.19	204.00	110.00	2.02	0.06	0.00	0.04
15		159	CLA-01	TF-02	980.24	393.00	120.00	-20.02	0.17	0.10	0.10
16		161	CONNECTION-2	TF-02	1.00	393.00	130.00	42.34	0.35	0.000	0.35
17		17	CLA-10	CLA-11	89.30	297.00	120.00	17.68	0.26	0.03	0.32
18		19	CLA-10	CLA-09	98.50	155.00	100.00	-1.90	0.10	0.02	0.17
19		191	TF-02	CLA-26	980.99	297.00	120.00	22.32	0.32	0.48	0.49
20		193	CLA-54	CLA-02	162.86	297.00	120.00	29.99	0.43	0.14	0.84
21		195	CLA-54	CLA-05	83.15	155.00	100.00	5.23	0.28	0.09	1.10
22		197	CLA-07	CLA-06	88.38	204.00	110.00	3.04	0.09	0.01	0.09
23		199	CLA-55	CLA-15	81.06	204.00	110.00	1.18	0.04	0.00	0.02
24		205	CLA-34	CLA-24	87.49	155.00	100.00	-3.56	0.19	0.05	0.54
25		207	CLA-25	CLA-26	71.68	297.00	120.00	-19.89	0.29	0.03	0.39
26		21	CLA-11	CLA-08	77.39	204.00	110.00	7.48	0.23	0.04	0.47
27		211	CLA-23	CLA-16	75.34	204.00	110.00	3.64	0.11	0.01	0.12
28		213	CLA-33	CLA-12	83.72	155.00	100.00	-3.52	0.19	0.04	0.53
29		215	CLA-28A	CLA-28	43.13	204.00	110.00	-1.52	0.05	0.00	0.02
30		217	CLA-32A	CLA-32	42.54	204.00	110.00	-1.52	0.05	0.00	0.02
31		219	CONNECTION-1	CLA-01	1.00	393.00	120.00	16.04	0.13	0.0000	0.07
32		23	CLA-08	CLA-07	77.03	204.00	110.00	5.18	0.16	0.02	0.24
33		25	CLA-27	CLA-05	85.51	155.00	100.00	-4.62	0.24	0.08	0.88
34		29	CLA-07	CLA-14	122.11	155.00	100.00	1.09	0.06	0.01	0.06
35		31	CLA-14	CLA-20	77.44	155.00	100.00	0.78	0.04	0.00	0.03
36		33	CLA-20	CLA-21	79.13	155.00	100.00	-1.43	0.08	0.01	0.10
37		35	CLA-14	CLA-13	77.51	155.00	100.00	-2.33	0.12	0.02	0.25
38		37	CLA-08	CLA-13	124.48	155.00	100.00	1.01	0.05	0.01	0.05
39		39	CLA-11	CLA-12	121.20	297.00	120.00	8.99	0.13	0.01	0.09
40		41	CLA-12	CLA-13	78.38	155.00	100.00	3.06	0.16	0.03	0.41
41		43	CLA-12	CLA-24	80.77	297.00	120.00	1.57	0.02	0.000	0.00
42		45	CLA-24	CLA-25	73.62	297.00	120.00	-2.97	0.04	0.000	0.01
43		47	CLA-25	CLA-22	75.05	204.00	110.00	7.23	0.22	0.03	0.44
44		49	CLA-22	CLA-13	150.36	155.00	100.00	-0.22	0.01	0.000	0.00
45		51	CLA-21	CLA-22	82.10	204.00	110.00	-4.19	0.13	0.01	0.16
46		53	CLA-30	CLA-33	72.99	155.00	100.00	-2.61	0.14	0.02	0.31
47		55	CLA-30	CLA-31	74.77	155.00	100.00	0.53	0.03	0.00	0.02
48		57	CLA-31	CLA-34	81.48	155.00	100.00	-2.35	0.12	0.02	0.25
49		59	CLA-31	CLA-32	76.20	155.00	100.00	1.97	0.10	0.01	0.18
50		61	CLA-25	CLA-28	64.06	204.00	110.00	9.25	0.28	0.04	0.70
51		63	CLA-32	CLA-38	105.48	204.00	110.00	5.68	0.17	0.03	0.28
52		67	CLA-30	CLA-37	85.27	155.00	100.00	1.32	0.07	0.01	0.09
53		69	CLA-37	CLA-38	159.94	204.00	110.00	5.13	0.16	0.04	0.23
54		71	CLA-37	CLA-36	240.46	204.00	110.00	-5.02	0.15	0.05	0.22
55		73	CLA-36	CLA-29	113.49	155.00	100.00	-2.30	0.12	0.03	0.24
56		75	CLA-02	CLA-35	296.18	297.00	120.00	8.58	0.12	0.02	0.08
57		77	CLA-35	CLA-36	202.13	204.00	110.00	8.20	0.25	0.11	0.56

APPENDIX D

- Fernbank Trunk Sewer Design
- MSS Sanitary Drainage Area Plan, (Drawing 101108-SAN)
- Figure 6.1 – MSS Sanitary HGL
- Sanitary Sewer Hydraulic Grade Line Analysis (2031) from MSS Report
- 2017 Sanitary Sewer HGL Analysis
- Appendix 6 – B.1 City of Ottawa Sewer Design Guidelines
- Section 1.7 – MOE Design Guidelines
- Sanitary Sewer Design Sheets
- Drainage Area Plans 27970-501, 501A and 501B

FERNBANK CDP LANDS - SANITARY TRUNK SEWER
PEAK FLOW DESIGN SHEET

AREA			RESIDENTIAL												MIXED USE		COMMERCIAL		INSTITUTIONAL		C+I	INFILTRATION				PIPE							
			LOW DENSITY		MEDIUM DENSITY		HIGH DENSITY		MIXED USE		TOTAL																						
ID	From	To	Area (ha)	Pop.	Area (ha)	Pop.	Area (ha)	Pop.	Area (ha)	Pop.	Pop.	Accum. Pop.	Peak Factor	Peak Flow (l/s)	Area (ha)	Accum. Area (ha)	Area (ha)	Accum. Area (ha)	Area (ha)	Accum. Area (ha)	Peak Flow (l/s)	Total Area (ha)	Accum. Area (ha)	Infil. Flow (l/s)	Total Flow (l/s)	Size (mm)	Type	Slope (%)	Length (m)	Capacity (l/s)	Full Flow Vel. (m/s)	Q/Q_{full} (%)	Actual Vel. (m/s)
F1			99.45	9189	8.31	1247	0.00	0	0.00	0	10436	10436	2.9	124.1	0.00	0.00	0.63	0.63	23.23	23.23	20.7	200.11	200.11	56.0	200.9								
	FT24	FT23									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT23	FT22									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT22	FT21									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT21	FT20									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT20	FT19									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	0.39	107.5	400.0	1.37	50.2%	1.37
	FT19	FT18									0	10436	2.9	124.1		0.00		0.63		23.23	20.7		200.11	56.0	200.9	600	C 100-D	1.87	120.0	876.0	3.00	22.9%	2.34
F2			2.90	268	1.80	270	0.00	0	0.00	0	538	538	4.0	8.6	0.00	0.00	0.00	0.00	0.40	0.40	0.5	13.19	13.19	3.7	12.7								
F3			15.95	1474	14.90	2235	0.00	0	10.57	856	4565	4565	3.3	60.7	10.57	10.57	0.60	0.60	11.57	11.57	15.2	77.57	77.57	21.7	97.6								
	FT18	FT17									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.4	519.4	1.14	56.1%	1.17
	FT17	FT16									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT16	FT15									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT15	FT14									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT14	FT13									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT13	FT12									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT12	FT11									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT11	FT10									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.20	113.0	519.4	1.14	56.1%	1.17
	FT10	FT09									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.58	84.1	884.5	1.94	33.0%	1.72
	FT09	FT08									0	15539	2.8	173.9		10.57		1.23		35.20	36.2		290.87	81.4	291.6	750	C 100-D	0.58	40.9	884.5	1.94	33.0%	1.72
F4			60.08	5551	16.71	2506	0.00	0	5.62	455	6512	8512	3.0	104.3	5.62	5.62	0.00	0.00	19.62	19.62	[illegible]	164.76	164.76	46.1	169.9								
F5			7.70	711	2.90	435	0.00	0	6.70	543	1689	1689	3.6	24.9	6.70	6.70	0.00	0.00	0.79	0.79	[illegible]	22.81	22.81	6.4	34.9								
F6			29.70	2744	9.95	1493	5.04	680	0.00	0	4917	4917	3.3	64.8	0.00	0.00	0.00	0.00	16.15	16.15	14.0	89.34	89.34	25.0	105.8								
	FT08	FT07									0	30658	2.5	306.5		22.89		1.23		71.76	[illegible]		567.78	159.0	538.8	1200	C 100-D	0.20	77.5	1819.0	1.56	29.6%	1.32
	FT07	FT06									0	30658	2.5	306.5		22.89		1.23		71.76	[illegible]		567.78	159.0	538.8	1200	C 100-D	0.20	77.5	1819.0	1.56	29.6%	1.32
	FT06	FT05									0	30658	2.5	306.5		22.89		1.23		71.76	[illegible]		567.78	159.0	538.8	1200	C 100-D	0.20	24.6	1819.0	1.56	29.6%	1.32
	FT05	FT04									0	30658	2.5	306.5		22.89		1.23		71.76	[illegible]		567.78	159.0	538.8	1200	C 100-D	0.20	96.0	1819.0	1.56	29.6%	1.32
	FT04	FT03									0	30658	2.5	306.5		22.89		1.23		71.76	[illegible]		567.78	159.0	538.8	1200	C 100-D	0.20	95.0	1819.0	1.56	29.6%	1.32
	FT03	FT02									0	30658	2.5	306.5		22.89		1.23		71.76	[illegible]		567.78	159.0	538.8	1200	C 100-D	0.20	107.5	1819.0	1.56	29.6%	1.32
	FT02	FT01									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	107.5	1819.0	1.56	29.6%	1.32
	FT01	OTT1									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.8	1200	C 100-D	0.20	61.4	1819.0	1.56	29.6%	1.32
	OTT1	GC									0	30658	2.5	306.5		22.89		1.23		71.76	73.3		567.78	159.0	538.0	1200	C 100-D	0.20	19.1	1819.0	1.56	29.6%	1.32

Design Parameters:

Avg Flow/Person = 350 l/day
Comm./Inst. Flow = 50,000 l/ha/day
Infiltration = 0.28 l/s/ha

Pipe Friction n = 0.013
Residential Peaking Factor = Harmon Equation (max 4, min 2)
Peaking Factor Comm./Inst. = 1.5

	Units/Net ha	Pop/Unit	
Low Density Residential =	28	3.30	
Medium Density Residential =	60	2.50	(Multi Family Residential)
High Density Residential =	75	1.80	
Mixed Use =	90	1.80	(50% of mixed use area is residential)

Project: Fernbank Sanitary Trunk (108180-08)
Designed: KJM
Checked: MAB
Dwg. Reference: 108180-FTS
Date: January 27, 2012

LICENSED PROFESSIONAL ENGINEER
K.J. MURPHY
100123021
JAN. 26/12
PROVINCE OF ONTARIO

M:\2008\108180\DATA\Calculations\SAN\Trunk Sewer\Trunk Sewer Design Sheets (20120127).xlsx

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

No.	REVISION	DATE	BY
3	ISSUED WITH MASTER SERVICING STUDY	MAY 25/09	MAB
2	UPDATED WITH DRAFT MASTER SERVICING STUDY	SEP 12/08	MAB
1	ISSUED WITH DRAFT MASTER SERVICING STUDY	MAY 02/08	MAB

LICENSED PROFESSIONAL ENGINEER — M.A. BISSETT — PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER — J.G. RIDDELL — PROVINCE OF ONTARIO

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DESIGN	KJM
CHECKED	MAB
DRAWN	KJM
CHECKED	MAB
APPROVED	JGR

SCALE 1 : 5000

CITY OF OTTAWA

FERNBANK CDP

SANITARY DRAINAGE AREA PLAN

PROJECT No. 101108-0

DATE AUGUST 2007

DRAWING No. 101108-SAN

TABLE D-2: FERNBANK CDP LANDS - NEW TRUNK SEWER
SANITARY SEWER HYDRAULIC GRADE LINE ANALYSIS (2031)

This spreadsheet uses the Darcy-Weisbach equation to calculate hydraulic losses through a pipe network with a specified flow rate. Minor losses are accounted for including both pipe bend losses and structure losses
The spreadsheet returns the upstream hydraulic grade line if surcharged, or the pipe obvert if free flow conditions exist. The HGL slope is calculated and the minimum USF is established +0.30m above the HGL.

Bend Coefficients

0	45	90	<---Bend (in degrees)
0.00	0.29	1.02	900 mm pipe or greater (benched)
0.00	0.40	1.32	825 mm pipe or smaller (sump)

MANHOLE		INVERT ELEV.		OBVERT ELEV.		GROUND ELEV.	COVER	PIPE PARAMETERS				TOTAL FLOW	Q_{cap}	Q_a/Q_{cap}	COMPUTATIONAL COLUMNS					HEAD LOSS	SURCHARGE	HGL			PIPE
U/S	D/S	U/S (m)	D/S (m)	U/S (m)	D/S (m)	U/S (m)	U/S (m)	Dia (N) (mm)	Dia (A) (m)	Length (m)	'n'	(m^3/s)	(m^3/s)		Pipe Area (m^2)	L/D	Friction Factor (f)	Velocity V (m/s)	$V^2/2g$	HL (m)	U/S (m)	U/S (m)	D/S (m)	Slope (%)	Slope (%)
Hazeldean Pump Station																						95.00	<- 100yr Starting HGL		
974	HPS	90.88	90.74	91.70	91.57	99.50	7.80	825	838	66	0.013	0.528	0.677	0.78	0.552	79	0.02245	0.96	0.05	0.09	3.39	95.09	95.00	0.14%	0.20%
972	974	92.04	90.88	92.87	91.70	100.25	7.38	825	838	586	0.013	0.528	0.666	0.79	0.552	699	0.02245	0.96	0.05	0.82	3.04	95.91	95.09	0.14%	0.20%
970	972	92.54	92.27	93.14	92.87	99.65	6.51	600	610	178	0.013	0.133	0.249	0.53	0.292	292	0.02496	0.46	0.01	0.09	2.86	96.00	95.91	0.05%	0.15%
968	970	93.20	92.94	93.40	93.14	98.20	4.80	200	203	82	0.013	0.014	0.019	0.73	0.032	406	0.03600	0.43	0.01	0.15	2.75	96.15	96.00	0.18%	0.32%
966	970	92.98	92.61	93.51	93.14	98.35	4.84	525	533	249	0.013	0.122	0.173	0.70	0.223	466	0.02610	0.55	0.02	0.21	2.71	96.21	96.00	0.08%	0.15%
964	966	96.24	93.26	96.49	93.51	100.45	3.96	250	254	298	0.013	0.030	0.062	0.48	0.051	1171	0.03342	0.59	0.02	0.73	0.45	96.94	96.21	0.24%	1.00%
962	964	97.90	96.24	98.15	96.49	102.40	4.25	250	254	479	0.013	0.030	0.037	0.82	0.051	1884	0.03342	0.59	0.02	1.12	0.00	98.15	96.94	0.25%	0.35%
960	966	93.18	93.06	93.63	93.51	98.25	4.62	450	457	82	0.013	0.072	0.114	0.63	0.164	179	0.02747	0.44	0.01	0.05	2.63	96.26	96.21	0.06%	0.15%
958	960	93.45	93.18	93.90	93.63	97.95	4.05	450	457	177	0.013	0.060	0.116	0.51	0.164	387	0.02747	0.36	0.01	0.07	2.43	96.33	96.26	0.04%	0.15%
956	958	94.27	93.45	94.72	93.90	99.00	4.28	450	457	411	0.013	0.060	0.133	0.45	0.164	899	0.02747	0.36	0.01	0.18	1.79	96.51	96.33	0.04%	0.20%
954	956	94.83	94.34	95.21	94.72	98.15	2.95	375	381	330	0.013	0.035	0.070	0.50	0.114	866	0.02920	0.31	0.00	0.12	1.43	96.64	96.51	0.04%	0.15%
952	972	93.95	92.42	94.40	92.87	99.95	5.55	450	457	282	0.013	0.167	0.219	0.76	0.164	617	0.02747	1.02	0.05	0.98	2.48	96.88	95.91	0.35%	0.54%
950	952	94.28	93.95	94.73	94.40	100.30	5.57	450	457	221	0.013	0.097	0.115	0.85	0.164	483	0.02747	0.59	0.02	0.24	2.39	97.12	96.88	0.11%	0.15%
948	950	94.57	94.28	95.02	94.73	101.00	5.98	450	457	195	0.013	0.085	0.115	0.74	0.164	427	0.02747	0.52	0.01	0.17	2.27	97.29	97.12	0.09%	0.15%
946	948	95.86	94.64	96.24	95.02	100.60	4.36	375	381	243	0.013	0.085	0.130	0.66	0.114	638	0.02920	0.75	0.03	0.58	1.63	97.87	97.29	0.24%	0.50%
944	946	96.88	95.86	97.26	96.24	101.40	4.15	375	381	511	0.013	0.064	0.082	0.79	0.114	1340	0.02920	0.57	0.02	0.65	1.27	98.52	97.87	0.13%	0.20%
942	944	101.65	97.01	101.90	97.26	106.00	4.11	250	254	516	0.013	0.041	0.059	0.70	0.051	2033	0.03342	0.81	0.03	2.31	0.00	101.90	98.52	0.65%	0.90%
940	952	96.42	94.10	96.72	94.40	101.40	4.68	300	305	310	0.013	0.058	0.087	0.66	0.073	1017	0.03145	0.79	0.03	1.03	1.20	97.92	96.88	0.33%	0.75%
938	940	96.97	96.42	97.27	96.72	101.95	4.68	300	305	156	0.013	0.045	0.060	0.76	0.073	512	0.03145	0.62	0.02	0.36	1.00	98.27	97.92	0.23%	0.35%
936	938	98.10	97.02	98.35	97.27	102.20	3.85	250	254	108	0.013	0.019	0.062	0.30	0.051	425	0.03342	0.37	0.01	0.10	0.02	98.37	98.27	0.09%	1.00%
934	972	94.86	92.27	95.46	92.87	103.00	7.54	600	610	1007	0.013	0.283	0.325	0.87	0.292	1652	0.02496	0.97	0.05	2.05	2.50	97.96	95.91	0.20%	0.26%
932	934	95.39	94.93	95.92	95.46	103.80	7.88	525	533	455	0.013	0.098	0.143	0.68	0.223	853	0.02610	0.44	0.01	0.22	2.26	98.18	97.96	0.05%	0.10%
930	932	95.81	95.47	96.26	95.92	103.40	7.14	450	457	308	0.013	0.077	0.099	0.78	0.164	673	0.02747	0.47	0.01	0.21	2.13	98.39	98.18	0.07%	0.11%
928	930	99.91	96.06	100.11	96.26	103.20	3.09	200	203	55	0.013	0.031	0.091	0.34	0.032	271	0.03600	0.95	0.05	0.47	0.00	100.11	98.39	3.12%	7.00%
926	930	96.62	95.88	97.00	96.26	102.50	5.51	375	381	530	0.013	0.039	0.068	0.57	0.114	1391	0.02920	0.34	0.01	0.25	1.64	98.64	98.39	0.05%	0.14%
924	934	100.22	94.93	100.75	95.46	108.20	7.46	525	533	669	0.013	0.190	0.399	0.48	0.223	1254	0.02610	0.85	0.04	1.26	0.00	100.75	97.96	0.42%	0.79%
922	924	100.89	100.22	101.42	100.75	107.95	6.54	525	533	290	0.013	0.190	0.216	0.88	0.223	544	0.02610	0.85	0.04	0.53	0.00	101.42	100.75	0.23%	0.23%
920	922	101.37	100.89	101.90	101.42	107.60	5.70	525	533	265	0.013	0.169	0.191	0.89	0.223	497	0.02610	0.76	0.03	0.43	0.00	101.90	101.42	0.18%	0.18%
918	920	104.73	101.65	104.98	101.90	108.30	3.32	250	254	363	0.013	0.019	0.057	0.34	0.051	1430	0.03342	0.38	0.01	0.35	0.00	104.98	101.90	0.85%	0.85%
916	920	102.15	101.52	102.53	101.90	107.30	4.77	375	381	314	0.013	0.050	0.082	0.60	0.114	824	0.02920	0.43	0.01	0.24	0.00	102.53	101.90	0.20%	0.20%
914	916	102.61	102.23	102.91	102.53	107.25	4.34	300	305	152	0.013	0.032	0.050	0.63	0.073	498	0.03145	0.44	0.01	0.16	0.00	102.91	102.53	0.25%	0.25%
912	920	101.76	101.45	102.21	101.90	107.70	5.49	450	457	207	0.013	0.112	0.115	0.98	0.164	453	0.02747	0.68	0.02	0.35	0.04	102.25	101.90	0.17%	0.15%
910	912	102.73	101.96	102.98	102.21	107.10	4.12	250	254	320	0.013	0.021	0.030	0.69	0.051	1258	0.03342	0.41	0.01	0.37	0.00	102.98	102.25	0.23%	0.24%
908	912	104.32	101.91	104.62	102.21	111.70	7.08	300	305	396	0.013	0.076	0.079	0.97	0.073	1299	0.03145	1.04	0.06	2.35	0.00	104.62	102.25	0.60%	0.61%
906	908	109.97	104.37	110.22	104.62	113.65	3.43	250	254	373	0.013	0.017	0.076	0.23	0.051	1470	0.03342	0.34	0.01	0.30	0.00	110.22	104.62	1.50%	1.50%
904	908	105.05	104.32	105.35	104.62	110.20	4.85	300	305	306	0.013	0.048	0.049	0.97	0.073	1002	0.03145	0.66	0.02	0.70	0.00	105.35	104.62	0.24%	0.24%
902	904	105.47	105.10	105.72	105.35	109.60	3.88	250	254	154	0.013	0.020	0.030	0.66	0.051	605	0.03342	0.40	0.01	0.18	0.00	105.72	105.35	0.24%	0.24%

MANHOLE LOSS

Diameter (mm)			Bend					
U/S MH	Pipe In	Pipe Out	Angle	K_o	C_d	K_t	K_{MH}	HL_{MH} (m)
1500	825	825	0	0.18	1.00	0.00	0.18	0.01
1500	600	825	90	0.18	2.60	1.32	1.79	0.08
1200	525	600	90	0.20	1.49	1.32	1.62	0.02
1200	200	200	0	0.60	1.00	0.00	0.60	0.01
1200	450	525	90	0.23	1.59	1.32	1.68	0.03
1200	250	250	90	0.48	1.00	1.32	1.80	0.03
1200	250	250	0	0.48	1.00	0.00	0.48	0.01
1200	450	450	0	0.27	1.00	0.00	0.27	0.00
1200	450	450	0	0.27	1.00	0.00	0.27	0.00
1200	375	450	90	0.27	1.73	1.32	1.78	0.01
1200	300	375	0	0.32	1.95	0.00	0.63	0.00
1200	450	450	90	0.27	1.00	1.32	1.59	0.08
1200	450	450	0	0.27	1.00	0.00	0.27	0.00
1200	375	450	0	0.27	1.73	0.00	0.46	0.01
1200	375	375	90	0.32	1.00	1.32	1.64	0.05
1200	250	375	0	0.32	3.38	0.00	1.08	0.02
1200	250	250	0	0.48	1.00	0.00	0.48	0.02
1200	300	300	0	0.40	1.00	0.00	0.40	0.01
1200	250	300	90	0.40	1.73	1.32	2.01	0.04
1200	250	250	0	0.48	1.00	0.00	0.48	0.00
1200	525	600	90	0.20	1.49	1.32	1.62	0.08
1200	450	525	0	0.23	1.59	0.00	0.36	0.00
1200	375	450	0	0.27	1.73	0.00	0.46	0.01
1200	200	200	0	0.60	1.00	0.00	0.60	0.03
1200	300	375	0	0.32	1.95	0.00	0.63	0.00
1200	525	525	90	0.23	1.00	1.32	1.55	0.06
1200	525	525	0	0.23	1.00	0.00	0.23	0.01
1200	450	525	90	0.23	1.59	1.32	1.68	0.05
1200	250	250	0	0.48	1.00	0.00	0.48	0.00
1200	300	375	0	0.32	1.95	0.00	0.63	0.01
1200	300	300	0	0.40	1.00	0.00	0.40	0.00
1200	300	450	90	0.27	3.38	1.32	2.22	0.05
1200	250	250	0	0.48	1.00	0.00	0.48	0.00
1200	300	300	90	0.40	1.00	1.32	1.72	0.10
1200	250	250	90	0.48	1.00	1.32	1.80	0.01
1200	250	300	0	0.40	1.73	0.00	0.69	0.02
1200	250	250	90	0.48	1.00	1.32	1.80	0.01

Average Daily Flow= 350 L/cap/day
Comm/Inst Flow= 50000 L/ha/day
Industrial Flow= 35000 L/ha/day
Max Res Peak Factor= 4.00
Comm Peak Factor= 1.50
Indst Peak Factor= 1.50

Industrial Peak Factor= per MOE graph
Extraneous Flow= 0.28
Minimum Velocity= 0.60
Manning's n= 0.013

HGL=Major + Minor Losses
Major Loss= Pipe Friction (Darcy-Weisbach)
Minor Loss= Head loss correction for flow through MH, changes in pipe size, and pipe bends
Friction Factor= 8g/c^2, where c=(1/n)*(D/4)^1/6

Designed: KJM
Checked: MAB
Dwg. Reference: 101106-SAN

PROJECT: Fernbank CDP
CLIENT:
Date: May 8, 2009

M:\2003\103106\Data\Calculations\20090113 Preferred Internal SAN Design Sheets.xls

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SANITARY HYDRAULIC GRADE LINE DESIGN SHEET
CRT LANDS - FERNBANK SANITARY TRUNK SEWER
CITY OF OTTAWA
CLARIDGE HOMES

JOB #: 27970 - 5.7
DATE: February 09 2017
DESIGN: WY

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	HPS	FT01	
INVERT ELEVATION (m)	90.340	90.450	
OBVERT ELEVATION (m)	91.559	91.669	
DIAMETER (mm)			1219.2
LENGTH (m)			55.71
FLOW (l/s)			725.0
HGL (m) ***	95.371	95.389	0.018
MANHOLE COEF K= 0.05	LOSS (m)	0.0010	
TOTAL HGL (m)		95.390	
MAX. SURCHARGE (mm)		3721	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.200	0.305	1.55	1806.41

HYDRAULIC SLOPE = 0.03 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT01	FT02	
INVERT ELEVATION (m)	90.440	90.620	
OBVERT ELEVATION (m)	91.659	91.839	
DIAMETER (mm)			1219.2
LENGTH (m)			107.50
FLOW (l/s)			725.0
HGL (m) ***	95.390	95.424	0.034
MANHOLE COEF K= 0.05	LOSS (m)	0.0010	
TOTAL HGL (m)		95.425	
MAX. SURCHARGE (mm)		3586	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.170	0.305	1.43	1663.48

HYDRAULIC SLOPE = 0.03 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT02	FT03	
INVERT ELEVATION (m)	90.640	90.910	
OBVERT ELEVATION (m)	91.859	92.129	
DIAMETER (mm)			1219.2
LENGTH (m)			107.5
FLOW (l/s)			725.0
HGL (m) ***	95.425	95.459	0.034
MANHOLE COEF K= 0.05	LOSS (m)	0.001	
TOTAL HGL (m)		95.460	
MAX. SURCHARGE (mm)		3331	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.250	0.305	1.75	2037.34

HYDRAULIC SLOPE = 0.03 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT03	FT04	
INVERT ELEVATION (m)	90.920	91.100	
OBVERT ELEVATION (m)	92.139	92.319	
DIAMETER (mm)			1219.2
LENGTH (m)			95.00
FLOW (l/s)			725.0
HGL (m) ***	95.460	95.490	0.030
MANHOLE COEF K= 0.05	LOSS (m)	0.001	
TOTAL HGL (m)		95.491	
MAX. SURCHARGE (mm)		3172	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.190	0.30	1.52	1769.541032

HYDRAULIC SLOPE = 0 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow $K_L = 0.05$
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2 / 2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT04	FT05	
INVERT ELEVATION (m)	91.110	91.250	
OBVERT ELEVATION (m)	92.329	92.469	
DIAMETER (mm)			1219.2
LENGTH (m)			89.00
FLOW (l/s)			725.0
HGL (m) ***	95.491	95.520	0.028
MANHOLE COEF K= 0.40	LOSS (m)	0.008	
TOTAL HGL (m)		95.527	
MAX. SURCHARGE (mm)		3058	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.160	0.30	1.38	1612.334705
HYDRAULIC SLOPE =		0.04 %				

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend K_L=0.40
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT05	FT06	
INVERT ELEVATION (m)	91.320	91.370	
OBVERT ELEVATION (m)	92.539	92.589	
DIAMETER (mm)			1219.2
LENGTH (m)			24.60
FLOW (l/s)			725.0
HGL (m) ***	95.527	95.535	0.008
MANHOLE COEF K= 0.40	LOSS (m)	0.008	
TOTAL HGL (m)		95.543	
MAX. SURCHARGE (mm)		2954	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.200	0.30	1.57	1832.751722
HYDRAULIC SLOPE =		0.06 %				

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend K_L=0.40
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT06	FT07	
INVERT ELEVATION (m)	91.400	91.510	
OBVERT ELEVATION (m)	92.619	92.729	
DIAMETER (mm)			1219.2
LENGTH (m)			83.50
FLOW (l/s)			725.0
HGL (m) ***	95.543	95.570	0.027
MANHOLE COEF K= 0.05	LOSS (m)	0.001	
TOTAL HGL (m)		95.571	
MAX. SURCHARGE (mm)		2841	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.130	0.30	1.26	1475.500267
HYDRAULIC SLOPE =		0.03 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through flow K_L=0.05
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT07	FT08	
INVERT ELEVATION (m)	91.520	91.690	
OBVERT ELEVATION (m)	92.739	92.909	
DIAMETER (mm)			1219.2
LENGTH (m)			77.50
FLOW (l/s)			725.0
HGL (m) ***	95.571	95.595	0.025
MANHOLE COEF K= 0.05	LOSS (m)	0.001	
TOTAL HGL (m)		95.598	
MAX. SURCHARGE (mm)		2687	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
1.2192	1.17	3.83	0.220	0.30	1.63	1903.968667
HYDRAULIC SLOPE =		0.03 %				

Head loss in manhole simplified method p. 71 (MWDM)
Straight through K_L= 0.05
Velocity = Flow / Area = 0.62 m/s
$HL = K_L * V^2/ 2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT08	FT09	
INVERT ELEVATION (m)	92.120	92.350	
OBVERT ELEVATION (m)	92.882	93.112	
DIAMETER (mm)			762
LENGTH (m)			40.90
FLOW (l/s)			479.8
HGL (m) ***	95.596	95.666	0.070
MANHOLE COEF K= 1.32	LOSS (m)	0.075	
TOTAL HGL (m)		95.741	
MAX. SURCHARGE (mm)		2629	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.560	0.19	1.91	870.4994435
HYDRAULIC SLOPE =		0.35 %				

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend — K_b = 0.40
from figure 1.7.2, Qu =480, Qo =725; Qu/Qo = 0.660 — K_L = 0.92
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT09	FT10	
INVERT ELEVATION (m)	92.400	92.780	
OBVERT ELEVATION (m)	93.162	93.542	
DIAMETER (mm)			762
LENGTH (m)			84.06
FLOW (l/s)			479.8
HGL (m) ***	95.741	95.884	0.144
MANHOLE COEF K= 0.40	LOSS (m)	0.023	
TOTAL HGL (m)		95.907	
MAX. SURCHARGE (mm)		2365	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.450	0.19	1.71	780.48
HYDRAULIC SLOPE =		0.20 %				

Head loss in manhole simplified method p. 71 (MWDM)
45 degree bend — K_L=0.40
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT10	FT11	
INVERT ELEVATION (m)	92.780	92.960	
OBVERT ELEVATION (m)	93.542	93.722	
DIAMETER (mm)			762
LENGTH (m)			100.79
FLOW (l/s)			479.8
HGL (m) ***	95.907	96.079	0.172
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.082	
MAX. SURCHARGE (mm)		2360	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.180	0.19	1.08	490.56
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
Straight through — K_L=0.05
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT11	FT12	
INVERT ELEVATION (m)	92.960	93.160	
OBVERT ELEVATION (m)	93.722	93.922	
DIAMETER (mm)			762
LENGTH (m)			108.60
FLOW (l/s)			479.8
HGL (m) ***	96.082	96.267	0.186
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.270	
MAX. SURCHARGE (mm)		2348	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.180	0.19	1.09	498.16
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through — K_L=0.05
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT12	FT13	
INVERT ELEVATION (m)	93.170	93.450	
OBVERT ELEVATION (m)	93.932	94.212	
DIAMETER (mm)			762
LENGTH (m)			129.2
FLOW (l/s)			479.8
HGL (m) ***	96.270	96.491	0.221
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.494	
MAX. SURCHARGE (mm)		2282	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.220	0.19	1.19	540.40
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT13	FT14	
INVERT ELEVATION (m)	93.460	93.660	
OBVERT ELEVATION (m)	94.222	94.422	
DIAMETER (mm)			762
LENGTH (m)			115.27
FLOW (l/s)			479.8
HGL (m) ***	96.494	96.691	0.197
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.694	
MAX. SURCHARGE (mm)		2272	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.170	0.19	1.06	483.53
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT14	FT15	
INVERT ELEVATION (m)	93.670	93.880	
OBVERT ELEVATION (m)	94.432	94.642	
DIAMETER (mm)			762
LENGTH (m)			118.1
FLOW (l/s)			479.8
HGL (m) ***	96.694	96.895	0.202
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		96.898	
MAX. SURCHARGE (mm)		2256	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.762	0.46	2.39	0.180	0.19	1.07	489.50
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT15	FT16	
INVERT ELEVATION (m)	93.890	94.170	
OBVERT ELEVATION (m)	94.652	94.932	
DIAMETER (mm)			762
LENGTH (m)			110.6
FLOW (l/s)			479.8
HGL (m) ***	96.898	97.087	0.189
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		97.090	
MAX. SURCHARGE (mm)		2158	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel (m/s)	Q (l/s)
0.762	0.46	2.39	0.250	0.19	1.28	584.07
HYDRAULIC SLOPE =		0.17 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/ 2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT16	FT17	
INVERT ELEVATION (m)	94.190	94.480	
OBVERT ELEVATION (m)	94.952	95.242	
DIAMETER (mm)			762
LENGTH (m)			126.4
FLOW (l/s)			479.8
HGL (m) ***	97.090	97.306	0.216
MANHOLE COEF K= 0.05	LOSS (m)	0.003	
TOTAL HGL (m)		97.309	
MAX. SURCHARGE (mm)		2067	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.762	0.46	2.39	0.230	0.19	1.22	556.02

HYDRAULIC SLOPE = 0.17 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT17	FT18	
INVERT ELEVATION (m)	94.510	94.690	
OBVERT ELEVATION (m)	95.272	95.452	
DIAMETER (mm)			762
LENGTH (m)			88.5
FLOW (l/s)			479.8
HGL (m) ***	97.309	97.460	0.151
MANHOLE COEF K= 0.63	LOSS (m)	0.036	
TOTAL HGL (m)		97.495	
MAX. SURCHARGE (mm)		2043	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.762	0.46	2.39	0.200	0.19	1.15	523.52

HYDRAULIC SLOPE = 0.21 %

Head loss in manhole simplified method p. 71 (MWDM)
from figure 1.7.2, Qu =387, Qo =480; Qu/Qo = 0.80 $K_L=0.63$
Velocity = Flow / Area = 1.05 m/s
$HL = K_L * V^2/ 2g$

BRANCH FROM MH FT18 TO MH 221

FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	FT18	MH 221	
INVERT ELEVATION (m)	98.294	98.610	
OBVERT ELEVATION (m)	98.548	98.864	
DIAMETER (mm)			254
LENGTH (m)			90.3
FLOW (l/s)			11.6
HGL (m) ***	98.548	98.579	0.031
MANHOLE COEF K= 1.50	LOSS (m)	0.004	
TOTAL HGL (m)		98.583	
MAX. SURCHARGE (mm)		-281	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.254	0.05	0.80	0.350	0.06	0.72	36.68

HYDRAULIC SLOPE = 0.04 %

Head loss in manhole simplified method p. 71 (MWDM)
outlet at right angles to inlet $K_L = 1.5$
Velocity = Flow / Area = 0.23 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	MH 221	MH 211	
INVERT ELEVATION (m)	98.771	99.000	
OBVERT ELEVATION (m)	99.025	99.254	
DIAMETER (mm)			254
LENGTH (m)			32.8
FLOW (l/s)			11.6
HGL (m) ***	99.025	99.036	0.011
MANHOLE COEF K= 1.50	LOSS (m)	0.004	
TOTAL HGL (m)		99.040	
MAX. SURCHARGE (mm)		-214	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.254	0.05	0.80	0.700	0.06	1.02	51.83

HYDRAULIC SLOPE = 0.05 %

Head loss in manhole simplified method p. 71 (MWDM)
outlet at right angles to inlet $K_L = 1.5$
Velocity = Flow / Area = 0.23 m/s
$HL = K_L * V^2/ 2g$

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FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	MH 211	MH 209	
INVERT ELEVATION (m)	99.010	99.388	
OBVERT ELEVATION (m)	99.264	99.642	
DIAMETER (mm)			254
LENGTH (m)			54.0
FLOW (l/s)			11.6
HGL (m) ***	99.040	99.059	0.019
MANHOLE COEF K= 0.05	LOSS (m)	0.000	
TOTAL HGL (m)		99.060	
MAX. SURCHARGE (mm)		-582	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.254	0.05	0.80	0.700	0.06	1.02	51.86
HYDRAULIC SLOPE = 0.04 %						

Head loss in manhole simplified method p. 71 (MWDM)
straight through — $K_L = 0.05$
Velocity = Flow / Area = 0.23 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	MH 209	MH 161A	
INVERT ELEVATION (m)	100.315	100.690	
OBVERT ELEVATION (m)	100.518	100.893	
DIAMETER (mm)			203.2
LENGTH (m)			53.6
FLOW (l/s)			8.3
HGL (m) ***	100.518	100.550	0.032
MANHOLE COEF K= 0.83	LOSS (m)	0.003	
TOTAL HGL (m)		100.552	
MAX. SURCHARGE (mm)		-341	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.2032	0.03	0.64	0.700	0.05	0.88	28.61
HYDRAULIC SLOPE = 0.06 %						

Head loss in manhole simplified method p. 71 (MWDM)
from figure 1.7.2, Qu =8.3, Qo =11.6; Qu/Qo = 0.72 — $K_L = 0.83$
Velocity = Flow / Area = 0.26 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
ROBERT GRANT AVE	MH 161A	MH 146A	
INVERT ELEVATION (m)	100.741	101.014	
OBVERT ELEVATION (m)	100.944	101.217	
DIAMETER (mm)			203.2
LENGTH (m)			39.0
FLOW (l/s)			6.8
HGL (m) ***	100.944	100.959	0.015
MANHOLE COEF K= 1.62	LOSS (m)	0.004	
TOTAL HGL (m)		100.963	
MAX. SURCHARGE (mm)		-254	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.2032	0.03	0.64	0.700	0.05	0.88	28.62
HYDRAULIC SLOPE = 0.05 %						

Head loss in manhole simplified method p. 71 (MWDM)
from figure 1.7.2, Qu =6.8, Qo =8.3; Qu/Qo = 0.82 — $K_L = 0.62$
outlet at 77 degree bend to inlet — $K_b = 1.00$
Velocity = Flow / Area = 0.21 m/s
$HL = K_L * V^2/2g$

BRANCH FROM MH FT18 TO FT19

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT18	FT19	
INVERT ELEVATION (m)	94.800	95.930	
OBVERT ELEVATION (m)	95.410	96.540	
DIAMETER (mm)			609.6
LENGTH (m)			124.5
FLOW (l/s)			387.0
HGL (m) ***	97.495	97.950	0.455
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		97.955	
MAX. SURCHARGE (mm)		1415	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.910	0.15	2.09	609.95
HYDRAULIC SLOPE = 0.37 %						

Head loss in manhole simplified method p. 71 (MWDM)
straight through — $K_L = 0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/2g$

IBI GROUP

SANITARY HYDRAULIC GRADE LINE DESIGN SHEET
CRT LANDS - FERNBANK SANITARY TRUNK SEWER
CITY OF OTTAWA
CLARIDGE HOMES

JOB #: 27970 - 5.7
DATE: February 09 2017
DESIGN: WY

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT19	FT20	
INVERT ELEVATION (m)	95.950	96.420	
OBVERT ELEVATION (m)	96.560	97.030	
DIAMETER (mm)			609.6
LENGTH (m)			103.6
FLOW (l/s)			387.0
HGL (m) ***	97.955	98.333	0.379
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		98.338	
MAX. SURCHARGE (mm)		1308	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.450	0.15	1.48	431.23
HYDRAULIC SLOPE =		0.37 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT20	FT21	
INVERT ELEVATION (m)	96.460	96.940	
OBVERT ELEVATION (m)	97.070	97.550	
DIAMETER (mm)			609.6
LENGTH (m)			106.34
FLOW (l/s)			387.0
HGL (m) ***	98.338	98.726	0.389
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		98.731	
MAX. SURCHARGE (mm)		1181	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.450	0.15	1.47	430.14
HYDRAULIC SLOPE =		0.37 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT21	FT22	
INVERT ELEVATION (m)	96.960	97.350	
OBVERT ELEVATION (m)	97.570	97.960	
DIAMETER (mm)			609.6
LENGTH (m)			108.6
FLOW (l/s)			387.0
HGL (m) ***	98.731	99.128	0.397
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		99.132	
MAX. SURCHARGE (mm)		1173	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.360	0.15	1.32	383.67
HYDRAULIC SLOPE =		0.37 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT22	FT23	
INVERT ELEVATION (m)	97.370	97.780	
OBVERT ELEVATION (m)	97.980	98.390	
DIAMETER (mm)			609.6
LENGTH (m)			106.2
FLOW (l/s)			387.0
HGL (m) ***	99.132	99.520	0.388
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		99.525	
MAX. SURCHARGE (mm)		1135	

MANNING FORMULA - FLOWING FULL						
DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd.R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.390	0.15	1.36	397.80
HYDRAULIC SLOPE =		0.37 %				

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/2g$

IBI GROUP

SANITARY HYDRAULIC GRADE LINE DESIGN SHEET
CRT LANDS - FERNBANK SANITARY TRUNK SEWER
CITY OF OTTAWA
CLARIDGE HOMES

JOB #: 27970 - 5.7
DATE: February 09 2017
DESIGN: WY

FRICTION LOSS	FROM MH	TO MH	PIPE ID
FERNBANK ROAD	FT23	FT24	
INVERT ELEVATION (m)	97.790	98.160	
OBVERT ELEVATION (m)	98.400	98.770	
DIAMETER (mm)			609.6
LENGTH (m)			108.9
FLOW (l/s)			387.0
HGL (m) ***	99.525	99.923	0.398
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		99.927	
MAX. SURCHARGE (mm)		1157	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.340	0.15	1.28	373.19

HYDRAULIC SLOPE = 0.37 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L=0.05$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/ 2g$

BRANCH FROM MH FT24 TO MH 102A

FRICTION LOSS	FROM MH	TO MH	PIPE ID
GOLDHAWK DRIVE	FT24	MH 102A	
INVERT ELEVATION (m)	98.180	98.842	
OBVERT ELEVATION (m)	98.790	99.452	
DIAMETER (mm)			609.6
LENGTH (m)			102.59
FLOW (l/s)			387.0
HGL (m) ***	99.927	100.302	0.375
MANHOLE COEF K= 1.50	LOSS (m)	0.135	
TOTAL HGL (m)		100.436	
MAX. SURCHARGE (mm)		985	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.645	0.15	1.76	514.30

HYDRAULIC SLOPE = 0.50 %

Head loss in manhole simplified method p. 71 (MWDM)
outlet at right angles to inlet $K_L = 1.5$
Velocity = Flow / Area = 1.33 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
GOLDHAWK DRIVE	MH 102A	MH 103A	
INVERT ELEVATION (m)	98.872	99.030	
OBVERT ELEVATION (m)	99.482	99.640	
DIAMETER (mm)			609.6
LENGTH (m)			45.00
FLOW (l/s)			385.0
HGL (m) ***	100.436	100.599	0.163
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		100.604	
MAX. SURCHARGE (mm)		964	

MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.351	0.15	1.30	379.37

HYDRAULIC SLOPE = 0.37 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.32 m/s
$HL = K_L * V^2/ 2g$

FRICTION LOSS	FROM MH	TO MH	PIPE ID
GOLDHAWK DRIVE	MH 103A	MH 104A	
INVERT ELEVATION (m)	99.060	99.230	
OBVERT ELEVATION (m)	99.670	99.840	
DIAMETER (mm)			609.6
LENGTH (m)			48.77
FLOW (l/s)			385.0
HGL (m) ***	100.604	100.780	0.176
MANHOLE COEF K= 0.05	LOSS (m)	0.004	
TOTAL HGL (m)		100.784	
MAX. SURCHARGE (mm)		945	

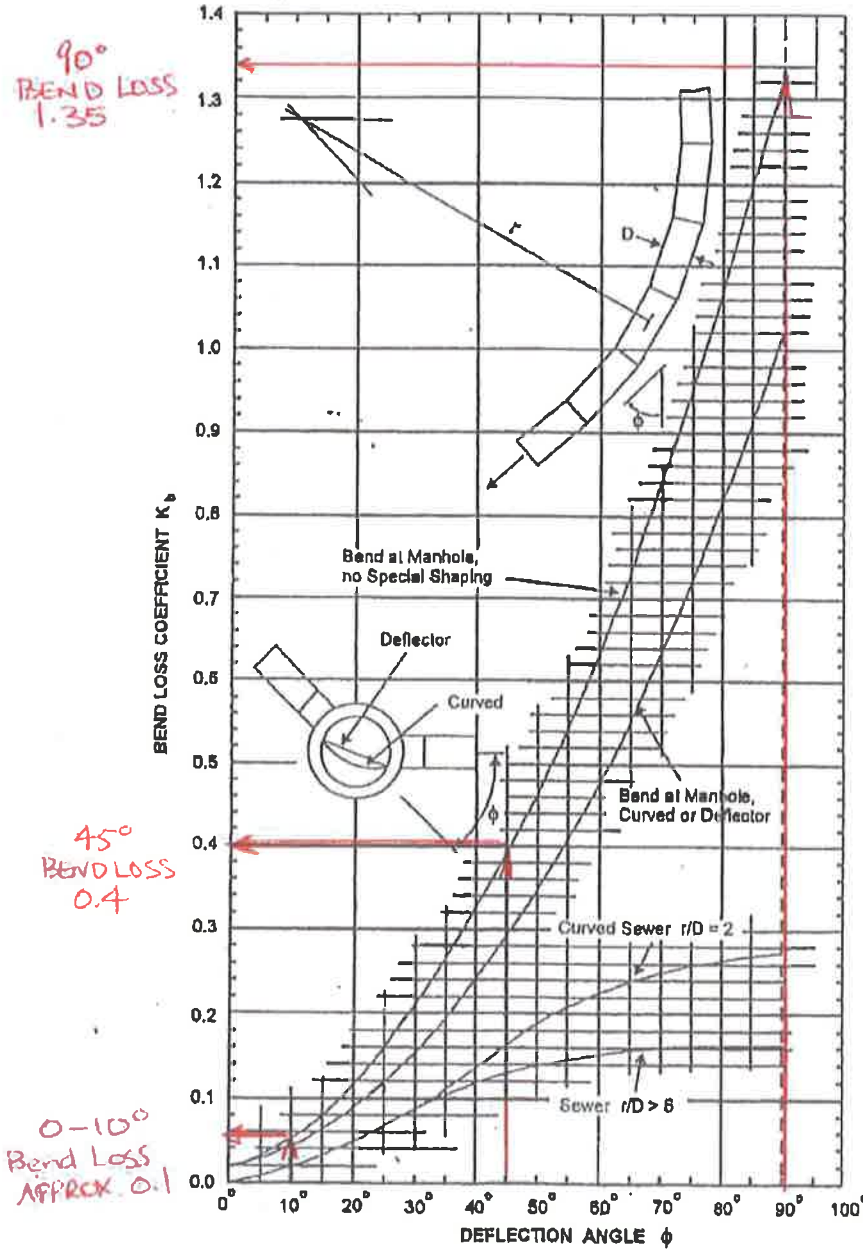
MANNING FORMULA - FLOWING FULL

DIA (m)	Area (m2)	Perim. (m)	Slope (%)	Hyd R. (m)	Vel. (m/s)	Q (l/s)
0.6096	0.29	1.91	0.349	0.15	1.30	377.99

HYDRAULIC SLOPE = 0.37 %

Head loss in manhole simplified method p. 71 (MWDM)
straight through $K_L = 0.05$
Velocity = Flow / Area = 1.32 m/s
$HL = K_L * V^2/ 2g$

Design Chart : Sewer Bend Loss Coefficients

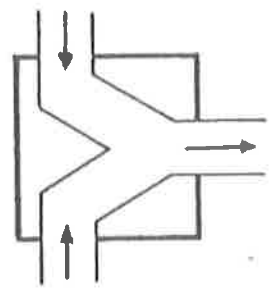


Source: American Iron and Steel Institute (1980)

1.7.3.2 Junctions

Tee - outlet at right angles to inlets and no deflector between inlets $K_L = 1.5$

- deflector between inlets for full height and width of incoming flows $K_L = 1.0$



Side and Cross Junctions - value of K_L is obtained from the following graph:

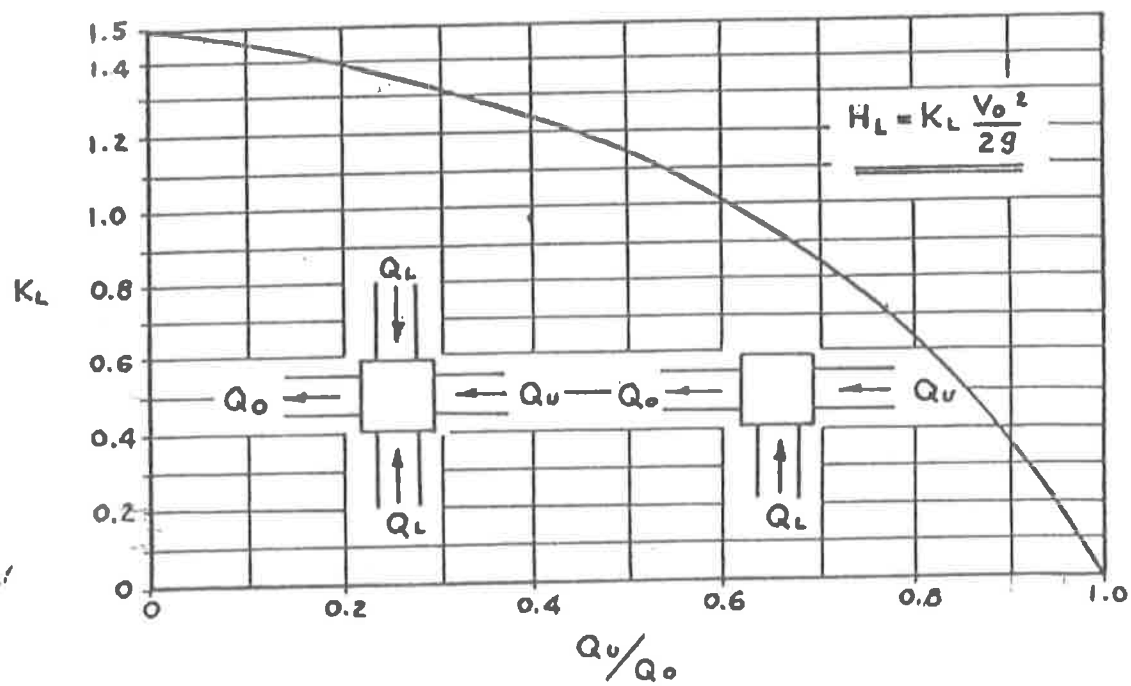
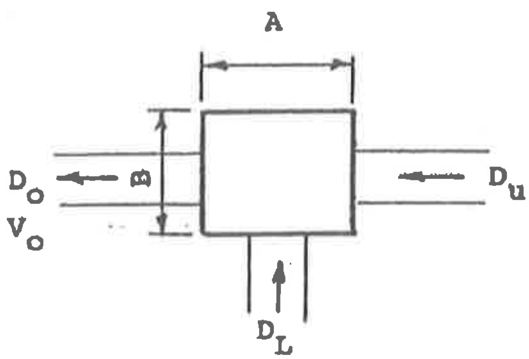


FIGURE 1.7.2.

1.7.4 Accurate Method of Head Loss Calculations

In this method, the head loss is calculated for each incoming sewer and is allowed for in the individual sewers as outlined in Section 1.7.2.2.

1.7.4.1 Manhole Abbreviations



1.7.4.2 Upstream In-line Sewer Head Loss

$$H_L = K_u \frac{V_o^2}{2g}$$

$$= \bar{K}_u \times \frac{K_u}{\bar{K}_u} \times \frac{V_o^2}{2\,g}$$

$\bar{K}_u$ is obtained from Figure 1.7.3

$\frac{K_u}{\bar{K}_u}$ is obtained from Figure 1.7.4

$\frac{V_o^2}{2\,g}$ is obtained from Figure 1.7.5

1.7.4.3 Upstream Lateral Sewer Head Loss

$$H_L = K_L \frac{V_o^2}{2\,g}$$

$$= \bar{K}_L \left[1 - \left(\frac{Qu}{Qo} \cdot \frac{Do}{Du} \right)^{\frac{2\,Do}{D_L}} \right] \frac{V_o^2}{2\,g}$$

1.7 HEAD LOSSES IN MANHOLES, CURVED SEWERS AND JUNCTION CHAMBERS

1.7.1 General

Where a manhole is placed on a sewer line, where two or more sewers meet in a manhole, where sewers meet in a specially designed junction chamber or where a sewer is placed on a curve there is a loss of energy greater than that of a straight length of sewer. These losses can be negligible as in the cases of small diameter sanitary sewers flowing partially full at minimum velocities or substantial as in the case of large diameter storm sewers turning 90° in a manhole at a high velocity.

The designer's responsibility is to ensure that he provides additional head energy in the sewer design to allow for the losses to be incurred. In cases where the head available is limited, he will have to adjust the design to provide for a system which is hydraulically smoother. This will require less head to be provided to overcome the energy losses.

The most complete study of this subject which has been undertaken to date has been done by Sangster, Wood, Smerdon and Bossy at the University of Missouri and published in their Bulletin No. 41 entitled "Pressure Changes at Storm Drain Junctions" and in the A.S.C.E. Journal of the Hydraulics Division entitled "Pressure Changes at Open Junctions in Conduits" - HY6 - #2057.

To facilitate the rapid determination of head losses in manholes, a number of typical manhole bends and junctions were studied. From this, a "simplified method" was established. This method has been found to be quite adequate for the vast majority of manholes and is outlined in Section 1.7.3.

An "accurate method" is also outlined in Section 1.7.4. This method is taken directly from the study with the addition of curves which aid in the solution of the formulas.

The head losses in radius pipe and in junction chambers are also described in Sections 1.7.5 and 1.7.6. For this purpose, a junction chamber is considered to be a manhole where two or more sewers enter the manhole with one or more entering at an angle other than 90° or 180° to the outlet sewer.

1.7.2 Addition of Energy to the System

1.7.2.1 Change in Pipe Size

In addition of energy to systems, the first point to keep in mind is that no energy is added when the crown of the inlet and outlet sewers are at the same elevation. Therefore, at changes in sewer size, the crown(s) of the incoming sewer(s) are to be at the same elevation where no energy is added or higher than the crown of the outgoing sewer where energy is to be added.

1.7.2.2 Addition of Energy

Energy is added to a system in two ways:

- Small Losses - where the head loss is 0.15m or less, the crown of the outlet pipe is dropped below the lowest incoming crown by the amount of the head loss.
- Larger Losses - where the head loss is greater than 0.15m, the crown of the outlet pipe is dropped below the lowest incoming crown by the amount of the head loss, and the upstream incoming crowns are dropped to the same elevation as the outlet crown. Sewers entering the manhole at 90° to the outlet need not be lowered.

The upstream sewers will be on a grade equal to the grade required to overcome the friction in the sewer plus the grade required to overcome the head loss in the downstream manhole.

1.7.3 Simplified Method of Head Loss Calculation

The head loss coefficient (K_L) for the particular bend or junction in the manhole is multiplied by the velocity head of the outlet sewer.

$$H_L = K_L \frac{Vo^2}{2g}$$

Head loss coeficients (K_L) to be used are:

900mm & > Benched
<900mm not Benched
If 1 pipe @ junction is >900mm, then benched

1.7.3.1 Bends

90° - No benching or deflector, or where they are only up to the springline	$K_L = 1.5$
90° - Benching or deflector to crown of sewers	$K_L = 1.0$

Less than 90° - Multiply the head loss coefficient for a 90° bend by a head loss ratio factor from the following curve:

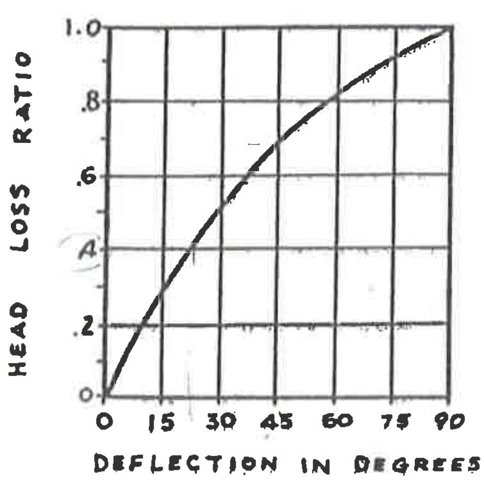


FIGURE 1.7.1.

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK FACTOR	PEAK FLOW	AREA (Ha)						PEAK FLOW	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY (full)	AVAILABLE CAPACITY	
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL													
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM		(L/s)	IND	CUM	IND	CUM	IND	CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
PUTNEY CRESCENT	141A	141A	142A			1		0.06	2.5	2.5	4.00	0.04		0.00		0.00		0.00	0.00	0.06	0.06	0.02	0.06	24.19	9.07	200	0.50	0.746	24.14	99.76
PUTNEY CRESCENT	142A	142A	143A			11		0.35	27.5	30.0	4.00	0.49		0.00		0.00		0.00	0.00	0.35	0.41	0.11	0.60	47.16	55.56	200	1.90	1.454	46.56	98.73
PUTNEY CRESCENT	143A	143A	144A			17		0.49	42.5	72.5	4.00	1.17		0.00		0.00		0.00	0.00	0.49	0.90	0.25	1.43	41.91	64.86	200	1.50	1.292	40.48	96.60
FINSBURY AVENUE	136AA	136A	144A			21		0.65	52.5	52.5	4.00	0.85		0.00		0.00		0.00	0.00	0.65	0.65	0.18	1.03	53.56	110.44	200	2.45	1.652	52.52	98.07
PUTNEY CRESCENT	144A	144A	145A			10		0.36	25.0	150.0	4.00	2.43		0.00		0.00		0.00	0.00	0.36	1.91	0.53	2.97	32.46	80.25	200	0.90	1.001	29.50	90.86
CLAPHAM TERRACE	136AB	136A	137A			10		0.37	25.0	25.0	4.00	0.41		0.00		0.00		0.00	0.00	0.37	0.37	0.10	0.51	24.19	78.00	200	0.50	0.746	23.69	97.90
BRIXTON WAY	137AA	137A	160A			12		0.35	30.0	55.0	4.00	0.89		0.00		0.00		0.00	0.00	0.35	0.72	0.20	1.09	41.91	50.77	200	1.50	1.292	40.81	97.39
BRIXTON WAY	160A	160A	145A			18		0.54	45.0	100.0	4.00	1.62		0.00		0.00		0.00	0.00	0.54	1.26	0.35	1.97	52.45	78.53	200	2.35	1.617	50.48	96.24
PUTNEY CRESCENT	145A	145A	146A			11		0.34	27.5	277.5	4.00	4.50		0.00		0.00		0.00	0.00	0.34	3.51	0.98	5.48	39.76	70.87	200	1.35	1.226	34.28	86.22
CLAPHAM WAY	137AB	137A	138A			9		0.38	22.5	22.5	4.00	0.36		0.00		0.00		0.00	0.00	0.38	0.38	0.11	0.47	37.48	78.00	200	1.20	1.156	37.01	98.74
PUTNEY CRESCENT	138A	138A	148A			10		0.35	25.0	47.5	4.00	0.77		0.00		0.00		0.00	0.00	0.35	0.73	0.20	0.97	40.49	77.95	200	1.40	1.248	39.51	97.59
PUTNEY CRESCENT	148A	148A	147A			7		0.26	17.5	65.0	4.00	1.05		0.00		0.00		0.00	0.00	0.26	0.99	0.28	1.33	55.70	59.50	200	2.65	1.718	54.37	97.61
PUTNEY CRESCENT	147A	147A	146A			0		0.03	0.0	65.0	4.00	1.05		0.00		0.00		0.00	0.00	0.03	1.02	0.29	1.34	55.70	12.47	200	2.65	1.718	54.36	97.60
BLOCK 323	146A	146A	161A			0		0.03	0.0	342.5	4.00	5.55		0.00		0.00		0.00	0.00	0.03	4.56	1.28	6.83	28.63	38.97	200	0.70	0.883	21.80	76.15
BLOCK 316	HYD. 2	161A	*Ex.209*			0		5.12	0.0	342.5	4.00	5.55		0.00		0.00		0.00	0.00	5.12	9.68	2.71	8.26	28.63	53.67	200	0.70	0.883	20.37	71.15
BLOCK 324	RES.1	BULKHEAD	*Ex.209*					1.89	170.1	170.1	4.00	2.76		0.00		0.00		0.00	0.00	1.89	1.89	0.53	3.29	43.87	8.00	250	0.50	0.866	40.58	92.51

Refer to ECA No. 9079-9LNNZC dated July 9, 2014 for description of existing sewers.

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
   Harmon Formula = 1+(14/(4+P^0.5))
   where P = population in thousands

Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	1 of 4

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE CAPACITY	
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL		FLOW									(full)		
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM	FACTOR	FLOW (L/s)	IND	CUM	IND	CUM	IND	CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
CLAPHAM TERRACE	136AC	136A	135A			11		0.41	27.5	27.5	4.00	0.45		0.00		0.00		0.00	0.00	0.41	0.41	0.11	0.56	27.59	65.31	200	0.65	0.851	27.03	97.97
CLAPHAM TERRACE	135A	135A	134A			9		0.31	22.5	50.0	4.00	0.81		0.00		0.00		0.00	0.00	0.31	0.72	0.20	1.01	27.59	57.36	200	0.65	0.851	26.57	96.33
PUTNEY CRESCENT	141A	141A	134A			9		0.34	22.5	22.5	4.00	0.36		0.00		0.00		0.00	0.00	0.34	0.34	0.10	0.46	32.46	75.02	200	0.90	1.001	32.00	98.58
PUTNEY CRESCENT	134A	134A	140A	6				0.34	19.8	92.3	4.00	1.50		0.00		0.00		0.00	0.00	0.34	1.40	0.39	1.89	32.46	78.00	200	0.90	1.001	30.57	94.18
OSTERLEY WAY	153A	153A	152A	8				0.51	26.4	26.4	4.00	0.43		0.00		0.00		0.00	0.00	0.51	0.51	0.14	0.57	29.63	49.25	200	0.75	0.914	29.06	98.07
OSTERLEY WAY	152A	152A	151A	17				0.78	56.1	82.5	4.00	1.34		0.00		0.00		0.00	0.00	0.78	1.29	0.36	1.70	29.63	95.75	200	0.75	0.914	27.93	94.27
OSTERLEY WAY	151A	151A	150A	10				0.47	33.0	115.5	4.00	1.87		0.00		0.00		0.00	0.00	0.47	1.76	0.49	2.36	29.63	59.68	200	0.75	0.914	27.27	92.02
OSTERLEY WAY	150A	150A	140A	9				0.42	29.7	145.2	4.00	2.35		0.00		0.00		0.00	0.00	0.42	2.18	0.61	2.96	29.63	62.98	200	0.75	0.914	26.67	90.00
PUTNEY CRESCENT	140A	140A	124A	3				0.24	9.9	247.4	4.00	4.01		0.00		0.00		0.00	0.00	0.24	3.82	1.07	5.08	32.46	78.00	200	0.90	1.001	27.38	84.36
BLOCK 343	RES.2	BLKHD	129A					1.21	108.9	108.9	4.00	1.76		0.00		0.00		0.00	0.00	1.21	1.21	0.34	2.10	20.24	19.00	200	0.35	0.624	18.14	89.61
BOBOLINK RIDGE	129A	129A	128A	0				0.09	0.0	108.9	4.00	1.76		0.00		0.00		0.00	0.00	0.09	1.30	0.36	2.13	31.02	45.00	250	0.25	0.612	28.89	93.14
BOBOLINK RIDGE	128AA	128A	127A	6				0.41	19.8	128.7	4.00	2.09		0.00		0.00		0.00	0.00	0.41	1.71	0.48	2.56	31.02	78.00	250	0.25	0.612	28.46	91.73
BOBOLINK RIDGE	127AA	127A	126A	10				0.53	33.0	161.7	4.00	2.62		0.00		0.00		0.00	0.00	0.53	2.24	0.63	3.25	31.02	78.00	250	0.25	0.612	27.77	89.53
BOBOLINK RIDGE	126A	126A	125A	5				0.33	16.5	178.2	4.00	2.89		0.00		0.00		0.00	0.00	0.33	2.57	0.72	3.61	31.02	47.81	250	0.25	0.612	27.41	88.37
BOBOLINK RIDGE	125A	125A	124A	12				0.56	39.6	217.8	4.00	3.53		0.00		0.00		0.00	0.00	0.56	3.13	0.88	4.41	31.02	74.85	250	0.25	0.612	26.61	85.80
BOBOLINK RIDGE	124A	124A	123A	11				0.61	36.3	501.5	3.97	8.07		0.00		0.00		0.00	0.00	0.61	7.56	2.12	10.19	31.02	88.85	250	0.25	0.612	20.83	67.15
DAGENHAM STREET	PARK1, 131A	131A	130A	7				1.70	23.1	23.1	4.00	0.37		0.00		0.00		0.00	0.00	1.70	1.70	0.48	0.85	34.22	43.00	200	1.00	1.055	33.37	97.51
DAGENHAM STREET	130A	130A	123A	8				0.46	26.4	49.5	4.00	0.80		0.00		0.00		0.00	0.00	0.46	2.16	0.60	1.41	34.22	87.11	200	1.00	1.055	32.81	95.89
BOBOLINK RIDGE	123A	123A	122A	2				0.14	6.6	557.6	3.95	8.92		0.00		0.00		0.00	0.00	0.14	9.86	2.76	11.68	31.02	25.98	250	0.25	0.612	19.34	62.34
BOBOLINK RIDGE	122A	122A	121A	5				0.26	16.5	574.1	3.94	9.17		0.00		0.00		0.00	0.00	0.26	10.12	2.83	12.00	31.02	36.36	250	0.25	0.612	19.02	61.31
BOBOLINK RIDGE	121A	121A	120A	6				0.30	19.8	593.9	3.93	9.47		0.00		0.00		0.00	0.00	0.30	10.42	2.92	12.38	31.02	40.43	250	0.25	0.612	18.64	60.08
ANGEL HEIGHTS	111A	111A	112A	1				0.08	3.3	3.3	4.00	0.05		0.00		0.00		0.00	0.00	0.08	0.08	0.02	0.08	28.63	12.92	200	0.70	0.883	28.55	99.73
ANGEL HEIGHTS	112A	112A	113A	13				0.77	42.9	46.2	4.00	0.75		0.00		0.00		0.00	0.00	0.77	0.85	0.24	0.99	28.63	95.21	200	0.70	0.883	27.64	96.55
ANGEL HEIGHTS	113A	113A	114A	6				0.29	19.8	66.0	4.00	1.07		0.00		0.00		0.00	0.00	0.29	1.14	0.32	1.39	28.63	38.92	200	0.70	0.883	27.24	95.15
ANGEL HEIGHTS	114A	114A	120A	6				0.35	19.8	85.8	4.00	1.39		0.00		0.00		0.00	0.00	0.35	1.49	0.42	1.81	28.63	70.46	200	0.70	0.883	26.82	93.69
BOBOLINK RIDGE	120A	120A	105A	11				0.62	36.3	716.0	3.89	11.28		0.00		0.00		0.00	0.00	0.62	12.53	3.51	14.79	36.70	90.60	250	0.35	0.724	21.91	59.71

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

Designed: J.I.M.
Checked: P.K.
Dwg. Reference: 27970 - 501, 501A, 501B

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27970.5.7.1	2017-07-14	2 of 4

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SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK FACTOR	PEAK FLOW	AREA (Ha)						PEAK FLOW	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY (full)	AVAILABLE CAPACITY	
													INSTITUTIONAL		COMMERCIAL		INDUSTRIAL													
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM		(L/s)	IND	CUM	IND	CUM	IND	CUM	(L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(m/s)	L/s	(%)
EMBANKMENT STREET	128AB	128A	188A	16				0.74	52.8	52.8	4.00	0.86		0.00		0.00		0.00	0.00	0.74	0.74	0.21	1.06	27.59	98.00	200	0.65	0.851	26.52	96.15
EMBANKMENT STREET	188A	188A	189A	11				0.52	36.3	89.1	4.00	1.44		0.00		0.00		0.00	0.00	0.52	1.26	0.35	1.80	27.59	74.80	200	0.65	0.851	25.79	93.49
BLOCK 344	RES.3	192A	189A					1.52	136.8	136.8	4.00	2.22		0.00		0.00		0.00	0.00	1.52	1.52	0.43	2.64	20.24	40.00	200	0.35	0.624	17.60	86.95
EMBANKMENT STREET	189A	189A	190A	14				0.69	46.2	272.1	4.00	4.41		0.00		0.00		0.00	0.00	0.69	3.47	0.97	5.38	20.24	92.53	200	0.35	0.624	14.86	73.42
EMBANKMENT STREET		190A	176A	0				0.00	0.0	272.1	4.00	4.41		0.00		0.00		0.00	0.00	0.00	3.47	0.97	5.38	20.24	10.78	200	0.35	0.624	14.86	73.42
BLOCK 345	INST.2	BULKHEAD	176A	0				0.00	0.0	0.0	4.00	0.00	6.53	6.53		0.00		0.00	5.67	6.53	6.53	1.83	7.50	20.24	21.00	200	0.35	0.624	12.75	62.97
COPE DRIVE	176A	176A	175A	3				0.63	9.9	282.0	4.00	4.57		6.53		0.00		0.00	5.67	0.63	10.63	2.98	13.21	20.24	76.03	200	0.35	0.624	7.03	34.72
COPE DRIVE	175A	175A	174A	5				0.46	16.5	298.5	4.00	4.84		6.53		0.00		0.00	5.67	0.46	11.09	3.11	13.61	20.24	84.94	200	0.35	0.624	6.63	32.76
BELSIZE WAY	127AB	127A	185A	11				0.53	36.3	36.3	4.00	0.59		0.00		0.00		0.00	0.00	0.53	0.53	0.15	0.74	27.59	88.50	200	0.65	0.851	26.85	97.33
BELSIZE WAY	185A	185A	186A	13				0.59	42.9	79.2	4.00	1.28		0.00		0.00		0.00	0.00	0.59	1.12	0.31	1.60	27.59	83.61	200	0.65	0.851	25.99	94.21
PINNER ROAD	191A	191A	186A	3				0.24	9.9	9.9	4.00	0.16		0.00		0.00		0.00	0.00	0.24	0.24	0.07	0.23	27.59	43.00	200	0.65	0.851	27.36	99.17
PINNER ROAD	186A	186A	187A	5				0.35	16.5	105.6	4.00	1.71		0.00		0.00		0.00	0.00	0.35	1.71	0.48	2.19	20.24	70.39	200	0.35	0.624	18.05	89.18
PINNER ROAD		187A	183A	0				0.00	0.0	105.6	4.00	1.71		0.00		0.00		0.00	0.00	0.00	1.71	0.48	2.19	20.24	9.00	200	0.35	0.624	18.05	89.18
FINSBURY AVENUE	182A	182A	183A	16				0.97	52.8	52.8	4.00	0.86		0.00		0.00		0.00	0.00	0.97	0.97	0.27	1.13	32.46	117.13	200	0.90	1.001	31.33	96.53
FINSBURY AVENUE	183A	183A	184A	4				0.33	13.2	171.6	4.00	2.78		0.00		0.00		0.00	0.00	0.33	3.01	0.84	3.62	20.24	65.71	200	0.35	0.624	16.62	82.10
FINSBURY AVENUE		184A	174A	0				0.00	0.0	171.6	4.00	2.78		0.00		0.00		0.00	0.00	0.00	3.01	0.84	3.62	20.24	17.89	200	0.35	0.624	16.62	82.10
COPE DRIVE	174A	174A	173A	7				0.47	23.1	493.2	3.98	7.95		6.53		0.00		0.00	5.67	0.47	14.57	4.08	17.69	31.02	82.90	250	0.25	0.612	13.33	42.96
COPE DRIVE	173A	173A	172A	6				0.41	19.8	513.0	3.97	8.25		6.53		0.00		0.00	5.67	0.41	14.98	4.19	18.11	31.02	76.02	250	0.25	0.612	12.91	41.62
BLOCK 313	INST.1	BULKHEAD	172A	0				0.00	0.0	0.0	4.00	0.00	2.88	2.88		0.00		0.00	2.50	2.88	2.88	0.81	3.31	20.24	16.00	200	0.35	0.624	16.94	83.67
COPE DRIVE	172A	172A	171B	3				0.23	9.9	522.9	3.96	8.40		9.41		0.00		0.00	8.17	0.23	18.09	5.07	21.63	31.02	36.96	250	0.25	0.612	9.39	30.27
COPE DRIVE	171B	171B	171A	2				0.22	6.6	529.5	3.96	8.50		9.41		0.00		0.00	8.17	0.22	18.31	5.13	21.79	31.02	41.21	250	0.25	0.612	9.23	29.75
DAGENHAM STREET	180A	180A	181A	7				0.50	23.1	23.1	4.00	0.37		0.00		0.00		0.00	0.00	0.50	0.50	0.14	0.51	20.24	90.00	200	0.35	0.624	19.73	97.46
DAGENHAM STREET	181A	181A	171A	0				0.11	0.0	23.1	4.00	0.37		0.00		0.00		0.00	0.00	0.11	0.61	0.17	0.55	20.24	67.50	200	0.35	0.624	19.70	97.31
COPE DRIVE	171A	171A	170B	1				0.17	3.3	555.9	3.95	8.90		9.41		0.00		0.00	8.17	0.17	19.09	5.35	22.41	45.12	37.91	300	0.20	0.618	22.71	50.33
COPE DRIVE	170B	170B	170A	3				0.25	9.9	565.8	3.95	9.04		9.41		0.00		0.00	8.17	0.25	19.34	5.42	22.63	45.12	43.98	300	0.20	0.618	22.49	49.84
BLOCK 312	RES.3A	BULKHEAD	sewer	0				3.26	195.6	195.6	4.00	3.17		0.00		0.00		0.00	0.00	3.26	3.26	0.91	4.08	20.24	16.22	200	0.35	0.624	16.16	79.83
COPE DRIVE	170A	170A	110A	6				0.62	19.8	781.2	3.87	12.24		9.41		0.00		0.00	8.17	0.62	23.22	6.50	26.91	45.12	120.00	300	0.20	0.618	18.21	40.36
GOLDHAWK DRIVE	306A	SOUTH	303A	31				1.83	102.3	102.3	4.00	1.66		0.00		0.00		0.00	0.00	1.83	1.83	0.51	2.17							
STREET NO. 26	304A	WEST	303A	14				0.69	46.2	46.2	4.00	0.75		0.00		0.00		0.00	0.00	0.69	0.69	0.19	0.94							
GOLDHAWK DRIVE	303A	303A	302A	10				0.62	33.0	181.5	4.00	2.94		0.00		0.00		0.00	0.00	0.62	3.14	0.88	3.82	20.24	94.58	200	0.35	0.624	16.42	81.13
Future Street	RES.5, 5A, Park3	EAST	302A					23.97	1421.4	1421.4	3.70	21.28		0.00		0.00		0.00	0.00	23.97	23.97	6.71	28.00							
GOLDHAWK DRIVE	302A	302A	301A	10				0.56	33.0	1635.9	3.65	24.20		0.00		0.00		0.00	0.00	0.56	27.67	7.75	31.95	50.44	70.68	300	0.25	0.691	18.49	36.66
GOLDHAWK DRIVE	301A	301A	207A	6				0.37	19.8	1655.7	3.65	24.47		0.00		0.00		0.00	0.00	0.37	28.04	7.85	32.32	50.44	70.00	300	0.25	0.691	18.12	35.93
STREET NO. 2	RES.4	EAST	207A					13.88	832.8	832.8	3.85	12.99		0.00		0.00		0.00	0.00	13.88	13.88	3.89	16.87							
GOLDHAWK DRIVE	207A	207A	206A	17				0.86	56.1	2544.6	3.50	36.10		0.00		0.00		0.00	0.00	0.86	42.78	11.98	48.08	70.84	107.19	375	0.15	0.621	22.76	32.13
GOLDHAWK DRIVE	206A	206A	205A	12				0.69	39.6	2584.2	3.50	36.60		0.00		0.00		0.00	0.00	0.69	43.47	12.17	48.78	70.84	106.61	375	0.15	0.621	22.07	31.15
GOLDHAWK DRIVE	205A	205A	110A	5				0.44	16.5	2600.7	3.49	36.81		0.00		0.00		0.00	0.00	0.44	43.91	12.29	49.11	70.84	100.61	375	0.15	0.621	21.73	30.68

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

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27970.5.7.1	2017-07-14	3 of 4

IBI GROUP

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

SANITARY SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				RESIDENTIAL									ICI AREAS							INFILTRATION ALLOWANCE			TOTAL	PROPOSED SEWER DESIGN						
				UNIT TYPES				AREA	POPULATION		PEAK	PEAK	AREA (Ha)						PEAK	AREA (Ha)		FLOW	FLOW	CAPACITY	LENGTH	DIA	SLOPE	VELOCITY	AVAILABLE CAPACITY	
STREET	AREA ID	FROM MH	TO MH	SF	SD	TH	APT	(Ha)	IND	CUM	FACTOR	FLOW (L/s)	INSTITUTIONAL IND	INSTITUTIONAL CUM	COMMERCIAL IND	COMMERCIAL CUM	INDUSTRIAL IND	INDUSTRIAL CUM	FLOW (L/s)	IND	CUM	(L/s)	(L/s)	(L/s)	(m)	(mm)	(%)	(full) (m/s)	L/s	(%)
																							0.00							
	LSPS	Allowance						0.00	0.0	0.0													108.00							
	STITTSVILLE 6 PS		110A					0.00	0.0	0.0				0.00		0.00		0.00	0.00				84.00							
Future Street	INST.3	BLKHD	110A					0.00	0.0	0.0			2.47	2.47		0.00		0.00	2.14											
	PARK4	BLKHD	110A					0.83	0.0	0.0				0.00		0.00		0.00	0.00											
	PARK5	BLKHD	110A					1.04	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.9	BLKHD	110A					34.81	2610.8	2610.8				0.00		0.00		0.00	0.00											
	RES.7	BLKHD	110A					4.24	318.0	318.0				0.00		0.00		0.00	0.00											
	RES.13	BLKHD	110A					2.22	133.2	133.2				0.00		0.00		0.00	0.00											
	RES.12	BLKHD	110A					43.89	2633.4	2633.4				0.00		0.00		0.00	0.00											
	INST.4	BLKHD	110A					0.00	0.0	0.0			2.44	2.44		0.00		0.00	2.12											
	COMM.	BLKHD	110A					0.00	0.0	0.0				0.00	0.63	0.63		0.00	0.55											
	HYD.4	BLKHD	110A					3.06	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.8	BLKHD	110A					2.30	172.5	172.5				0.00		0.00		0.00	0.00											
	HYD.5	BLKHD	110A					5.20	0.0	0.0				0.00		0.00		0.00	0.00											
Future Street	RES.11	BLKHD	110A					6.91	414.6	414.6				0.00		0.00		0.00	0.00											
	PARK6	BLKHD	110A					1.19	0.0	0.0				0.00		0.00		0.00	0.00											
	RES.10	BLKHD	110A					1.92	115.2	115.2				0.00		0.00		0.00	0.00											
	HYD.3	BLKHD	110A					6.31	0.0	0.0				0.00		0.00		0.00	0.00											
TOTAL		**BLKHD**	**110A**					**113.92**		**6397.7**	**3.14**	**81.49**		**4.91**		**0.63**		**0.00**	**4.81**	**119.46**	**119.46**	**33.45**	**311.74**	**320.28**	**24.02**	**600**	**0.25**	**1.097**	**8.54**	**2.67**
GOLDHAWK DRIVE		**110A**	**109A**					**0.00**	**0.0**	**9779.6**	**2.96**	**117.43**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**186.59**	**52.25**	**374.66**	**378.96**	**61.28**	**600**	**0.35**	**1.298**	**4.30**	**1.14**
GOLDHAWK DRIVE	**110A**	**1101A**	**1092A**	**1**				**0.18**	**3.3**	**3.3**	**4.00**	**0.05**								**0.18**	**0.18**	**0.05**	**0.10**	**28.63**	**61.28**	**200**	**0.70**	**0.883**	**28.52**	**99.64**
GOLDHAWK DRIVE		**109A**	**108A**					**0.00**	**0.0**	**9782.9**	**2.96**	**117.47**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**186.77**	**52.30**	**374.74**	**378.96**	**57.50**	**600**	**0.35**	**1.298**	**4.22**	**1.11**
GOLDHAWK DRIVE	**109A**	**1091A**	**1082A**	**5**				**0.32**	**16.5**	**16.5**	**4.00**	**0.27**								**0.32**	**0.32**	**0.09**	**0.36**	**28.63**	**57.50**	**200**	**0.70**	**0.883**	**28.27**	**98.75**
GOLDHAWK DRIVE		**108A**	**107A**					**0.00**	**0.0**	**9799.4**	**2.96**	**117.64**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.09**	**52.39**	**375.00**	**378.96**	**53.32**	**600**	**0.35**	**1.298**	**3.96**	**1.05**
GOLDHAWK DRIVE	**108A**	**1081A**	**1072A**	**4**				**0.30**	**13.2**	**13.2**	**4.00**	**0.21**							**0.00**	**0.30**	**0.30**	**0.08**	**0.30**	**28.63**	**53.32**	**200**	**0.70**	**0.883**	**28.33**	**98.96**
GOLDHAWK DRIVE		**107A**	**106A**					**0.00**	**0.0**	**9812.6**	**2.96**	**117.77**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.39**	**52.47**	**375.22**	**378.96**	**62.94**	**600**	**0.35**	**1.298**	**3.74**	**0.99**
GOLDHAWK DRIVE	**107A**	**1071A**	**1062A**	**7**				**0.31**	**23.1**	**23.1**	**4.00**	**0.37**		**0.00**		**0.00**		**0.00**	**0.00**	**0.31**	**0.31**	**0.09**	**0.46**	**28.63**	**62.94**	**200**	**0.70**	**0.883**	**28.17**	**98.39**
GOLDHAWK DRIVE		**106A**	**105A**					**0.00**	**0.0**	**9835.7**	**2.96**	**118.01**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**187.70**	**52.56**	**375.54**	**378.96**	**60.09**	**600**	**0.35**	**1.298**	**3.42**	**0.90**
GOLDHAWK DRIVE	**106A**	**1061A**	**1052A**	**2**				**0.24**	**6.6**	**6.6**	**4.00**	**0.11**		**0.00**		**0.00**		**0.00**	**0.00**	**0.24**	**0.24**	**0.07**	**0.17**	**28.63**	**60.09**	**200**	**0.70**	**0.883**	**28.45**	**99.39**
		105A	**104A**					**0.00**	**0.0**	**10558.3**	**2.93**	**125.37**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**200.47**	**56.13**	**386.48**	**389.64**	**72.85**	**600**	**0.37**	**1.335**	**3.16**	**0.81**
GOLDHAWK DRIVE	**105A**	**1051A**	**1042A**	**7**				**0.45**	**23.1**	**23.1**	**4.00**	**0.37**								**0.45**	**0.45**	**0.13**	**0.50**	**27.59**	**72.85**	**200**	**0.65**	**0.851**	**27.09**	**98.19**
GOLDHAWK DRIVE		**104A**	**103A**					**0.00**	**0.0**	**10581.4**	**2.93**	**125.60**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**200.92**	**56.26**	**386.84**	**389.64**	**48.77**	**600**	**0.37**	**1.335**	**2.80**	**0.72**
GOLDHAWK DRIVE	**104A**	**1041A**	**1032A**	**9**				**0.47**	**29.7**	**29.7**	**4.00**	**0.48**							**0.00**	**0.47**	**0.47**	**0.13**	**0.61**	**27.59**	**48.77**	**200**	**0.65**	**0.851**	**26.97**	**97.78**
GOLDHAWK DRIVE		**103A**	**102A**					**0.00**	**0.0**	**10611.1**	**2.93**	**125.90**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**201.39**	**56.39**	**387.27**	**389.64**	**45.00**	**600**	**0.37**	**1.335**	**2.37**	**0.61**
GOLDHAWK DRIVE	**103A, HYD1**	**1031A**	**1021A**	**6**				**2.01**	**19.8**	**19.8**	**4.00**	**0.32**							**0.00**	**2.01**	**2.01**	**0.56**	**0.88**	**27.59**	**45.00**	**200**	**0.65**	**0.851**	**26.70**	**96.80**
GOLDHAWK DRIVE	**102A**	**102A**	***FT-24 (EX)***					**0.12**	**0.0**	**10630.9**	**2.93**	**126.10**		**14.32**		**0.63**		**0.00**	**12.98**	**0.12**	**203.52**	**56.99**	**388.07**	**389.64**	**102.59**	**600**	**0.37**	**1.335**	**1.57**	**0.40**
HYDRO EASEMENT		***FT-24 (EX)***	***FT-23 (EX)***					**0.00**	**0.0**	**10650.7**	**2.93**	**126.30**		**14.32**		**0.63**		**0.00**	**12.98**	**0.00**	**205.53**	**57.55**	**388.83**	**400.03**	**107.50**	**600**	**0.39**	**1.371**	**11.20**	**2.80**

Design Parameters:

Residential			ICI Areas			Peak Factor
SF	3.3	p/p/u	INST	50,000	L/Ha/day	1.5
TH/SD	2.5	p/p/u	COM	50,000	L/Ha/day	1.5
APT	1.8	p/p/u	IND	35,000	L/Ha/day	MOE Chart
Low	60	p/p/Ha				
Med	75	p/p/Ha				
High	90	p/p/Ha				

Notes:
1. Mannings coefficient (n) = 0.013
2. Demand (per capita): 350 L/day
3. Infiltration allowance: 0.28 L/s/Ha
4. Residential Peaking Factor:
Harmon Formula = 1+(14/(4+P^0.5))
where P = population in thousands

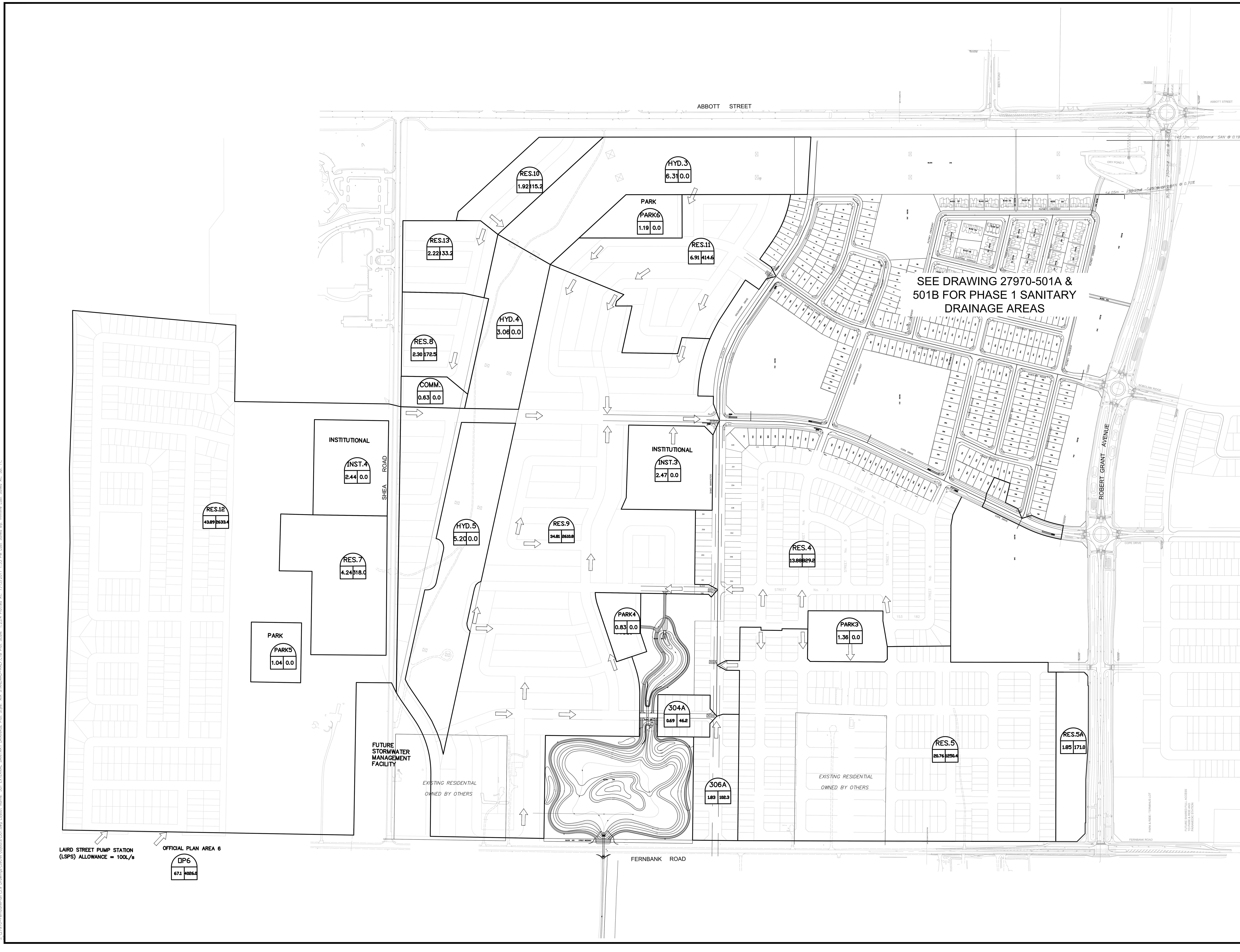
Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 501, 501A, 501B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	4 of 4



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2017

Plan Number ____________________

LEGEND :

145A / 0.38 / 27.5 — AREA IDENTIFICATION; POPULATION; AREA IN HECTARES

FUTURE MINOR FLOW DIRECTION

POPULATION :

SINGLE FAMILY = 3.4 PPU
TOWNHOUSE / SEMIS = 2.7 PPU

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

EXTERNAL SANITARY DRAINAGE

AREA PLAN

Scale 1:3000

Design	Date
J.I.M.	OCTOBER '12
Drawn	Checked
M.M.	P.K.
Project No.	Drawing No.
27970	501

D07-16-11-0003

#17366

CONT'D ON DWG
27970-501B

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

145A — AREA ID #
0.34 | 27.5 — POPULATION
AREA IN HECTARES
FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

IBI GROUP
400 – 333 Preston Street
Ottawa ON K1S 5N4 Canada
tel 613 225 1311 fax 613 225 9868
ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

SANITARY DRAINAGE
AREA PLAN

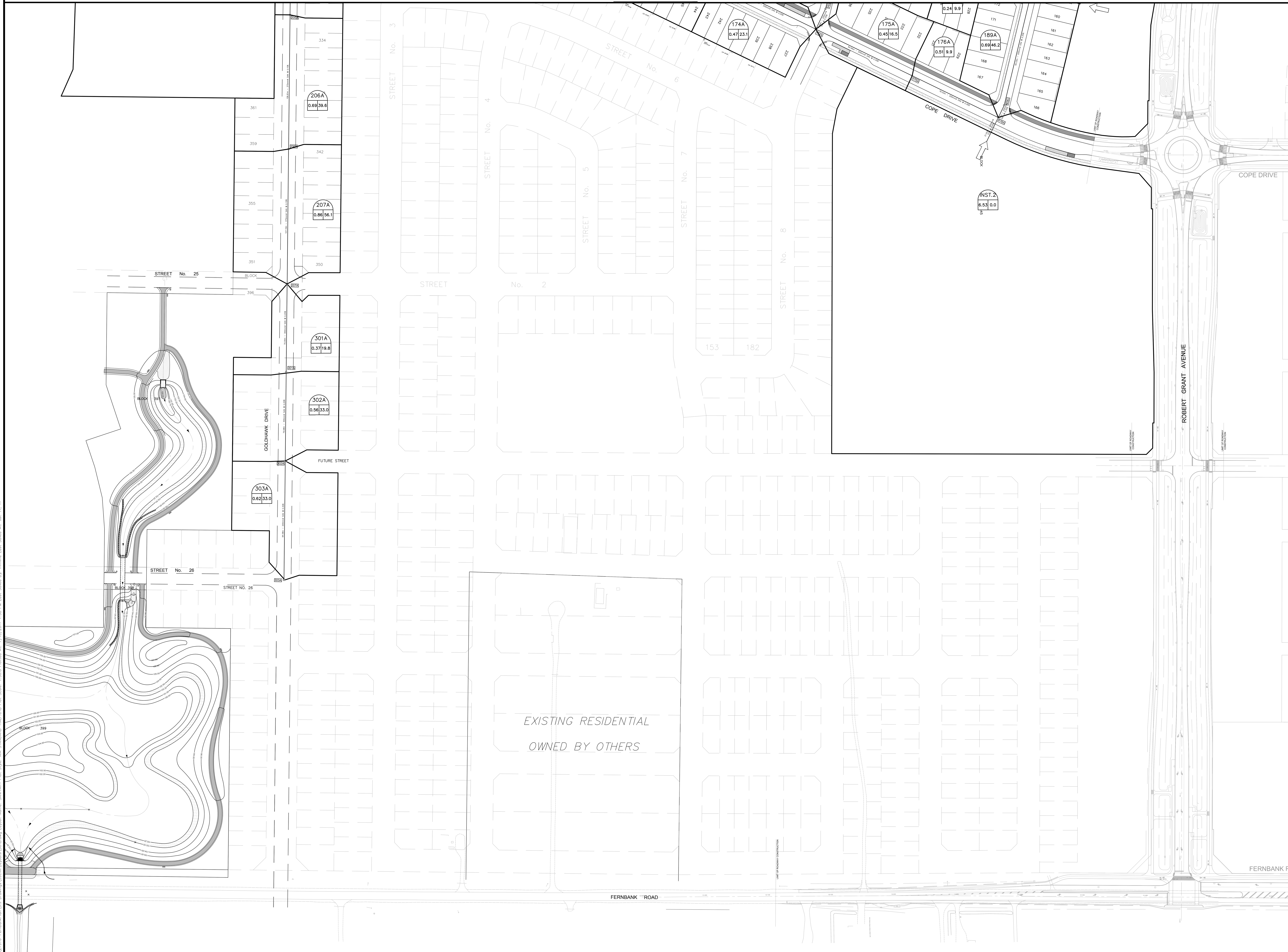
Scale 1:1250

Design	Date
J.I.M.	OCTOBER '12
Drawn	Checked
M.M.	P.K.
Project No.	Drawing No.
27970	501A

D07-16-11-0003

#17366

CONT'D ON DWG
27970-501A



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed

Date 2017

Plan Number

LEGEND :

145A 0.34 27.5 — AREA ID # — POPULATION — AREA IN HECTARES

FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

IBI GROUP
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ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

N

Drawing Title

SANITARY DRAINAGE
AREA PLAN

Scale 1:1250

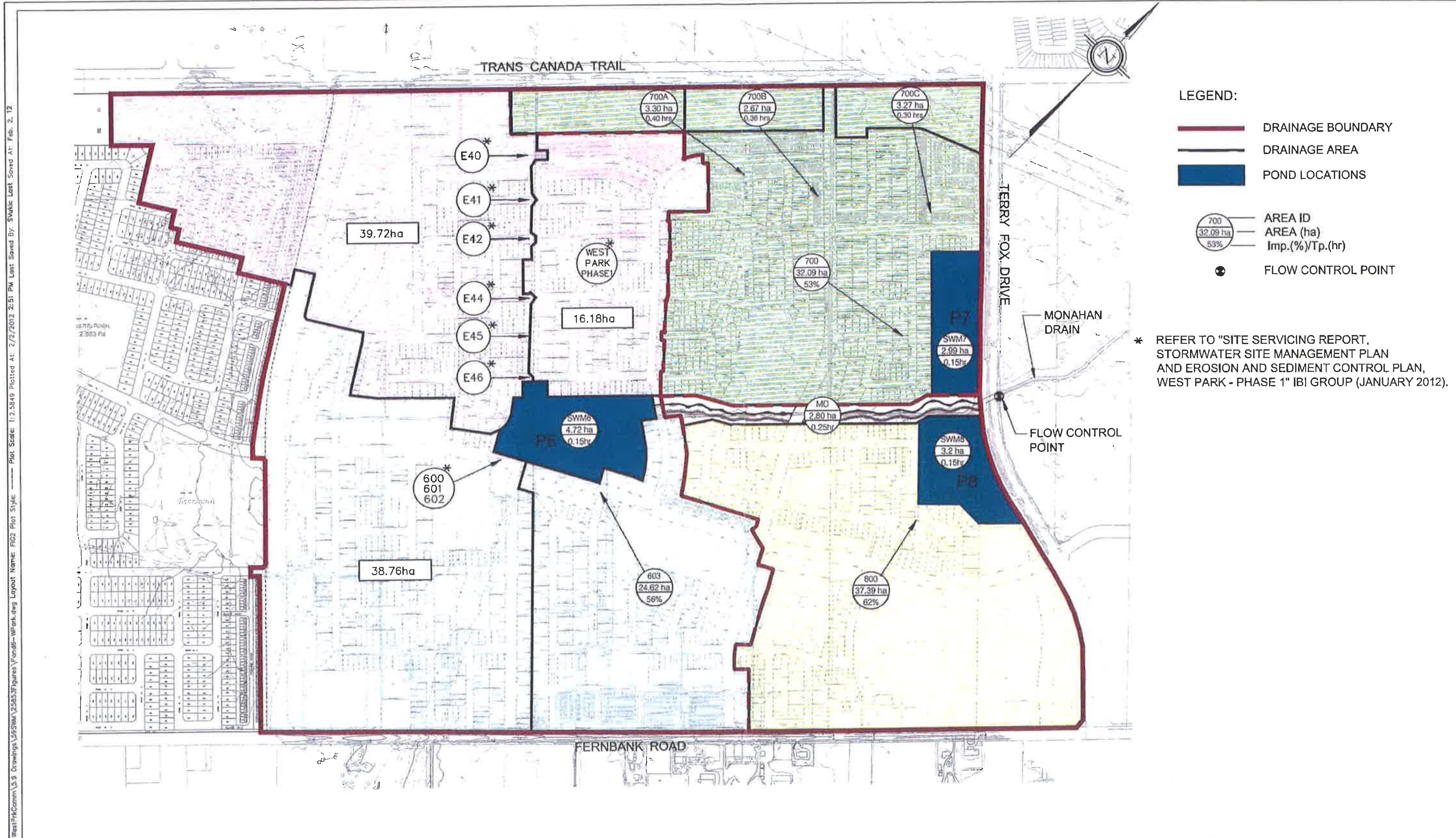
Design J.I.M.	Date OCTOBER '12
Drawn M.M.	Checked P.K.
Project No. 27970	Drawing No. 501B

D07-16-11-0003

#17366

APPENDIX E

- **Figure 2 – West Park Pond 6 Stormwater Management Report and Design Brief**
- **MSS Storm Drainage Area Plan Minor System Drainage (Drawing 101108-STM1)**
- **Storm Sewer Design Sheets**
- **Drainage Area Plans 500, 500A and 500B**



IBI GROUP

Scale

1:7500

Project Title

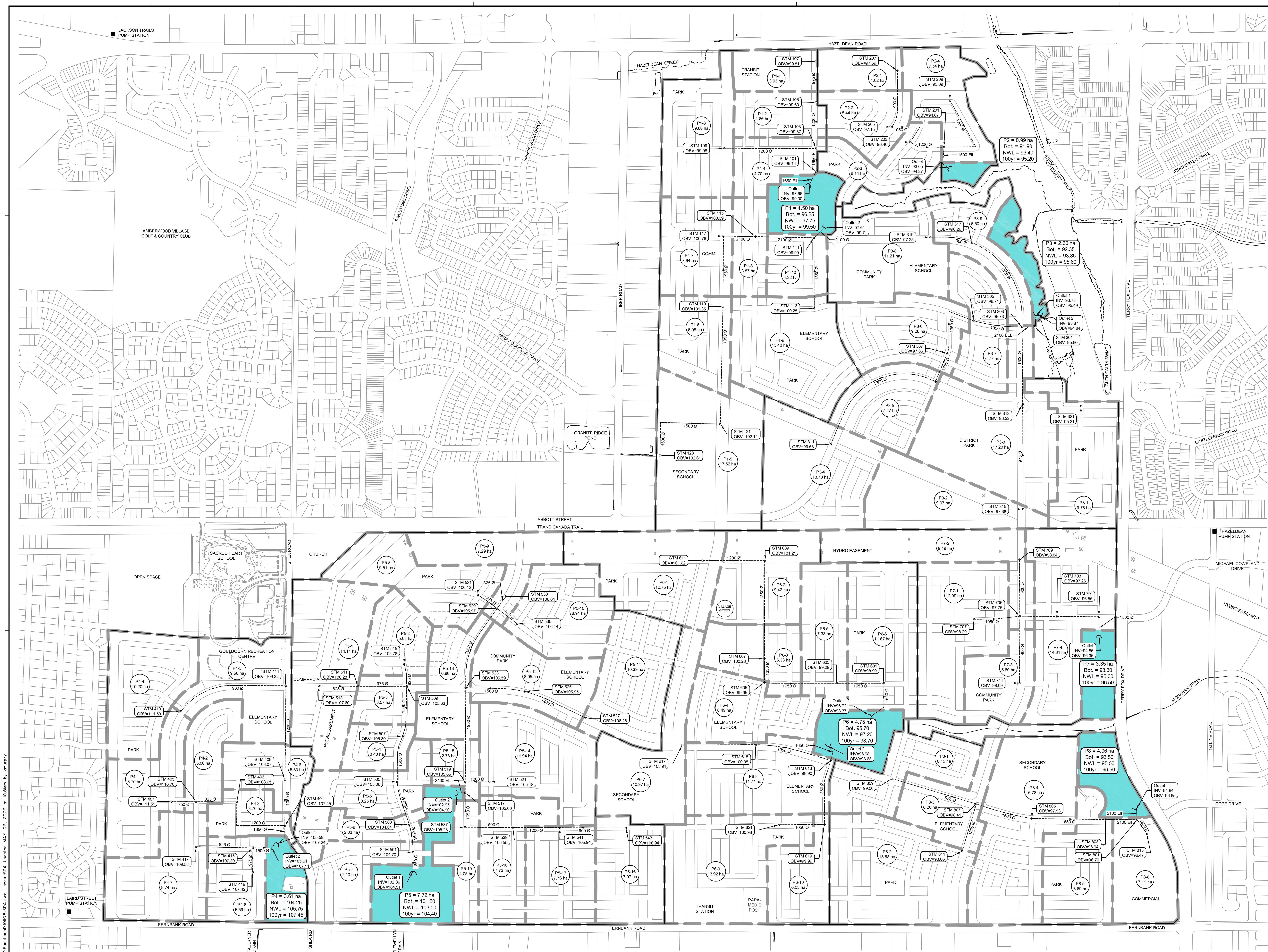
WEST PARK POND 6
STORMWATER MANAGEMENT
REPORT AND DESIGN BRIEF

Drawing Title

POST-DEVELOPMENT
DRAINAGE AREA PLAN

Sheet No.

FIGURE 2



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

No.	REVISION	DATE	BY
3	ISSUED WITH MASTER SERVICING STUDY	MAY 25/09	MAB
2	UPDATED WITH DRAFT MASTER SERVICING STUDY	SEP 12/08	MAB
1	ISSUED WITH DRAFT MASTER SERVICING STUDY	MAY 02/08	MAB

LICENSED PROFESSIONAL ENGINEER M.A. BISSETT PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER J.G. RIDDELL PROVINCE OF ONTARIO

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

DESIGN	KJM
CHECKED	MAB
DRAWN	KJM
CHECKED	MAB
APPROVED	JGR

SCALE 1 : 5000

CITY OF OTTAWA
FERNBANK CDP

STORM DRAINAGE AREA PLAN
MINOR SYSTEM DRAINAGE

PROJECT No. 101108-0
DATE AUGUST 2007
DRAWING No. 101108-STM1

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

STORM SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				AREA (Ha)										RATIONAL DESIGN FLOW													SEWER DATA								
STREET	AREA ID	FROM MH	TO MH	C= 0.20	C= 0.55	C= 0.65	C= 0.66	C= 0.75	C= 0.80	C= 0.90	C=	C=	C=	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr) (L/s)	(%)
PUTNEY CRESCENT	---	141	142					0.00						0.00	0.00	10.00	0.12	10.12	104.19	122.14	178.56	0.00				0.00	62.04	8.84	250			1.00	1.224	62.04	100.00%
PUTNEY CRESCENT	R142A, B	142	143		0.33									0.50	0.50	10.12	0.48	10.60	103.56	121.40	177.47	52.25				52.25	139.06	54.71	300			1.90	1.906	86.80	62.42%
PUTNEY CRESCENT	S143	143	144					0.32						0.67	1.17	10.60	0.68	11.28	101.13	118.54	173.26	118.50				118.50	266.03	65.86	450			0.80	1.620	147.53	55.45%
FINSBURY AVENUE	S136B, E, R136A	136	144		0.27			0.44						1.33	1.33	10.00	0.87	10.87	104.19	122.14	178.56	138.60				138.60	154.65	110.07	300			2.35	2.119	16.05	10.38%
PUTNEY CRESCENT	S144, R144A, B, C	144	145		0.57			0.25						1.39	3.89	11.28	0.74	12.02	97.90	114.73	167.68	381.31				381.31	401.29	80.25	525			0.80	1.796	19.98	4.98%
CLAPHAM TERRACE	S136C, D, R136B	136	137		0.23			0.18						0.73	0.73	10.00	0.94	10.94	104.19	122.14	178.56	75.75				75.75	100.88	77.99	300			1.00	1.383	25.14	24.92%
BRIXTON WAY	R137A	137	160		0.11									0.17	0.90	10.94	0.42	11.36	99.48	116.59	170.40	89.05				89.05	224.02	50.00	375			1.50	1.965	134.97	60.25%
BRIXTON WAY	S160A, B	160	145					0.43						0.90	1.79	11.36	0.54	11.90	97.50	114.26	166.98	174.69				174.69	280.40	78.98	375			2.35	2.459	105.71	37.70%
PUTNEY CRESCENT	S145A, B, R145	145	146		0.30			0.55						1.61	7.29	12.02	0.70	12.72	94.61	110.85	161.98	689.86				689.86	821.24	75.47	750			0.50	1.801	131.38	16.00%
CLAPHAM TERRACE	S137A, B, R137B	137	138		0.30			0.27						1.02	1.02	10.00	1.19	11.19	104.19	122.14	178.56	106.45				106.45	129.34	81.01	375			0.50	1.134	22.89	17.70%
PUTNEY CRESCENT	S138, R138	138	148		0.14			0.15						0.53	1.55	11.19	0.67	11.86	98.30	115.20	168.37	152.21				152.21	220.25	78.01	375			1.45	1.932	68.04	30.89%
PUTNEY CRESCENT	S148	148	147					0.22						0.46	2.01	11.86	0.38	12.24	95.28	111.65	163.15	191.25				191.25	297.76	59.30	375			2.65	2.612	106.51	35.77%
PUTNEY CRESCENT	---	147	146					0.00						0.00	2.01	12.24	0.10	12.34	93.68	109.76	160.37	188.02				188.02	332.54	12.13	450			1.25	2.026	144.52	43.46%
BLOCK 324		146	161											0.00	9.30	12.72	0.40	13.12	91.73	107.47	157.01	853.01				853.01	944.29	34.88	900			0.25	1.438	91.28	9.67%
BLOCK 324	R146	161	*Ex. 180*		0.14									0.21	9.51	13.12	0.56	13.68	90.15	105.61	154.28	857.65				857.65	944.29	48.00	900			0.25	1.438	86.65	9.18%
BLOCK 324	RES.1, RES. 2B	BULKHEAD	*Ex. 180*						2.45					5.45	5.45	13.00	0.07	13.07	90.63	106.17	155.11	493.82				493.82	731.45	5.00	900			0.15	1.114	237.62	32.49%
														Refer to ECA No. 9079-9LNNZC dated July 9, 2014 for description of existing sewers.																					

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1174.184 / (TC+6.014)^0.816] 10 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: J.I.M.
Checked: P.K.
Dwg. Reference: 27970 - 500, 500A, 500B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	1 of 3

IBI GROUP

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

STORM SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION / AREA (Ha)

STREET	AREA ID	FROM MH	TO MH	C= 0.20	C= 0.55	C= 0.65	C= 0.66	C= 0.75	C= 0.80	C= 0.90	C=	C=	C=
CLAPHAM TERRACE	S136A	136	135					0.17					
CLAPHAM TERRACE	S135A, B	135	134					0.26					
PUTNEY CRESCENT	---	141	134		0.00								
PUTNEY CRESCENT	S134A, B, C, R134	134	140		0.21			0.39					
OSTERLEY WAY	S153	153	152					0.12					
OSTERLEY WAY	S152A, B	152	151					0.40					
OSTERLEY WAY	S151A, R151A	151	150		0.18			0.10					
OSTERLEY WAY	S150A, B	150	140					0.32					
PUTNEY CRESCENT	S140, R140	140	124		0.21			0.25					
PUTNEY CRESCENT	S149A, B, S129C	149	128					0.22					
BLOCK 343	RES.2A	BULKHEAD	129						0.65				
BOBOLINK RIDGE		129	128					0.00					
BOBOLINK RIDGE	S128A, R128A	128	127		0.14			0.18					
BOBOLINK RIDGE	S127A, R127A	127	126		0.19			0.17					
FINSBURY AVENUE	S151B, C, R151B	151	126		0.20			0.25					
BOBOLINK RIDGE	---	126	125					0.00					
BOBOLINK RIDGE	S125, R125A, B	125	124		0.35			0.39					
BOBOLINK RIDGE	S124, R124A, B	124	123		0.32			0.26					
DAGENHAM STREET	R131	131	130		0.20								
DAGENHAM STREET	S130, R130A, B	130	123		0.33			0.36					
BOBOLINK RIDGE	---	123	122		0.00								
BOBOLINK RIDGE	S122, R122	122	121		0.17			0.31					
BOBOLINK RIDGE	R121	121	120		0.13								
ANGEL HEIGHTS	---	111	112		0.00								
ANGEL HEIGHTS	S112, R112A, B	112	113		0.20			0.27					
DAGENHAM STREET	PARK1	DICB	132	1.27									
DAGENHAM STREET	S132	132	113					0.24					
ANGEL HEIGHTS	S113	113	114					0.30					
ANGEL HEIGHTS	S114, R114	114	120		0.50			0.24					
BOBOLINK RIDGE	S120	120	105					0.28					
ANGEL HEIGHTS	S101	101	102					0.20					
GOLDHAWK DRIVE	R102	102	103		0.21								
GOLDHAWK DRIVE	S103, R103A, B	103	104		0.50			0.34					
GOLDHAWK DRIVE	S104, R104A, B, C	104	105		0.59			0.30					
GOLDHAWK DRIVE	S105A, S105B, R105	105	107		0.13	0.90							
GOLDHAWK DRIVE	S107	107	109			0.61							
GOLDHAWK DRIVE	S109	109	110			0.52							

RATIONAL DESIGN FLOW

STREET	AREA ID	FROM MH	TO MH	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)
CLAPHAM TERRACE	S136A	136	135	0.35	0.35	10.00	1.03	11.03	104.19	122.14	178.56	36.93				36.93
CLAPHAM TERRACE	S135A, B	135	134	0.54	0.90	11.03	1.08	12.11	99.05	116.08	169.66	88.80				88.80
PUTNEY CRESCENT	---	141	134	0.00	0.00	10.00	1.31	11.31	104.19	122.14	178.56	0.00				0.00
PUTNEY CRESCENT	S134A, B, C, R134	134	140	1.13	2.03	12.11	1.10	13.21	94.22	110.39	161.31	191.34				191.34
OSTERLEY WAY	S153	153	152	0.25	0.25	10.00	1.04	11.04	104.19	122.14	178.56	26.07				26.07
OSTERLEY WAY	S152A, B	152	151	0.83	1.08	11.04	1.82	12.85	99.02	116.05	169.61	107.36				107.36
OSTERLEY WAY	S151A, R151A	151	150	0.48	1.57	12.85	0.96	13.81	91.21	106.85	156.10	143.00				143.00
OSTERLEY WAY	S150A, B	150	140	0.67	2.24	13.81	0.91	14.72	87.62	102.63	149.90	195.83				195.83
PUTNEY CRESCENT	S140, R140	140	124	0.84	5.11	14.72	0.91	15.63	84.48	98.93	144.48	431.53				431.53
PUTNEY CRESCENT	S149A, B, S129C	149	128	0.46	0.46	10.00	0.61	10.61	104.19	122.14	178.56	47.79				47.79
BLOCK 343	RES.2A	BULKHEAD	129	1.45	1.45	13.00	0.27	13.27	90.63	106.17	155.11	131.01				131.01
BOBOLINK RIDGE		129	128	0.00	1.45	13.00	0.91	13.91	90.63	106.17	155.11	131.01				131.01
BOBOLINK RIDGE	S128A, R128A	128	127	0.59	2.49	13.91	1.57	15.49	87.25	102.19	149.26	217.56				217.56
BOBOLINK RIDGE	S127A, R127A	127	126	0.64	3.14	15.49	1.51	17.00	82.02	96.05	140.25	257.44				257.44
FINSBURY AVENUE	S151B, C, R151B	151	126	0.83	0.83	10.00	0.79	10.79	104.19	122.14	178.56	86.17				86.17
BOBOLINK RIDGE	---	126	125	0.00	3.97	17.00	0.81	17.81	77.61	90.86	132.63	307.77				307.77
BOBOLINK RIDGE	S125, R125A, B	125	124	1.35	5.31	17.81	1.39	19.20	75.45	88.32	128.91	400.95				400.95
BOBOLINK RIDGE	S124, R124A, B	124	123	1.03	11.45	19.20	1.23	20.44	72.05	84.32	123.05	825.24				825.24
DAGENHAM STREET	R131	131	130	0.31	0.31	10.00	0.84	10.84	104.19	122.14	178.56	31.86				31.86
DAGENHAM STREET	S130, R130A, B	130	123	1.26	1.56	10.84	1.75	12.59	99.94	117.13	171.20	156.00				156.00
BOBOLINK RIDGE	---	123	122	0.00	13.01	20.44	0.30	20.74	69.31	81.11	118.33	902.05				902.05
BOBOLINK RIDGE	S122, R122	122	121	0.91	13.92	20.74	0.39	21.13	68.68	80.36	117.24	956.05				956.05
BOBOLINK RIDGE	R121	121	120	0.20	14.12	21.13	0.37	21.50	67.86	79.41	115.84	958.22				958.22
ANGEL HEIGHTS	---	111	112	0.00	0.00	10.00	0.27	10.27	104.19	122.14	178.56	0.00				0.00
ANGEL HEIGHTS	S112, R112A, B	112	113	0.87	0.87	10.27	1.68	11.95	102.77	120.47	176.10	89.29				89.29
DAGENHAM STREET	PARK1	DICB	132	0.71	0.71	12.00	0.29	12.29	94.70	110.96	162.13	66.87				66.87
DAGENHAM STREET	S132	132	113	0.50	1.21	12.29	0.55	12.83	93.49	109.54	160.05	112.80				112.80
ANGEL HEIGHTS	S113	113	114	0.63	1.49	12.83	0.85	13.68	91.29	106.94	156.24	136.40				136.40
ANGEL HEIGHTS	S114, R114	114	120	1.26	2.76	13.68	1.43	15.11	88.09	103.18	150.72	243.05				243.05
BOBOLINK RIDGE	S120	120	105	0.58	17.46	21.50	0.96	22.45	67.13	78.54	114.57	1,172.18				1,172.18
ANGEL HEIGHTS	S101	101	102	0.42	0.42	10.00	0.52	10.52	104.19	122.14	178.56	43.45				43.45
GOLDHAWK DRIVE	R102	102	103	0.32	0.74	10.52	0.83	11.35	101.52	118.99	173.93	74.93				74.93
GOLDHAWK DRIVE	S103, R103A, B	103	104	1.47	2.21	11.35	1.01	12.36	97.55	114.32	167.07	215.73				215.73
GOLDHAWK DRIVE	S104, R104A, B, C	104	105	1.53	3.74	12.36	1.35	13.71	93.19	109.19	159.53	348.45				348.45
GOLDHAWK DRIVE	S105A, S105B, R105	105	107	1.83	23.03	22.45	1.31	23.77	65.29	76.38	111.40	1,503.33				1,503.33
GOLDHAWK DRIVE	S107	107	109	1.10	24.13	23.77	1.17	24.94	62.94	73.62	107.36	1,518.58				1,518.58
GOLDHAWK DRIVE	S109	109	110	0.94	25.07	24.94	0.67	25.62	60.99	71.33	104.01	1,528.92				1,528.92

SEWER DATA

STREET	AREA ID	FROM MH	TO MH	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr) (L/s)	(%)
CLAPHAM TERRACE	S136A	136	135	50.02	61.00	250			0.65	0.987	13.09	26.16%
CLAPHAM TERRACE	S135A, B	135	134	108.21	61.66	375			0.35	0.949	19.41	17.94%
PUTNEY CRESCENT	---	141	134	108.21	74.74	375			0.35	0.949	108.21	100.00%
PUTNEY CRESCENT	S134A, B, C, R134	134	140	265.43	78.10	525			0.35	1.188	74.09	27.91%
OSTERLEY WAY	S153	153	152	43.87	53.80	250			0.50	0.866	17.80	40.57%
OSTERLEY WAY	S152A, B	152	151	148.72	98.72	450			0.25	0.906	41.36	27.81%
OSTERLEY WAY	S151A, R151A	151	150	170.86	59.71	450			0.33	1.041	27.86	16.30%
OSTERLEY WAY	S150A, B	150	140	257.73	63.00	525			0.33	1.153	61.90	24.02%
PUTNEY CRESCENT	S140, R140	140	124	636.13	76.57	750			0.30	1.395	204.60	32.16%
PUTNEY CRESCENT	S149A, B, S129C	149	128	62.04	45.00	250			1.00	1.224	14.25	22.96%
BLOCK 343	RES.2A	BULKHEAD	129	303.78	13.50	675			0.12	0.822	172.76	56.87%
BOBOLINK RIDGE		129	128	303.78	45.00	675			0.12	0.822	172.76	56.87%
BOBOLINK RIDGE	S128A, R128A	128	127	473.55	81.00	825			0.10	0.858	255.99	54.06%
BOBOLINK RIDGE	S127A, R127A	127	126	473.55	78.00	825			0.10	0.858	216.11	45.64%
FINSBURY AVENUE	S151B, C, R151B	151	126	117.21	76.50	300			1.35	1.606	31.04	26.48%
BOBOLINK RIDGE	---	126	125	597.22	44.30	900			0.10	0.909	289.46	48.47%
BOBOLINK RIDGE	S125, R125A, B	125	124	739.33	80.07	975			0.10	0.959	338.38	45.77%
BOBOLINK RIDGE	S124, R124A, B	124	123	1,760.81	88.10	1350			0.10	1.192	935.57	53.13%
DAGENHAM STREET	R131	131	130	59.68	41.39	300			0.35	0.818	27.82	46.61%
DAGENHAM STREET	S130, R130A, B	130	123	179.46	84.37	525			0.16	0.803	23.46	13.07%
BOBOLINK RIDGE	---	123	122	1,760.81	21.46	1350			0.10	1.192	858.77	48.77%
BOBOLINK RIDGE	S122, R122	122	121	3,040.59	39.49	1500			0.17	1.667	2084.54	68.56%
BOBOLINK RIDGE	R121	121	120	3,040.59	36.84	1500			0.17	1.667	2082.37	68.49%
ANGEL HEIGHTS	---	111	112	42.08	13.58	250			0.46	0.830	42.08	100.00%
ANGEL HEIGHTS	S112, R112A, B	112	113	139.51	85.60	450			0.22	0.850	50.22	36.00%
DAGENHAM STREET	PARK1	DICB	132	100.88	23.70	300			1.00	1.383	34.02	33.72%
DAGENHAM STREET	S132	132	113	210.32	42.00	450			0.50	1.281	97.52	46.37%
ANGEL HEIGHTS	S113	113	114	248.09	43.13	600			0.15	0.850	111.69	45.02%
ANGEL HEIGHTS	S114, R114	114	120	367.27	69.17	750			0.10	0.805	124.22	33.82%
BOBOLINK RIDGE	S120	120	105	3,040.59	95.64	1500			0.17	1.667	1868.41	61.45%
ANGEL HEIGHTS	S101	101	102	129.34	35.48	375			0.50	1.134	85.89	66.41%
GOLDHAWK DRIVE	R102	102	103	126.19	38.36	450			0.18	0.769	51.26	40.62%
GOLDHAWK DRIVE	S103, R103A, B	103	104	303.78	49.62	675			0.12	0.822	88.05	28.98%
GOLDHAWK DRIVE	S104, R104A, B, C	104	105	473.55	69.59	825			0.10	0.858	125.10	26.42%
GOLDHAWK DRIVE	S105A, S105B, R105	105	107	5,720.16	126.10	2100			0.10	1.600	4216.82	73.72%
GOLDHAWK DRIVE	S107	107	109	5,720.16	112.64	2100			0.10	1.600	4201.58	73.45%
GOLDHAWK DRIVE	S109	109	110	5,720.16	64.64	2100			0.10	1.600	4191.24	73.27%

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Checked: P.K.
Dwg. Reference: 27970 - 500, 500A, 500B

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File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	2 of 3

IBI Group
400-333 Preston Street
Ottawa, Ontario
K1S 5N4

STORM SEWER DESIGN SHEET

PROJECT: CRT DEVELOPMENT
LOCATION: CITY OF OTTAWA
CLIENT: CRT DEVELOPMENT INC.

LOCATION				AREA (Ha)										RATIONAL DESIGN FLOW													SEWER DATA								
STREET	AREA ID	FROM MH	TO MH	C= 0.20	C= 0.55	C= 0.65	C= 0.66	C= 0.75	C= 0.80	C= 0.90	C=	C=	C=	IND 2.78AC	CUM 2.78AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr) (L/s)	(%)
EMBANKMENT STREET	S128B, R128B	128	188		0.09			0.31						0.78	0.78	10.00	1.76	11.76	104.19	122.14	178.56	81.68				81.68	108.21	100.00	375			0.35	0.949	26.53	24.52%
EMBANKMENT STREET	S188, R188A, B	188	189		0.19			0.30						0.92	1.70	11.76	0.97	12.72	95.75	112.20	163.96	162.77				162.77	210.32	74.32	450			0.50	1.281	47.54	22.61%
BLOCK 344	RES.3	BULKHEAD	189						1.58					3.51	3.51	*13.95*	0.66	14.61	87.11	102.03	149.03	306.10				306.10	402.33	35.00	750			0.12	0.882	96.23	23.92%
EMBANKMENT STREET	S189, R189	189	190		0.09			0.28						0.72	5.94	14.61	1.69	16.30	84.83	99.35	145.10	503.52				503.52	739.33	97.00	975			0.10	0.959	235.81	31.89%
EMBANKMENT STREET	S190	190	176					0.05						0.10	6.04	16.30	0.20	16.50	79.59	93.19	136.05	480.69				480.69	739.33	11.54	975			0.10	0.959	258.64	34.98%
COPE DRIVE	S177, R177	177	176		0.08			0.14						0.41	0.41	10.00	1.17	11.17	104.19	122.14	178.56	43.16				43.16	59.68	57.46	300			0.35	0.818	16.52	27.69%
BLOCK 345 (SCHOOL)	INST.2	BULKHEAD	176						6.57					14.61	14.61	12.00	0.15	12.15	94.70	110.96	162.13	1,383.66				1,383.66	1,575.26	12.00	1200			0.15	1.349	191.60	12.16%
COPE DRIVE	S176	176	175					0.14						0.29	21.36	16.50	1.05	17.55	79.01	92.51	135.05	1,687.52				1,687.52	2,332.02	80.65	1500			0.10	1.278	644.51	27.64%
COPE DRIVE	S175, R175	175	174		0.36			0.42						1.43	22.78	17.55	1.12	18.67	76.14	89.13	130.09	1,734.64				1,734.64	2,332.02	86.28	1500			0.10	1.278	597.38	25.62%
FINSBURY AVENUE	S182A,B, R182A,B,C	182	183		0.58			0.58						2.10	2.10	10.00	1.57	11.57	104.19	122.14	178.56	218.40				218.40	283.76	119.30	525			0.40	1.270	65.35	23.03%
PINNER ROAD	S191, R191A	191	186		0.19			0.60						1.54	1.54	10.00	0.55	10.55	104.19	122.14	178.56	160.61				160.61	378.96	43.00	600			0.35	1.298	218.35	57.62%
BELSIZE WAY	S127B, R127B, C	127	185		0.41			0.26						1.17	1.17	10.00	1.31	11.31	104.19	122.14	178.56	121.80				121.80	188.11	90.00	450			0.40	1.146	66.31	35.25%
BELSIZE WAY	---	185	186											0.00	1.17	11.31	1.29	12.60	97.75	114.56	167.42	114.27				114.27	175.96	82.92	450			0.35	1.072	61.69	35.06%
PINNER ROAD	S186, R186	186	187		0.23			0.23						0.83	3.54	12.60	1.38	13.97	92.21	108.04	157.85	326.60				326.60	473.55	70.83	825			0.10	0.858	146.95	31.03%
PINNER ROAD	---	187	183					0.00						0.00	3.54	13.97	0.19	14.17	87.03	101.93	148.88	308.22				308.22	473.55	10.00	825			0.10	0.858	165.33	34.91%
FINSBURY AVENUE	S183, R183	183	184		0.22			0.24						0.84	6.47	14.17	1.14	15.30	86.34	101.13	147.71	559.05				559.05	900.87	68.70	1050			0.10	1.008	341.82	37.94%
FINSBURY AVENUE	---	184	174					0.00						0.00	6.47	15.30	0.32	15.62	82.59	96.71	141.22	534.72				534.72	900.87	19.07	1050			0.10	1.008	366.15	40.64%
COPE DRIVE	S174, R174	174	173		0.12			0.25						0.70	29.96	18.67	0.94	19.61	73.30	85.80	125.21	2,196.41				2,196.41	3,792.13	81.44	1800			0.10	1.444	1595.72	42.08%
COPE DRIVE	S173	173	172					0.29						0.60	30.57	19.61	0.84	20.46	71.11	83.22	121.43	2,173.69				2,173.69	3,792.13	73.01	1800			0.10	1.444	1618.44	42.68%
BLOCK 313 (SCHOOL)	INST.1	BULKHEAD	172						2.88					6.41	6.41	12.00	0.25	12.25	94.70	110.96	162.13	606.54				606.54	755.43	17.02	900			0.16	1.150	148.90	19.71%
COPE DRIVE	S172	172	171					0.23						0.48	37.45	20.46	0.93	21.39	69.27	81.05	118.25	2,594.13				2,594.13	3,792.13	80.84	1800			0.10	1.444	1198.00	31.59%
DAGENHAM STREET	S180A,B, R180A	180	181		0.09			0.37						0.91	0.91	10.00	1.42	11.42	104.19	122.14	178.56	94.72				94.72	245.74	94.00	525			0.30	1.100	151.02	61.46%
DAGENHAM STREET	S181, R181	181	171		0.09			0.14						0.43	1.34	11.42	1.23	12.66	97.23	113.94	166.51	130.14				130.14	286.47	72.50	600			0.20	0.982	156.32	54.57%
COPE DRIVE	S171	171	170					0.26						0.54	39.33	21.39	0.94	22.33	67.34	78.79	114.94	2,648.73				2,648.73	3,792.13	81.06	1800			0.10	1.444	1143.40	30.15%
BLOCK 312	RES.3A	CBMH549	sewer				3.26							5.98	5.98	12.00	0.22	12.22	94.70	110.96	162.13	566.42				566.42	844.60	16.74	900			0.20	1.286	278.18	32.94%
COPE DRIVE	S170A,B	170	110					0.33						0.69	46.00	22.33	1.33	23.66	65.53	76.66	111.82	3,014.45				3,014.45	4,694.42	121.89	1950			0.10	1.523	1679.97	35.79%
GOLDHAWK DRIVE	S110B	110	205			0.47								0.85	71.92	25.62	0.83	26.45	59.93	70.09	102.19	4,310.29				4,310.29	11,180.46	94.32	2700			0.10	1.892	6870.17	61.45%
														0.00																					
GOLDHAWK DRIVE	INST.3	BULKHEAD	205						2.47					5.49	5.49	12.00	0.17	12.17	94.70	110.96	162.13	520.19				520.19	620.09	17.00	675			0.50	1.679	99.90	16.11%
GOLDHAWK DRIVE	205A, 205B	205	206			1.46								2.64	80.05	26.45	0.94	27.39	58.68	68.62	100.04	4,697.53				4,697.53	11,180.46	107.00	2700			0.10	1.892	6482.93	57.98%
GOLDHAWK DRIVE	S206	206	207			0.84								1.52	81.57	27.39	0.90	28.29	57.33	67.04	97.72	4,676.48				4,676.48	11,726.17	107.16	2700			0.11	1.984	7049.69	60.12%
														0.00																					
STREET NO. 2	RES. 4, 6 & 7		207			22.96			1.89					45.69	45.69	10.00	0.83	10.83	104.19	122.14	178.56	4,760.80				4,760.80	5,720.16	80.00	2100			0.10	1.600	959.36	16.77%
STREET NO. 2	S305	305	CULVERT			0.03								0.05	0.05												13,335.43	22.00	1500			3.27	7.311	13335.43	100.00%
STREET NO. 26	S304	304	CULVERT			0.03								0.05	0.05												12,579.97	22.00	1500			2.91	6.896	12579.97	100.00%
FUTURE STREET	S304B	304	303			0.69								1.25	1.25												5,720.16	98.94	2100			0.10	1.600	5720.16	100.00%
GOLDHAWK DRIVE	S303, S306	303	302			3.19								5.76	7.01												5,720.16	94.58	2100			0.10	1.600	5720.16	100.00%
GOLDHAWK DRIVE	S302,Park3,Res 5	302	301	1.36		10.06								18.93	25.95	These pipes are sized by stormwater modeling (See Design Brief-Fernbank Pond 5 Stormwater Management Facility Report)											5,720.16	70.65	2100			0.10	1.600	5720.16	100.00%
GOLDHAWK DRIVE	S301	301	207			0.49								0.89	26.83												5,720.16	70.00	2100			0.10	1.600	5720.16	100.00%
STREET NO. 25	---	207	300											0.00	154.09												2,332.02	93.73	1500			0.10	1.278	2332.02	100.00%
POND		300	HEADWALL	9.21		52.74								100.42	254.51												3,006.86	75.63	1650			0.10	1.362	3006.86	100.00%

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1174.184 / (TC+6.014)^0.816] 10 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: J.I.M.

Checked: P.K.

Dwg. Reference: 27970 - 500, 500A, 500B

No.	Revision	Date
1.	Submission No. 1 to City of Ottawa	2013-08-29
2.	Submission No. 2 to City of Ottawa	2014-01-22
3.	Submission No. 3 to City of Ottawa	2014-08-22
4.	Submission No. 4 to City of Ottawa	2015-06-15
5.	Submission No. 5 to City of Ottawa	2016-11-10
6.	Submission for MOE Approval	2017-02-10
7.	Resubmission for MOE Approval	2017-07-14

File Reference:	Date:	Sheet No:
27970.5.7.1	2017-07-14	3 of 3

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

22 — AREA NUMBER

6.53 | 0.80 — RUN OFF COEFFICIENT

AREA IN HECTARES

⇨ FUTURE MINOR FLOW DIRECTION

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

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ibigroup.com

Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

EXTERNAL STORM DRAINAGE

AREA PLAN

Scale

1:2500

Design J.I.M.	Date OCTOBER '12
Drawn M.M.	Checked P.K.
Project No. 27970	Drawing No. 500

D07-16-11-0003

#17366

CONT'D ON DWG
27970-500B

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

S145 — AREA ID #
0.34 — RUN OFF COEFFICIENT
0.75 — AREA IN HECTARES

FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

14			
13			
12			
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8	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
7	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
6	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
5	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
4	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
3	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
2	REVISIONS AS PER RELOCATION OF FOUNDER AVENUE	JIM	13:12:12
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29
No.	REVISIONS	By	Date

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS FERNBANK COMMUNITY PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

N

Drawing Title

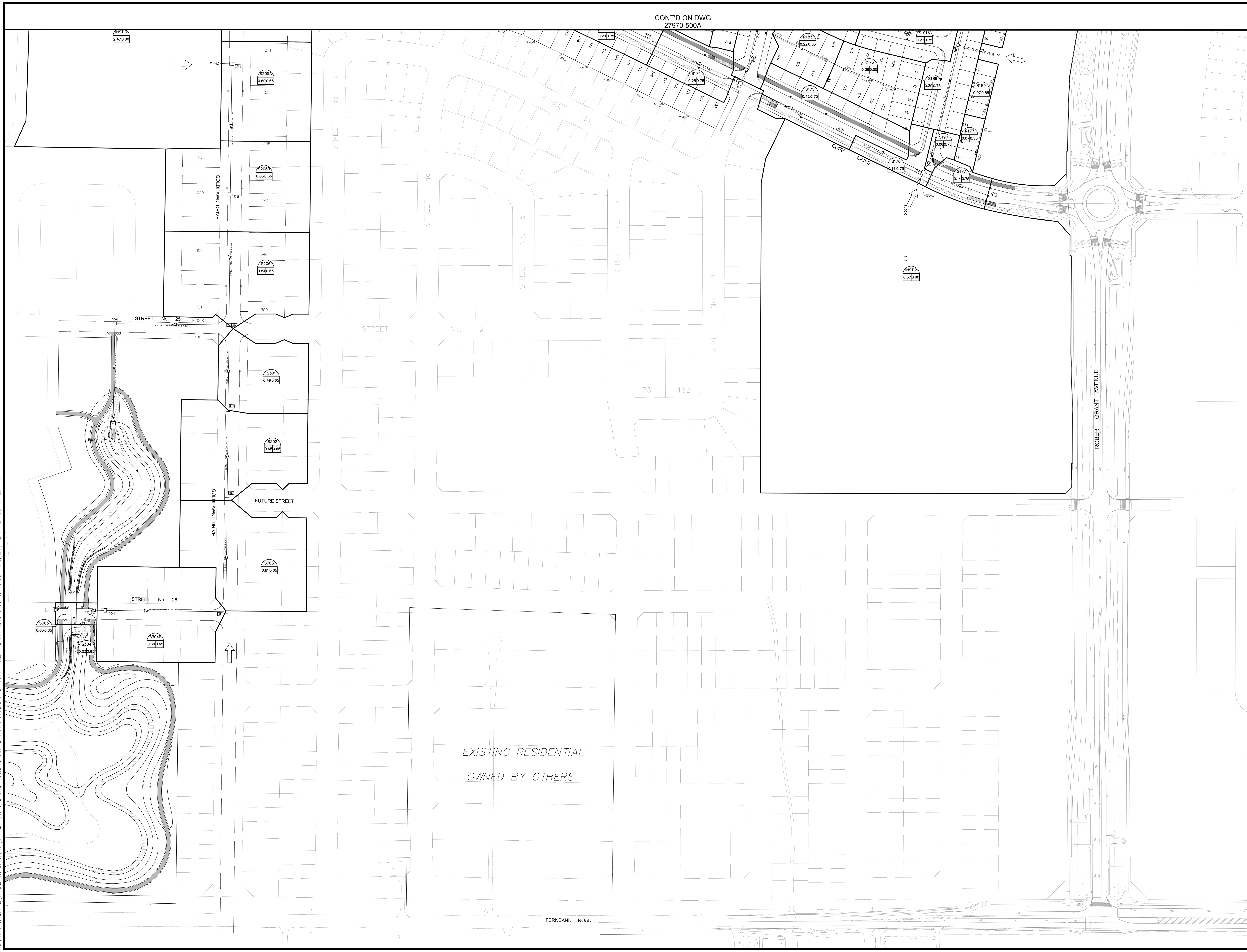
STORM DRAINAGE AREA PLAN

Scale: 1:1250

Design	Date
J.I.M.	OCTOBER '12
Drawn	**Checked**
M.M.	P.K.
Project No.	**Drawing No.**
27970	500A

D07-16-11-0003

#17366



REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND :

S145 — AREA ID #

0.34 0.75 — RUN OFF COEFFICIENT

— AREA IN HECTARES

⇨ FUTURE MINOR FLOW DIRECTION

NOTES:

1. THIS ALLOWANCE IS FOR OPA66 EXPANSION AREAS 6a, 6b AND 6c.

2. AN ALLOWANCE OF 100l/s HAS BEEN MADE FOR FLOWS TRIBUTARY TO THE LAIRD STREET PUMP STATION.

No.	REVISIONS	By	Date
14			
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4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

N

Drawing Title

STORM DRAINAGE
AREA PLAN

Scale 1:1250

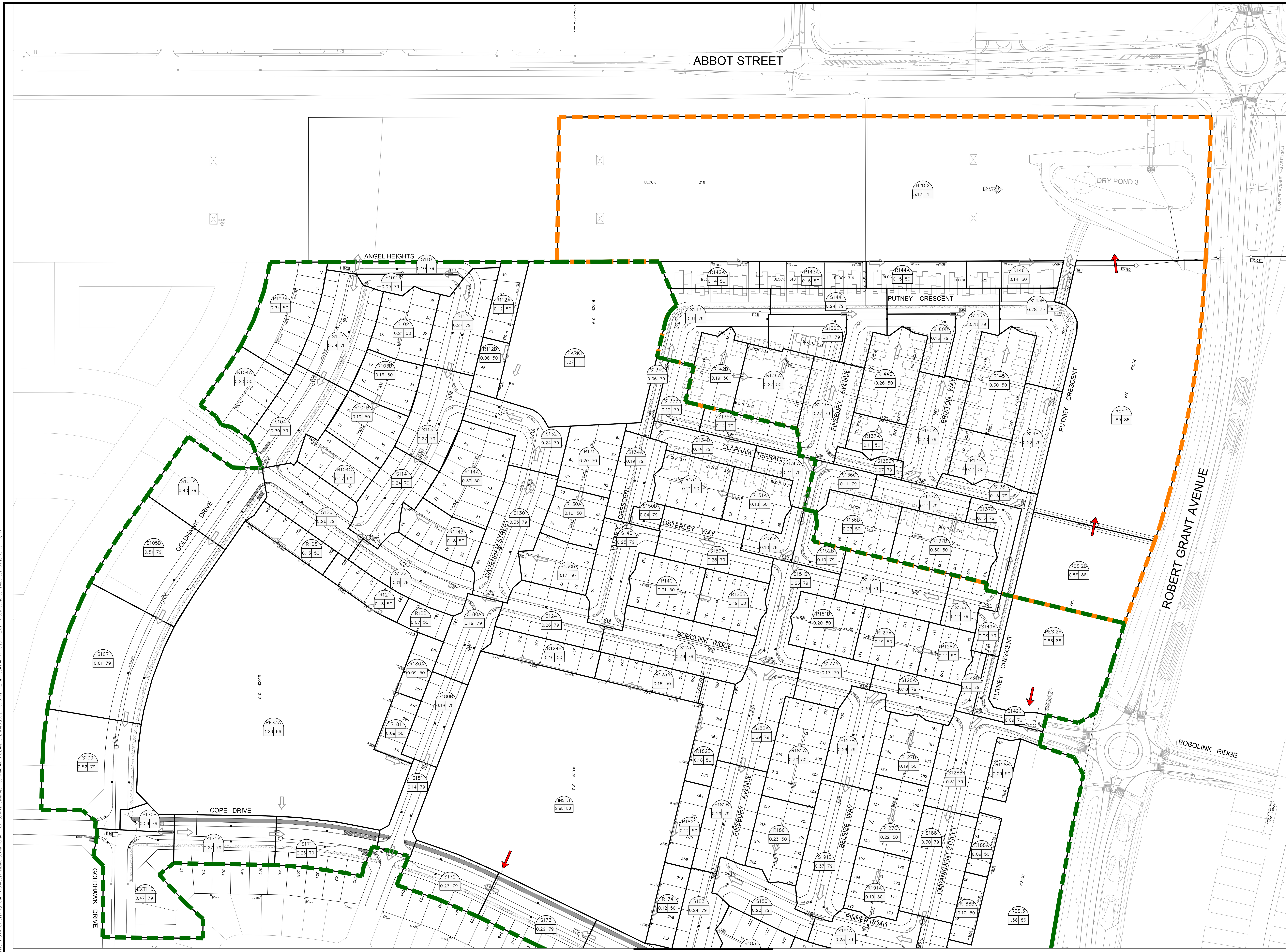
Design	J.I.M.	Date	OCTOBER '12
Drawn	M.M.	Checked	P.K.
Project No.	27970	Drawing No.	500B

D07-16-11-0003

#17366

APPENDIX F

- Drawings 27970-750A, 750B, 751A, 751B
- Phase 1A: Correspondence with Novatech confirming maximum allowable release rate and boundary condition
- Depth and Velocity Results
- Cross-sections of side lots
- XPSWMM schematic
- Summary of HGL
- CD of model files



CONT'D ON DWG
27970-750B

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND:

- DRAINAGE BOUNDARIES
- S188 / 0.30 / 75 — AREA ID, Imp.(%), AREA (ha)
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 5 - PHASE 1A
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 6 - PHASE 1
- MAJOR FLOW
- TOTAL FLOW
- EMERGENCY FLOW

No.	REVISIONS	By	Date
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3	RESUBMISSION FOR MOE APPROVAL	M.B.	17:07:14
2	SUBMISSION FOR MOE APPROVAL	M.B.	17:02:10
1	SUBMISSION No. 5 FOR CITY REVIEW	M.B.	16/11/10

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Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
M.S.BLACK
100101736
2017/07/14
PROVINCE OF ONTARIO

N

Drawing Title

DDSWMM DRAINAGE
AREA PLAN

Scale
1:1250

Design	Date
M.B.	NOV. 2016
Drawn	Checked
S.V.	P.S.
Project No.	Drawing No.
27970	750A

D07-16-11-0003

#17366

CONT'D ON DWG
27970-750A

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Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND:

- DRAINAGE BOUNDARIES
- S188 / 0.30 / 75 — AREA ID, Imp.(%), AREA (ha)
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 5 - PHASE 1A
- MINOR SYSTEM: DRAINAGE AREA TRIBUTARY TO POND 6 - PHASE 1
- MAJOR FLOW
- TOTAL FLOW
- EMERGENCY FLOW

No.	REVISIONS	By	Date
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4			
3	RESUBMISSION FOR MOE APPROVAL	M.B.	17:07:14
2	SUBMISSION FOR MOE APPROVAL	M.B.	17:02:10
1	SUBMISSION No. 5 FOR CITY REVIEW	M.B.	16/11/10

CRT DEVELOPMENT INC.

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Project Title
CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
M.S.BLACK
100101736
2017/07/14
PROVINCE OF ONTARIO

N

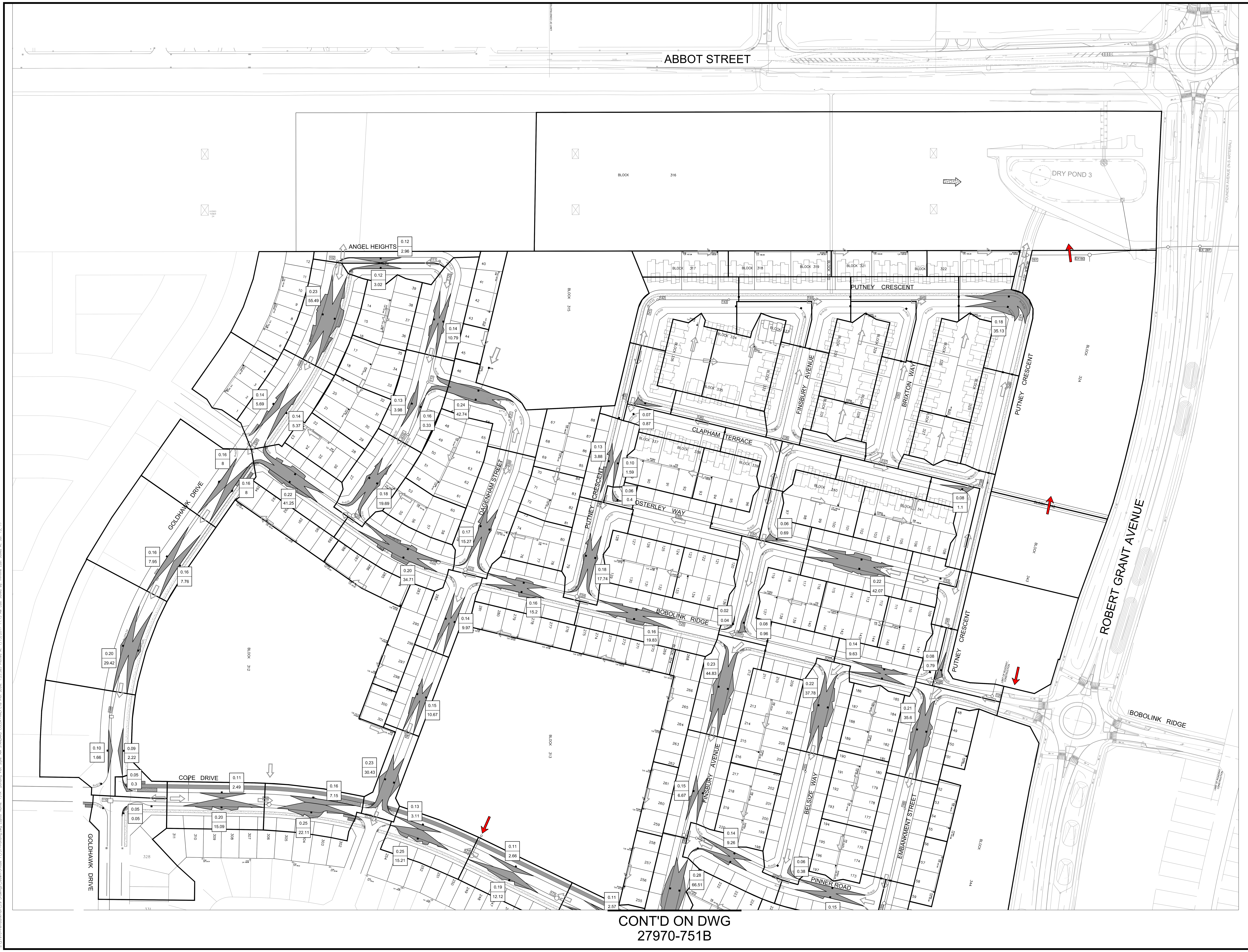
Drawing Title
DDSWMM DRAINAGE
AREA PLAN

Scale
1:1250

Design	Date
M.B.	NOV. 2016
Drawn	Checked
S.V.	P.S.
Project No.	Drawing No.
27970	750B

D07-16-11-0003

#17366



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DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND:

- DRAINAGE BOUNDARIES
- 0.12 DEPTH (m)
- 3.02 VOLUME (m³)
- STATIC PONDING
- MAJOR FLOW
- TOTAL FLOW
- EMERGENCY FLOW

No.	REVISIONS	By	Date
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3	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
2	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
1	SUBMISSION No. 5 FOR CITY REVIEW	M.B.	16/11/10

CRT DEVELOPMENT INC.

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Project Title
CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title
PONDING

Scale
1:1250

Design	Date
J.I.M.	NOV. 2016
Drawn	Checked
S.V.	J.I.M.
Project No.	Drawing No.
27970	751A

D07-16-11-0003

#17366

CONT'D ON DWG
27970-751A

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ____________________

Date ____________________ 2017

Plan Number ____________________

LEGEND:

DRAINAGE BOUNDARIES

0.12 — DEPTH (m)
3.02 — VOLUME (m³)

STATIC PONDING

MAJOR FLOW

TOTAL FLOW

EMERGENCY FLOW

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
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8			
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5			
4			
3	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
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1	SUBMISSION No. 5 FOR CITY REVIEW	JIM	16/11/10

CRT DEVELOPMENT INC.

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Project Title
CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title
PONDING

Scale
1:1250

Design	Date
J.I.M.	NOV. 2016
Drawn	Checked
S.V.	J.I.M.
Project No.	Drawing No.
27970	751B

D07-16-11-0003

#17366

Meghan Black

From: Mike Petepiece <m.petepiece@novatech-eng.com>
Sent: Monday, November 07, 2016 1:59 PM
To: Meghan Black
Subject: RE: Major flow hydrograph to dry pond

Hi Meghan,
I added your major system hydrograph to our model and can confirm that the dry pond will have sufficient storage to accommodate the major system runoff volume and peak flow. Let me know what you need from us to satisfy the City's review requirements.
Regards,

Michael Petepiece, P.Eng Project Manager
NOVATECH Engineers, Planners & Landscape Architects
240 Michael Cowpland Drive, Suite 200, Ottawa, ON, K2M 1P6 | Tel: 613.254.9643 x235 | Fax: 613.254.5867

From: Meghan Black [mailto:mblack@IBIGroup.com]
Sent: Monday, November 07, 2016 12:45 PM
To: Mike Petepiece <m.petepiece@novatech-eng.com>
Subject: Major flow hydrograph to dry pond

Hi Mike,

Please find attached the major flow hydrograph to the existing dry pond (100 year peak flow 1.25 cms). Can you please confirm this flow is acceptable?

With respect to the minor system, PH1A is restricted to 1200 l/s, the allowable release rate to the existing storm outlet. The corresponding boundary condition is 100.59 m.

Thank you,
Meghan

Meghan Black P.Eng., LEED® AP

Associate | Manager, Water/Wastewater
email mblack@IBIGroup.com web www.ibigroup.com

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IBI Defining the cities of tomorrow

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{min} + \frac{Q_x - Q_{min}}{Q_{max} - Q_{min}} (v_{max} - v_{min})$$

Depth:

$$d_x = d_{min} + \frac{Q_x - Q_{min}}{Q_{max} - Q_{min}} (d_{max} - d_{min})$$

100 Year 3 Hour Chicago Storm Phase 1																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S153	18	1.33	**29**	**0.029**	0.011	0.032	0.488	0.639	**0.617**	0.029	0.036	0.055	0.060	**0.055**	0.026	0.039	**0.037**	0.000	**0.037**	0.023
S149A	18	0.53	**43**	**0.043**	0.043	0.078	0.489	0.566	**0.489**	0.042	0.051	0.065	0.070	**0.066**	0.052	0.064	**0.052**	0.000	**0.052**	0.025
S149C	18	0.53	**104**	**0.104**	0.096	0.119	0.886	0.935	**0.903**	0.100	0.115	0.090	0.095	**0.091**	0.081	0.088	**0.083**	0.080	**0.163**	0.075
S149B	18	0.55	**71**	**0.071**	0.057	0.072	0.621	0.658	**0.656**	0.061	0.073	0.075	0.080	**0.079**	0.074	0.081	**0.081**	0.000	**0.081**	0.053
S128A(D1)	18	0.51	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.140	**0.140**	N/A
S127B(D2)	18	0.69	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.220	**0.220**	N/A
S191B	18	0.69	**57**	**0.057**	0.049	0.089	0.558	0.646	**0.576**	0.051	0.061	0.070	0.075	**0.073**	0.052	0.064	**0.054**	0.060	**0.114**	0.031
S128B(D3)	18	0.53	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.210	**0.210**	N/A
S188	18	0.53	**88**	**0.088**	0.078	0.127	0.566	0.639	**0.581**	0.086	0.100	0.085	0.090	**0.086**	0.064	0.077	**0.067**	0.000	**0.067**	0.039
S189(D4)	18	0.54	**36**	**0.036**	0.020	0.043	0.403	0.489	**0.463**	0.034	0.042	0.060	0.065	**0.061**	N/A	N/A	**N/A**	0.110	**0.171**	0.028
S191A(D5)	18	0.97	**45**	**0.045**	0.027	0.058	0.543	0.658	**0.610**	0.043	0.053	0.065	0.070	**0.066**	N/A	N/A	**N/A**	0.150	**0.216**	0.040
S186(D6)	18	1.14	**58**	**0.058**	0.029	0.063	0.592	0.717	**0.699**	0.053	0.063	0.070	0.075	**0.072**	N/A	N/A	**N/A**	0.140	**0.212**	0.051
S152A(D7)	18	0.69	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.220	**0.220**	N/A
S152B	18	0.52	**32**	**0.032**	0.024	0.033	0.502	0.543	**0.538**	0.027	0.034	0.055	0.060	**0.059**	0.054	0.061	**0.060**	0.060	**0.120**	0.032
S151B(D8)	18	0.61	**113**	**0.113**	0.084	0.137	0.607	0.686	**0.650**	0.100	0.115	0.090	0.095	**0.094**	N/A	N/A	**N/A**	0.050	**0.144**	0.061
S127A	18	0.51	**41**	**0.041**	0.020	0.042	0.396	0.479	**0.475**	0.034	0.042	0.060	0.065	**0.064**	0.039	0.052	**0.051**	0.000	**0.051**	0.024
S182A(D9)	18	1.04	**49**	**0.049**	0.028	0.060	0.565	0.685	**0.644**	0.043	0.053	0.065	0.070	**0.068**	N/A	N/A	**N/A**	0.230	**0.298**	0.044
S182B(D10)	18	1.14	**42**	**0.042**	0.029	0.063	0.592	0.717	**0.640**	0.035	0.043	0.060	0.065	**0.064**	N/A	N/A	**N/A**	0.130	**0.194**	0.041
S183(D11)	18	0.7	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.280	**0.280**	N/A
S190	18	0.62	**10**	**0.010**	0.007	0.012	0.395	0.446	**0.426**	0.008	0.011	0.035	0.040	**0.038**	0.034	0.040	**0.038**	0.050	**0.088**	0.016
S177	26	0.52	**45**	**0.045**	0.030	0.064	0.528	0.621	**0.569**	0.042	0.051	0.065	0.070	**0.067**	0.059	0.078	**0.067**	0.000	**0.067**	0.038
S176	26	0.52	**53**	**0.053**	0.051	0.063	0.600	0.633	**0.606**	0.051	0.061	0.070	0.075	**0.071**	0.071	0.077	**0.072**	0.000	**0.072**	0.044
S175(D12)	26	0.55	**141**	**0.141**	0.115	0.198	0.682	0.755	**0.705**	0.132	0.150	0.100	0.105	**0.102**	N/A	N/A	**N/A**	0.110	**0.212**	0.072
S174(D13)	26	0.55	**98**	**0.098**	0.065	0.115	0.639	0.682	**0.667**	0.086	0.100	0.085	0.090	**0.089**	N/A	N/A	**N/A**	0.155	**0.244**	0.060
S173(D14)	26	0.81	**143**	**0.143**	0.140	0.241	0.828	0.917	**0.831**	0.136	0.155	0.100	0.105	**0.102**	N/A	N/A	**N/A**	0.145	**0.247**	0.085
S172(D15)	26	0.73	**134**	**0.134**	0.133	0.228	0.786	0.870	**0.787**	0.132	0.150	0.100	0.105	**0.101**	N/A	N/A	**N/A**	0.165	**0.266**	0.079
S135A	18	0.56	**37**	**0.037**	0.034	0.045	0.559	0.599	**0.570**	0.034	0.042	0.060	0.065	**0.062**	0.061	0.067	**0.063**	0.000	**0.063**	0.036
S135B	18	0.91	**70**	**0.070**	0.058	0.074	0.764	0.814	**0.802**	0.063	0.075	0.075	0.080	**0.078**	0.067	0.074	**0.072**	0.070	**0.142**	0.058
S134C	18	0.51	**15**	**0.015**	0.011	0.017	0.407	0.452	**0.437**	0.011	0.016	0.040	0.045	**0.044**	0.040	0.047	**0.045**	0.000	**0.045**	0.020
S136A	18	0.56	**29**	**0.029**	0.025	0.034	0.516	0.559	**0.535**	0.027	0.034	0.055	0.060	**0.057**	0.054	0.061	**0.057**	0.000	**0.057**	0.031
S134B	18	0.56	**57**	**0.057**	0.045	0.058	0.599	0.639	**0.636**	0.051	0.061	0.070	0.075	**0.073**	0.067	0.074	**0.073**	0.000	**0.073**	0.047
S134A(D16)	18	1	**123**	**0.123**	0.108	0.175	0.778	0.878	**0.800**	0.119	0.136	0.095	0.100	**0.096**	N/A	N/A	**N/A**	0.115	**0.211**	0.077

100 Year 3 Hour Chicago Storm Phase 1																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S151A	18	0.52	**25**	**0.025**	0.024	0.033	0.502	0.543	**0.507**	0.021	0.027	0.050	0.055	**0.053**	0.054	0.061	**0.055**	0.000	**0.055**	0.028
S150A	18	0.79	**91**	**0.091**	0.053	0.096	0.597	0.691	**0.680**	0.088	0.103	0.085	0.090	**0.086**	0.052	0.064	**0.063**	0.000	**0.063**	0.043
S150B	18	1	**12**	**0.012**	0.010	0.015	0.505	0.571	**0.531**	0.012	0.016	0.040	0.045	**0.040**	0.034	0.040	**0.036**	0.060	**0.096**	0.019
S140(D17)	18	0.86	**188**	**0.188**	0.162	0.245	0.814	0.902	**0.842**	0.176	0.198	0.110	0.115	**0.113**	N/A	N/A	**N/A**	0.180	**0.293**	0.095
S125(D18)	18	0.55	**8**	**0.008**	0.007	0.021	0.316	0.415	**0.323**	0.005	0.008	0.030	0.035	**0.035**	N/A	N/A	**N/A**	0.160	**0.195**	0.011
S124(D19)	18	0.66	**185**	**0.185**	0.142	0.214	0.713	0.791	**0.760**	0.170	0.192	0.110	0.115	**0.113**	N/A	N/A	**N/A**	0.160	**0.273**	0.086
S130(D20)	18	0.66	**71**	**0.071**	0.048	0.087	0.545	0.632	**0.596**	0.061	0.073	0.075	0.080	**0.079**	N/A	N/A	**N/A**	0.170	**0.249**	0.047
S180A(D21)	18	1.17	**186**	**0.186**	0.116	0.189	0.841	0.950	**0.946**	0.176	0.198	0.110	0.115	**0.112**	N/A	N/A	**N/A**	0.140	**0.252**	0.106
S180B(D22)	18	1.12	**97**	**0.097**	0.063	0.114	0.710	0.823	**0.785**	0.088	0.103	0.085	0.090	**0.088**	N/A	N/A	**N/A**	0.150	**0.238**	0.069
S181(D23)	18	0.73	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.230	**0.230**	N/A
S170A(D24)	26	0.92	**5**	**0.005**	0.002	0.014	0.338	0.536	**0.388**	0.003	0.006	0.025	0.030	**0.029**	N/A	N/A	**N/A**	0.155	**0.184**	0.011
S171(D25)	26	0.73	**69**	**0.069**	0.036	0.075	0.625	0.736	**0.719**	0.061	0.073	0.075	0.080	**0.078**	N/A	N/A	**N/A**	0.205	**0.283**	0.056
S132(D26)	18	0.67	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.240	**0.240**	N/A
S112(D27)	18	0.67	**21**	**0.021**	0.008	0.022	0.344	0.450	**0.442**	0.021	0.027	0.050	0.055	**0.050**	N/A	N/A	**N/A**	0.140	**0.190**	0.022
S113(D28)	18	0.99	**36**	**0.036**	0.028	0.059	0.554	0.671	**0.584**	0.035	0.043	0.060	0.065	**0.061**	N/A	N/A	**N/A**	0.095	**0.156**	0.035
S114(D29)	18	0.83	**101**	**0.101**	0.098	0.159	0.708	0.800	**0.713**	0.088	0.103	0.085	0.090	**0.089**	N/A	N/A	**N/A**	0.180	**0.269**	0.064
S122(D30)	18	0.83	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.200	**0.200**	N/A
S120(D31)	18	0.7	**36**	**0.036**	0.023	0.049	0.460	0.558	**0.509**	0.034	0.042	0.060	0.065	**0.061**	N/A	N/A	**N/A**	0.220	**0.281**	0.031
S110(D32)	18	0.55	**20**	**0.020**	0.017	0.025	0.473	0.516	**0.489**	0.016	0.021	0.045	0.050	**0.049**	N/A	N/A	**N/A**	0.120	**0.169**	0.024
S102(D33)	18	0.55	**14**	**0.014**	0.012	0.017	0.427	0.473	**0.445**	0.011	0.016	0.040	0.045	**0.043**	N/A	N/A	**N/A**	0.120	**0.163**	0.019
S103(D34)	24	0.71	**0**	**0.000**	N/A	N/A	N/A	N/A	**N/A**	N/A	N/A	N/	N/A	**N/A**	N/A	N/A	**N/A**	0.230	**0.230**	N/A
S104(D35)	24	0.7	**114**	**0.114**	0.071	0.129	0.613	0.711	**0.686**	0.100	0.115	0.090	0.095	**0.095**	N/A	N/A	**N/A**	0.140	**0.235**	0.065
S105A(D36)	24	0.55	**203**	**0.203**	0.186	0.280	0.712	0.789	**0.726**	0.192	0.215	0.115	0.120	**0.117**	N/A	N/A	**N/A**	0.160	**0.277**	0.085
S105B(D37)	24	0.6	**164**	**0.164**	0.119	0.194	0.658	0.743	**0.709**	0.150	0.170	0.105	0.110	**0.108**	N/A	N/A	**N/A**	0.160	**0.268**	0.077
S107(D38)	24	0.6	**122**	**0.122**	0.119	0.194	0.658	0.743	**0.661**	0.115	0.132	0.095	0.100	**0.097**	N/A	N/A	**N/A**	0.200	**0.297**	0.064
S109(D39)	24	0.68	**106**	**0.106**	0.071	0.129	0.613	0.711	**0.672**	0.100	0.115	0.090	0.095	**0.092**	N/A	N/A	**N/A**	0.110	**0.202**	0.062
S170B	26	0.68	**9**	**0.009**	0.002	0.011	0.244	0.387	**0.355**	0.008	0.011	0.035	0.040	**0.036**	0.015	0.029	**0.026**	0.050	**0.076**	0.009

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{min} + \frac{Q_x - Q_{min}}{Q_{max} - Q_{min}} (v_{max} - v_{min})$$

Depth:

$$d_x = d_{min} + \frac{Q_x - Q_{min}}{Q_{max} - Q_{min}} (d_{max} - d_{min})$$

Phase 1A 100 Year 3 Hour Chicago Storm																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S143	18	1.65	**82**	**0.082**	0.076	0.138	0.862	0.999	**0.875**	0.078	0.091	0.080	0.085	**0.082**	0.052	0.064	**0.053**	0.000	**0.053**	0.047
S136E	18	0.83	**143**	**0.143**	0.098	0.159	0.708	0.800	**0.776**	0.136	0.155	0.100	0.105	**0.102**	0.064	0.077	**0.074**	0.000	**0.074**	0.057
S136B	18	2.58	**67**	**0.067**	0.044	0.095	0.890	1.078	**0.975**	0.065	0.078	0.075	0.080	**0.076**	0.039	0.052	**0.045**	0.000	**0.045**	0.044
S144	18	0.83	**392**	**0.392**	0.343	0.470	0.969	1.048	**0.999**	0.390	0.430	0.145	0.150	**0.145**	0.103	0.116	**0.108**	0.000	**0.108**	0.108
S160B	18	0.89	**82**	**0.082**	0.056	0.101	0.633	0.734	**0.691**	0.075	0.088	0.080	0.085	**0.083**	0.052	0.064	**0.059**	0.000	**0.059**	0.041
S136D	18	0.78	**18**	**0.018**	0.014	0.021	0.504	0.558	**0.535**	0.016	0.021	0.045	0.050	**0.047**	0.040	0.047	**0.044**	0.000	**0.044**	0.024
S160A	18	1.25	**96**	**0.096**	0.066	0.120	0.751	0.869	**0.817**	0.091	0.106	0.085	0.090	**0.087**	0.052	0.064	**0.059**	0.000	**0.059**	0.048
S145A	18	2.75	**547**	**0.547**	0.486	0.647	1.085	1.170	**1.117**	0.533	0.580	0.160	0.165	**0.162**	0.116	0.129	**0.121**	0.000	**0.121**	0.135
S136C	18	0.78	**30**	**0.030**	0.029	0.040	0.609	0.659	**0.614**	0.028	0.035	0.055	0.060	**0.057**	0.054	0.061	**0.055**	0.000	**0.055**	0.034
S137A	18	0.51	**125**	**0.125**	0.106	0.127	0.716	0.749	**0.746**	0.115	0.132	0.095	0.100	**0.098**	0.094	0.101	**0.100**	0.000	**0.100**	0.075
S137B(D1)	18	1.61	**99**	**0.099**	0.099	0.125	1.083	1.147	**1.083**	0.091	0.106	0.085	0.090	**0.088**	N/A	N/A	**N/A**	0.070	**0.158**	0.095
S138	18	1.61	**128**	**0.128**	0.125	0.154	1.147	1.210	**1.154**	0.123	0.141	0.095	0.100	**0.096**	0.081	0.088	**0.082**	0.000	**0.082**	0.094
S148	18	1.43	**160**	**0.160**	0.129	0.209	0.930	1.050	**0.977**	0.141	0.160	0.100	0.105	**0.105**	0.064	0.077	**0.069**	0.000	**0.069**	0.067
S145B	18	3.3	**688**	**0.688**	0.638	0.739	1.458	1.502	**1.480**	0.680	0.734	0.175	0.180	**0.176**	0.103	0.111	**0.107**	0.190	**0.297**	0.158
BLK335	N/A	2	**741**	**0.741**	0.739	0.848	1.502	1.543	**1.503**	0.734	0.789	0.180	0.185	**0.181**	0.111	0.118	**0.111**	0.000	**0.111**	0.167

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}(v_{\max} - v_{\min})$$

Depth:

$$d_x = d_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}(d_{\max} - d_{\min})$$

100 Year 3 Hour Chicago Storm + 20% Phase 1																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S153	18	1.33	**40**	**0.040**	0.032	0.068	0.639	0.774	**0.669**	0.036	0.045	0.060	0.065	**0.062**	0.039	0.052	**0.042**	0.000	**0.042**	0.028
S149A	18	0.53	**62**	**0.062**	0.043	0.078	0.489	0.566	**0.531**	0.061	0.073	0.075	0.080	**0.075**	0.052	0.064	**0.059**	0.000	**0.059**	0.031
S149C	18	0.53	**182**	**0.182**	0.175	0.207	1.028	1.073	**1.038**	0.170	0.192	0.110	0.115	**0.113**	0.101	0.108	**0.103**	0.080	**0.183**	0.106
S149B	18	0.55	**118**	**0.118**	0.108	0.130	0.730	0.764	**0.745**	0.115	0.132	0.095	0.100	**0.096**	0.094	0.101	**0.097**	0.000	**0.097**	0.072
S128A(D1)	18	0.51	**55**	**0.055**	0.042	0.077	0.479	0.555	**0.507**	0.051	0.061	0.070	0.075	**0.072**	N/A	N/A	**N/A**	0.140	**0.212**	0.036
S127B(D2)	18	0.69	**44**	**0.044**	0.023	0.049	0.460	0.558	**0.539**	0.042	0.051	0.065	0.070	**0.066**	N/A	N/A	**N/A**	0.220	**0.286**	0.036
S191B	18	0.69	**93**	**0.093**	0.089	0.145	0.646	0.729	**0.652**	0.086	0.100	0.085	0.090	**0.088**	0.064	0.077	**0.065**	0.060	**0.125**	0.042
S128B(D3)	18	0.53	**16**	**0.016**	0.007	0.020	0.308	0.403	**0.374**	0.016	0.021	0.045	0.050	**0.045**	N/A	N/A	**N/A**	0.210	**0.255**	0.017
S188	18	0.53	**119**	**0.119**	0.078	0.127	0.566	0.639	**0.627**	0.115	0.132	0.095	0.100	**0.096**	0.064	0.077	**0.075**	0.000	**0.075**	0.047
S189(D4)	18	0.54	**63**	**0.063**	0.043	0.078	0.489	0.566	**0.533**	0.061	0.073	0.075	0.080	**0.076**	N/A	N/A	**N/A**	0.110	**0.186**	0.040
S191A(D5)	18	0.97	**164**	**0.164**	0.105	0.171	0.762	0.860	**0.850**	0.155	0.176	0.105	0.110	**0.107**	N/A	N/A	**N/A**	0.150	**0.257**	0.091
S186(D6)	18	1.14	**241**	**0.241**	0.187	0.282	0.937	1.039	**0.995**	0.222	0.247	0.120	0.125	**0.124**	N/A	N/A	**N/A**	0.140	**0.264**	0.123
S152A(D7)	18	0.69	**13**	**0.013**	0.008	0.023	0.351	0.460	**0.387**	0.011	0.016	0.040	0.045	**0.042**	N/A	N/A	**N/A**	0.220	**0.262**	0.016
S152B	18	0.52	**50**	**0.050**	0.044	0.057	0.583	0.621	**0.601**	0.042	0.051	0.065	0.070	**0.069**	0.067	0.074	**0.070**	0.060	**0.130**	0.042
S151B(D8)	18	0.61	**189**	**0.189**	0.137	0.206	0.686	0.760	**0.742**	0.170	0.192	0.110	0.115	**0.114**	N/A	N/A	**N/A**	0.050	**0.164**	0.085
S127A	18	0.51	**58**	**0.058**	0.042	0.077	0.479	0.555	**0.514**	0.051	0.061	0.070	0.075	**0.073**	0.052	0.064	**0.057**	0.000	**0.057**	0.030
S182A(D9)	18	1.04	**156**	**0.156**	0.110	0.178	0.793	0.895	**0.862**	0.155	0.176	0.105	0.110	**0.105**	N/A	N/A	**N/A**	0.230	**0.335**	0.091
S182B(D10)	18	1.14	**158**	**0.158**	0.115	0.187	0.830	0.937	**0.894**	0.155	0.176	0.105	0.110	**0.106**	N/A	N/A	**N/A**	0.130	**0.236**	0.094
S183(D11)	18	0.7	**357**	**0.357**	0.313	0.428	0.884	0.956	**0.912**	0.356	0.390	0.145	0.150	**0.145**	N/A	N/A	**N/A**	0.280	**0.425**	0.132
S190	18	0.62	**16**	**0.016**	0.012	0.018	0.446	0.494	**0.478**	0.016	0.021	0.045	0.050	**0.045**	0.040	0.047	**0.045**	0.050	**0.095**	0.021
S177	26	0.52	**59**	**0.059**	0.030	0.064	0.528	0.621	**0.607**	0.051	0.061	0.070	0.075	**0.074**	0.059	0.078	**0.075**	0.000	**0.075**	0.046
S176	26	0.52	**72**	**0.072**	0.063	0.077	0.633	0.665	**0.654**	0.061	0.073	0.075	0.080	**0.080**	0.077	0.083	**0.081**	0.000	**0.081**	0.053
S175(D12)	26	0.55	**362**	**0.362**	0.320	0.486	0.837	0.920	**0.858**	0.356	0.390	0.145	0.150	**0.146**	N/A	N/A	**N/A**	0.110	**0.256**	0.125
S174(D13)	26	0.55	**531**	**0.531**	0.486	0.703	0.920	1.002	**0.937**	0.504	0.556	0.165	0.170	**0.168**	N/A	N/A	**N/A**	0.155	**0.323**	0.157
S173(D14)	26	0.81	**483**	**0.483**	0.388	0.590	1.015	1.116	**1.063**	0.479	0.520	0.160	0.165	**0.161**	N/A	N/A	**N/A**	0.145	**0.306**	0.171
S172(D15)	26	0.73	**812**	**0.812**	0.810	1.159	1.155	1.289	**1.156**	0.791	0.856	0.190	0.195	**0.192**	N/A	N/A	**N/A**	0.165	**0.357**	0.221
S135A	18	0.56	**50**	**0.050**	0.045	0.058	0.599	0.639	**0.614**	0.042	0.051	0.065	0.070	**0.069**	0.067	0.074	**0.070**	0.000	**0.070**	0.043
S135B	18	0.91	**118**	**0.118**	0.116	0.141	0.910	0.956	**0.914**	0.103	0.119	0.090	0.095	**0.095**	0.088	0.094	**0.088**	0.070	**0.158**	0.081
S134C	18	0.51	**21**	**0.021**	0.017	0.024	0.452	0.493	**0.475**	0.021	0.027	0.050	0.055	**0.050**	0.047	0.054	**0.051**	0.000	**0.051**	0.024
S136A	18	0.56	**39**	**0.039**	0.034	0.045	0.559	0.599	**0.577**	0.034	0.042	0.060	0.065	**0.063**	0.061	0.067	**0.064**	0.000	**0.064**	0.037
S134B	18	0.56	**80**	**0.080**	0.074	0.091	0.677	0.714	**0.690**	0.073	0.086	0.080	0.085	**0.083**	0.081	0.088	**0.083**	0.000	**0.083**	0.058
S134A(D16)	18	1	**214**	**0.214**	0.175	0.264	0.878	0.973	**0.920**	0.198	0.222	0.115	0.120	**0.118**	N/A	N/A	**N/A**	0.115	**0.233**	0.109

100 Year 3 Hour Chicago Storm + 20% Phase 1																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S151A	18	0.52	**35**	**0.035**	0.033	0.044	0.543	0.583	**0.550**	0.034	0.042	0.060	0.065	**0.061**	0.061	0.067	**0.062**	0.000	**0.062**	0.034
S150A	18	0.79	**125**	**0.125**	0.096	0.155	0.691	0.780	**0.735**	0.119	0.136	0.095	0.100	**0.097**	0.064	0.077	**0.070**	0.000	**0.070**	0.052
S150B	18	1	**20**	**0.020**	0.015	0.023	0.571	0.632	**0.609**	0.016	0.021	0.045	0.050	**0.049**	0.040	0.047	**0.044**	0.060	**0.104**	0.027
S140(D17)	18	0.86	**332**	**0.332**	0.245	0.349	0.902	0.986	**0.972**	0.304	0.335	0.135	0.140	**0.140**	N/A	N/A	**N/A**	0.180	**0.320**	0.136
S125(D18)	18	0.55	**65**	**0.065**	0.044	0.080	0.502	0.582	**0.549**	0.061	0.073	0.075	0.080	**0.077**	N/A	N/A	**N/A**	0.160	**0.237**	0.042
S124(D19)	18	0.66	**388**	**0.388**	0.306	0.419	0.864	0.935	**0.916**	0.377	0.417	0.145	0.150	**0.146**	N/A	N/A	**N/A**	0.160	**0.306**	0.134
S130(D20)	18	0.66	**119**	**0.119**	0.087	0.142	0.632	0.713	**0.679**	0.115	0.132	0.095	0.100	**0.096**	N/A	N/A	**N/A**	0.170	**0.266**	0.065
S180A(D21)	18	1.17	**453**	**0.453**	0.407	0.558	1.151	1.244	**1.179**	0.430	0.473	0.150	0.155	**0.153**	N/A	N/A	**N/A**	0.140	**0.293**	0.180
S180B(D22)	18	1.12	**355**	**0.355**	0.279	0.399	1.030	1.126	**1.091**	0.351	0.390	0.140	0.145	**0.141**	N/A	N/A	**N/A**	0.150	**0.291**	0.153
S181(D23)	18	0.73	**268**	**0.268**	0.225	0.322	0.831	0.909	**0.866**	0.240	0.269	0.125	0.130	**0.130**	N/A	N/A	**N/A**	0.230	**0.360**	0.112
S170A(D24)	26	0.92	**38**	**0.038**	0.014	0.040	0.536	0.702	**0.689**	0.035	0.043	0.060	0.065	**0.062**	N/A	N/A	**N/A**	0.155	**0.217**	0.043
S171(D25)	26	0.73	**422**	**0.422**	0.368	0.560	0.964	1.060	**0.991**	0.390	0.425	0.150	0.155	**0.155**	N/A	N/A	**N/A**	0.205	**0.360**	0.153
S132(D26)	18	0.67	**144**	**0.144**	0.142	0.214	0.713	0.791	**0.715**	0.132	0.150	0.100	0.105	**0.103**	N/A	N/A	**N/A**	0.240	**0.343**	0.074
S112(D27)	18	0.67	**48**	**0.048**	0.048	0.087	0.545	0.632	**0.545**	0.042	0.051	0.065	0.070	**0.068**	N/A	N/A	**N/A**	0.140	**0.208**	0.037
S113(D28)	18	0.99	**131**	**0.131**	0.108	0.175	0.778	0.878	**0.812**	0.119	0.136	0.095	0.100	**0.098**	N/A	N/A	**N/A**	0.095	**0.193**	0.080
S114(D29)	18	0.83	**208**	**0.208**	0.159	0.240	0.800	0.886	**0.852**	0.198	0.222	0.115	0.120	**0.117**	N/A	N/A	**N/A**	0.180	**0.297**	0.100
S122(D30)	18	0.83	**13**	**0.013**	0.009	0.025	0.385	0.505	**0.415**	0.012	0.016	0.040	0.045	**0.041**	N/A	N/A	**N/A**	0.200	**0.241**	0.017
S120(D31)	18	0.7	**133**	**0.133**	0.089	0.145	0.646	0.729	**0.711**	0.132	0.150	0.100	0.105	**0.100**	N/A	N/A	**N/A**	0.220	**0.320**	0.071
S110(D32)	18	0.55	**34**	**0.034**	0.034	0.045	0.559	0.599	**0.559**	0.034	0.042	0.060	0.065	**0.060**	N/A	N/A	**N/A**	0.120	**0.180**	0.034
S102(D33)	18	0.55	**32**	**0.032**	0.025	0.034	0.516	0.559	**0.549**	0.027	0.034	0.055	0.060	**0.059**	N/A	N/A	**N/A**	0.120	**0.179**	0.032
S103(D34)	24	0.71	**33**	**0.033**	0.033	0.071	0.507	0.613	**0.507**	0.027	0.034	0.055	0.060	**0.059**	N/A	N/A	**N/A**	0.230	**0.289**	0.030
S104(D35)	24	0.7	**196**	**0.196**	0.129	0.210	0.711	0.803	**0.787**	0.192	0.215	0.115	0.120	**0.116**	N/A	N/A	**N/A**	0.140	**0.256**	0.091
S105A(D36)	24	0.55	**411**	**0.411**	0.400	0.548	0.862	0.933	**0.867**	0.390	0.425	0.150	0.155	**0.153**	N/A	N/A	**N/A**	0.160	**0.313**	0.133
S105B(D37)	24	0.6	**367**	**0.367**	0.293	0.418	0.824	0.901	**0.870**	0.356	0.390	0.145	0.150	**0.147**	N/A	N/A	**N/A**	0.160	**0.307**	0.128
S107(D38)	24	0.6	**330**	**0.330**	0.293	0.418	0.824	0.901	**0.847**	0.324	0.356	0.140	0.145	**0.141**	N/A	N/A	**N/A**	0.200	**0.341**	0.119
S109(D39)	24	0.68	**327**	**0.327**	0.316	0.452	0.890	0.973	**0.897**	0.324	0.356	0.140	0.145	**0.140**	N/A	N/A	**N/A**	0.110	**0.250**	0.126
S170B	26	0.68	**15**	**0.015**	0.011	0.033	0.387	0.507	**0.409**	0.011	0.016	0.040	0.045	**0.044**	0.029	0.044	**0.032**	0.050	**0.082**	0.013

Velocity x Depth Calculation

Iteration equation:

Velocity:

$$v_x = v_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}\left(v_{\max} - v_{\min}\right)$$

Depth:

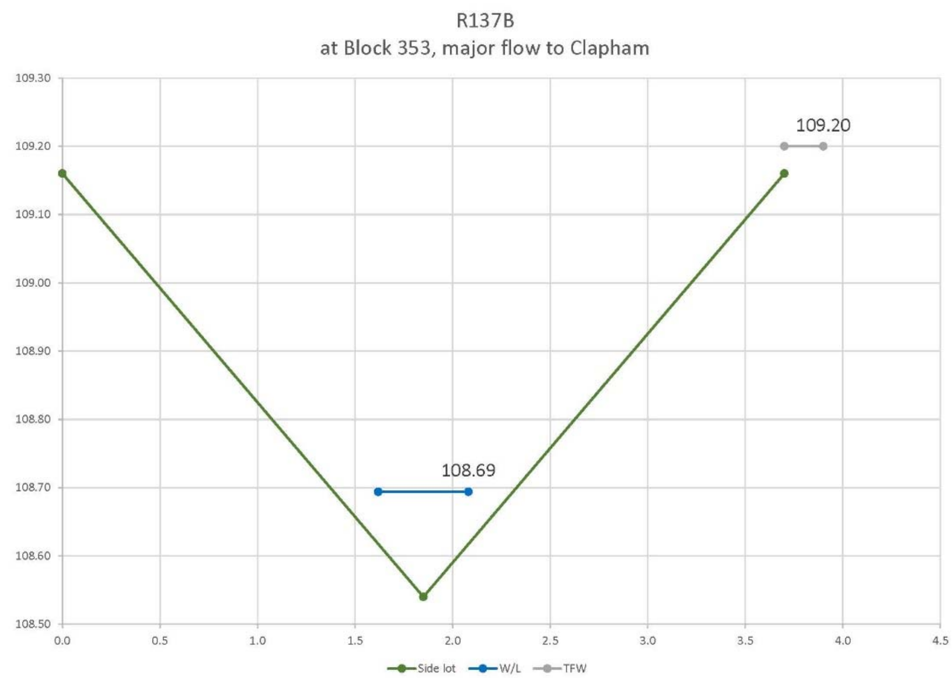
$$d_x = d_{\min} + \frac{Q_x - Q_{\min}}{Q_{\max} - Q_{\min}}\left(d_{\max} - d_{\min}\right)$$

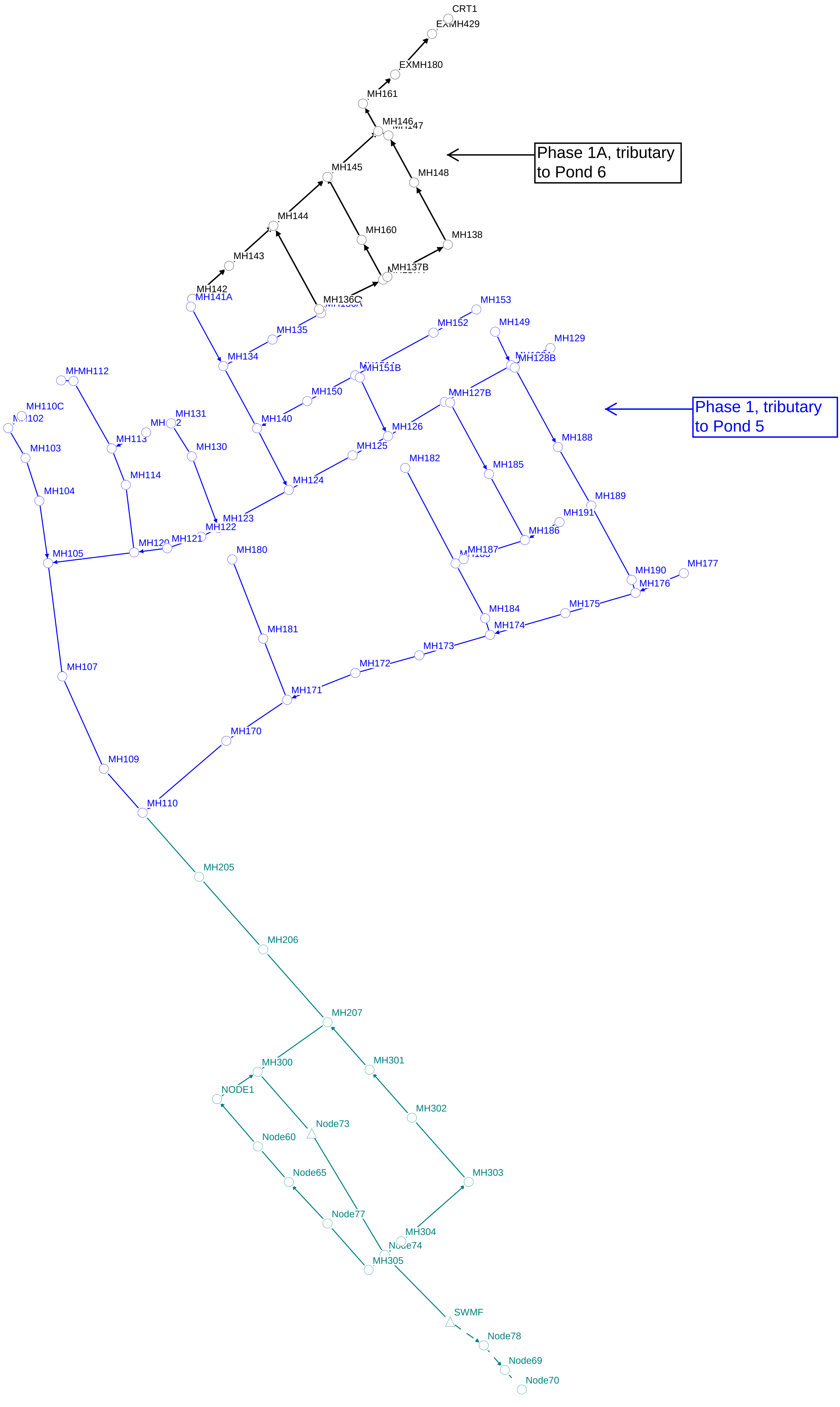
Phase 1A 100 Year 3 Hour Chicago Storm + 20%																				
					SWMHYMO PH1VXD.out					Sawtooth Profile: Calculation Sheet: Overflow for Typical Road Ponding Area					Continuous Grade Profile: SWMHYMO PH1VXD.out					
Area ID (Dummy Segment, if applicable)	ROW (for Street Segments)	Longitudinal Slope (%)	Overflow Flowrate		Flowrate (cms)		Velocity (m/s)			Flowrate (cms)		Dynamic Depth (m)			Dynamic Depth (m)			Ponding Depth (m)		Velocity x Depth
			Qx (l/s)	Qx (cms)	Qmin	Qmax	vmin	vmax	vx	Qmin	Qmax	dmin	dmax	dx	dmin	dmax	dx	Static	Maximum	(m^2/s)
S143	18	1.65	**112**	**0.112**	0.076	0.138	0.862	0.999	**0.942**	0.106	0.123	0.090	0.095	**0.092**	0.052	0.064	**0.059**	0.000	**0.059**	0.056
S136E	18	0.83	**210**	**0.210**	0.159	0.240	0.800	0.886	**0.854**	0.198	0.222	0.115	0.120	**0.118**	0.077	0.090	**0.085**	0.000	**0.085**	0.073
S136B	18	2.58	**93**	**0.093**	0.044	0.095	0.890	1.078	**1.071**	0.091	0.106	0.085	0.090	**0.086**	0.039	0.052	**0.051**	0.000	**0.051**	0.055
S144	18	0.83	**574**	**0.574**	0.470	0.625	1.048	1.130	**1.103**	0.563	0.610	0.165	0.170	**0.166**	0.116	0.129	**0.125**	0.000	**0.125**	0.138
S160B	18	0.89	**124**	**0.124**	0.101	0.165	0.734	0.828	**0.768**	0.119	0.136	0.095	0.100	**0.096**	0.064	0.077	**0.069**	0.000	**0.069**	0.053
S136D	18	0.78	**25**	**0.025**	0.021	0.029	0.558	0.609	**0.584**	0.021	0.028	0.050	0.055	**0.053**	0.047	0.054	**0.051**	0.000	**0.051**	0.029
S160A	18	1.25	**131**	**0.131**	0.120	0.195	0.869	0.982	**0.886**	0.123	0.141	0.095	0.100	**0.097**	0.064	0.077	**0.066**	0.000	**0.066**	0.058
S145A	18	2.75	**805**	**0.805**	0.647	0.875	1.170	1.320	**1.274**	0.789	0.846	0.185	0.190	**0.186**	0.129	0.142	**0.138**	0.000	**0.138**	0.176
S136C	18	0.78	**40**	**0.040**	0.040	0.053	0.659	0.707	**0.659**	0.035	0.043	0.060	0.065	**0.063**	0.061	0.067	**0.061**	0.000	**0.061**	0.040
S137A	18	0.51	**191**	**0.191**	0.178	0.207	0.815	0.846	**0.829**	0.170	0.192	0.110	0.115	**0.115**	0.115	0.121	**0.118**	0.000	**0.118**	0.098
S137B(D1)	18	1.61	**172**	**0.172**	0.154	0.188	1.210	1.272	**1.243**	0.160	0.181	0.105	0.110	**0.108**	N/A	N/A	**N/A**	0.070	**0.178**	0.134
S138	18	1.61	**213**	**0.213**	0.188	0.226	1.272	1.331	**1.311**	0.204	0.229	0.115	0.120	**0.117**	0.094	0.101	**0.099**	0.000	**0.099**	0.129
S148	18	1.43	**262**	**0.262**	0.209	0.315	1.050	1.164	**1.107**	0.255	0.287	0.125	0.130	**0.126**	0.077	0.090	**0.084**	0.000	**0.084**	0.092
S145B	18	3.3	**1054**	**1.054**	0.966	1.093	1.583	1.621	**1.609**	1.032	1.098	0.205	0.210	**0.207**	0.126	0.134	**0.132**	0.190	**0.322**	0.212
BLK335	N/A	2	**1147**	**1.147**	1.093	1.228	1.621	1.658	**1.636**	1.098	1.166	0.210	0.215	**0.214**	0.134	0.142	**0.137**	0.000	**0.137**	0.224

Appendix F

Major flow at side lots

There is one location, R137B, where major flow from rear yards cascades to the street via a side lot. The water surface elevation has been evaluated and is presented below at the cross-section of the side lot. Top of foundation wall elevation is indicated. The water surface elevation is more than the 0.15 m below top of foundation wall, the requested clearance. It should be noted that a conservative 3H:1V has been applied to the cross-section side slopes.





SWMM

Version 9.12

27970 CRT

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10/25/16

HGL SUMMARY PHASE 1 AND PHASE 1A

PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago		100 year 3 hour Chicago + 20%		July 1979		August 1988		August 1996	
			Elevation (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)
Trunk to Pond 5	MH207	Proposed Ground	107.17	104.53	2.64	104.58	2.59	104.55	2.62	104.54	2.63	104.23	2.94
	MH206	Proposed Ground	107.15	104.57	2.58	104.63	2.52	104.60	2.55	104.58	2.57	104.25	2.90
	MH205	Proposed Ground	107.28	104.62	2.66	104.68	2.60	104.64	2.64	104.62	2.66	104.28	3.00
1	MH110	Proposed Ground	107.52	104.69	2.83	104.75	2.77	104.71	2.81	104.69	2.83	104.33	3.19
1	MH109	Proposed Ground	107.45	104.71	2.74	104.77	2.68	104.72	2.73	104.71	2.74	104.33	3.12
1	MH107	Proposed Ground	107.41	104.73	2.68	104.80	2.61	104.75	2.66	104.73	2.68	Free flow	N/A
1	MH105	USF	105.65	104.76	0.89	104.83	0.82	104.79	0.86	104.77	0.88	Free flow	N/A
1	MH104	USF	105.85	104.80	1.05	104.87	0.98	104.83	1.02	104.81	1.04	Free flow	N/A
1	MH103	USF	105.75	104.81	0.94	104.89	0.86	104.85	0.90	104.83	0.92	Free flow	N/A
1	MH102	USF	105.95	104.82	1.13	104.89	1.06	104.85	1.10	104.84	1.11	Free flow	N/A
1	MH110C	Proposed Ground	107.93	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH170	USF	105.50	104.86	0.64	104.94	0.56	104.87	0.63	104.86	0.64	104.43	1.07
1	MH171	USF	105.35	104.96	0.39	105.04	0.31	104.96	0.39	104.96	0.39	104.48	0.87
1	MH172	USF	105.50	105.03	0.47	105.12	0.38	105.03	0.47	105.05	0.45	Free flow	N/A
1	MH173	USF	105.65	105.07	0.58	105.17	0.48	105.08	0.57	105.10	0.55	Free flow	N/A
1	MH174	USF	105.80	105.13	0.67	105.24	0.56	105.14	0.66	105.18	0.62	Free flow	N/A
1	MH175	USF	106.00	105.18	0.82	105.28	0.72	105.19	0.81	105.22	0.78	Free flow	N/A
1	MH176	USF	106.10	105.23	0.87	105.33	0.77	105.24	0.86	105.27	0.83	Free flow	N/A
1	MH177	Proposed Ground	106.55	105.28	1.27	105.34	1.21	105.30	1.25	105.34	1.21	Free flow	N/A
1	MH181	USF	105.65	105.19	0.46	105.28	0.37	105.06	0.59	105.06	0.59	Free flow	N/A
1	MH180	USF	105.85	105.42	0.43	105.52	0.33	105.18	0.67	105.19	0.66	Free flow	N/A
1	MH184	USF	105.68	105.19	0.49	105.30	0.38	105.20	0.48	105.24	0.44	Free flow	N/A
1	MH183	USF	105.95	105.32	0.63	105.42	0.53	105.34	0.61	105.38	0.57	Free flow	N/A
1	MH182	USF	106.19	105.83	0.36	105.96	0.23	105.86	0.33	105.92	0.27	Free flow	N/A
1	MH187	USF	105.75	105.37	0.38	105.47	0.28	105.39	0.36	105.44	0.31	Free flow	N/A
1	MH186	USF	106.05	105.53	0.52	105.68	0.37	105.57	0.48	105.63	0.42	Free flow	N/A
1	MH191	USF	106.02	105.61	0.41	105.78	0.24	105.67	0.35	105.73	0.29	Free flow	N/A
1	MH185	USF	106.45	105.66	0.79	105.82	0.63	105.72	0.73	105.77	0.68	Free flow	N/A
1	MH127	USF	106.70	105.80	0.90	105.99	0.71	105.87	0.83	105.92	0.78	Free flow	N/A
1	MH190	USF	106.35	105.26	1.09	105.36	0.99	105.26	1.09	105.30	1.05	Free flow	N/A
1	MH189	USF	106.05	105.31	0.74	105.41	0.64	105.31	0.74	105.34	0.71	Free flow	N/A
1	MH188	USF	106.55	105.44	1.11	105.58	0.97	105.46	1.09	105.49	1.06	Free flow	N/A
1	MH128	USF	106.65	Free flow	N/A	105.78	0.87	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH120	USF	105.70	104.87	0.83	104.95	0.75	104.90	0.80	104.87	0.83	Free flow	N/A
1	MH121	USF	105.70	104.88	0.82	104.96	0.74	104.92	0.78	104.88	0.82	Free flow	N/A
1	MH122	USF	105.90	Free flow	N/A	104.98	0.92	104.94	0.96	Free flow	N/A	Free flow	N/A
1	MH123	USF	106.00	Free flow	N/A	105.01	0.99	104.97	1.03	Free flow	N/A	Free flow	N/A
1	MH124	USF	106.10	Free flow	N/A	105.07	1.03	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH125	USF	106.20	Free flow	N/A	105.13	1.07	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH126	USF	106.35	Free flow	N/A	105.17	1.18	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH129	Proposed Ground	109.23	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH114	USF	106.00	104.97	1.03	105.08	0.92	105.03	0.97	104.98	1.02	Free flow	N/A
1	MH113	USF	106.05	105.09	0.96	105.21	0.84	105.17	0.88	105.12	0.93	Free flow	N/A
1	MH112	USF	106.10	105.16	0.94	105.28	0.82	105.25	0.85	105.19	0.91	Free flow	N/A
1	MH111	Proposed Ground	108.19	Free flow	N/A	105.28	2.91	105.25	2.94	105.20	2.99	Free flow	N/A
1	MH132	USF	106.15	Free flow	N/A	105.34	0.81	105.30	0.85	Free flow	N/A	Free flow	N/A
1	MH130	USF	106.25	105.02	1.23	105.12	1.13	105.09	1.16	105.02	1.23	Free flow	N/A
1	MH131	USF	106.15	Free flow	N/A	105.14	1.01	105.13	1.03	Free flow	N/A	Free flow	N/A
1	MH140	USF	106.25	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH134	USF	106.40	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A

HGL SUMMARY PHASE 1 AND PHASE 1A

PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago		100 year 3 hour Chicago + 20%		July 1979		August 1988		August 1996	
			Elevation (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)
1	MH141	Proposed Ground	108.40	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH135	USF	106.76	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH150	USF	106.65	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH152	USF	107.40	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH153	USF	107.25	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH151	USF	107.00	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1	MH149	USF	106.71	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	CRT1	Proposed Ground	103.30	100.89	N/A	100.89	N/A	100.89	N/A	100.89	N/A	100.89	N/A
1A	MH162	Proposed Ground	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH161	Proposed Ground	104.20	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH146	USF	103.61	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH147	USF	104.06	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH148	USF	104.56	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH138	USF	106.01	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH145	USF	103.61	102.75	0.86	102.76	0.85	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH160	USF	105.53	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH137	USF	106.26	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH136	USF	106.71	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH144	USF	104.81	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH143	USF	105.11	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A
1A	MH142	USF	106.11	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A	Free flow	N/A

HGL SUMMARY PHASE 1
(TRIB. TO POND 5)

PHASE	MH	USF or Proposed Ground		100 year 24 hour SCS		100 year 24 hour SCS + 20%	
			Elevation (m)	HGL (m)	Freeboard (m)	HGL (m)	Freeboard (m)
Trunk to Pond 5	MH207	Proposed Ground	107.17	104.49	2.68	104.67	2.50
	MH206	Proposed Ground	107.15	104.53	2.62	104.73	2.42
	MH205	Proposed Ground	107.28	104.57	2.71	104.78	2.50
1	MH110	Proposed Ground	107.52	104.64	2.88	104.86	2.66
1	MH109	Proposed Ground	107.45	104.65	2.80	104.88	2.57
1	MH107	Proposed Ground	107.41	104.68	2.73	104.90	2.51
1	MH105	USF	105.65	104.71	0.94	104.94	0.71
1	MH104	USF	105.85	104.75	1.10	104.98	0.87
1	MH103	USF	105.75	104.76	0.99	105.00	0.75
1	MH102	USF	105.95	Free flow	N/A	105.00	0.95
1	MH110C	Proposed Ground	107.93	Free flow	N/A	105.01	2.92
1	MH170	USF	105.50	104.79	0.71	105.05	0.45
1	MH171	USF	105.35	104.87	0.48	105.16	0.19
1	MH172	USF	105.50	104.93	0.57	105.23	0.27
1	MH173	USF	105.65	104.97	0.68	105.28	0.37
1	MH174	USF	105.80	105.02	0.78	105.35	0.45
1	MH175	USF	106.00	105.06	0.94	105.39	0.61
1	MH176	USF	106.10	105.10	1.00	105.44	0.66
1	MH177	Proposed Ground	106.55	Free flow	N/A	105.45	1.10
1	MH181	USF	105.65	105.00	0.65	105.40	0.25
1	MH180	USF	105.85	105.23	0.62	105.63	0.22
1	MH184	USF	105.68	105.06	0.62	105.41	0.27
1	MH183	USF	105.95	105.14	0.81	105.54	0.41
1	MH182	USF	106.19	105.62	0.57	106.05	0.14
1	MH187	USF	105.75	105.16	0.59	105.59	0.16
1	MH186	USF	106.05	105.27	0.78	105.76	0.29
1	MH191	USF	106.02	105.33	0.69	105.84	0.18
1	MH185	USF	106.45	105.42	1.03	105.91	0.54
1	MH127	USF	106.70	Free flow	N/A	106.05	0.65
1	MH190	USF	106.35	105.13	1.22	105.47	0.88
1	MH189	USF	106.05	105.17	0.88	105.52	0.53
1	MH188	USF	106.55	Free flow	N/A	105.67	0.88
1	MH128	USF	106.65	Free flow	N/A	105.90	0.75
1	MH120	USF	105.70	104.81	0.89	105.05	0.65
1	MH121	USF	105.70	Free flow	N/A	105.07	0.63
1	MH122	USF	105.90	Free flow	N/A	105.09	0.81
1	MH123	USF	106.00	Free flow	N/A	105.12	0.88
1	MH124	USF	106.10	Free flow	N/A	105.16	0.94
1	MH125	USF	106.20	Free flow	N/A	105.21	0.99
1	MH126	USF	106.35	Free flow	N/A	105.25	1.10
1	MH129	Proposed Ground	109.23	Free flow	N/A	Free flow	N/A
1	MH114	USF	106.00	104.93	1.07	105.18	0.82
1	MH113	USF	106.05	105.05	1.00	105.32	0.73
1	MH112	USF	106.10	105.12	0.98	105.39	0.71
1	MH111	Proposed Ground	108.19	Free flow	N/A	105.40	2.79
1	MH132	USF	106.15	Free flow	N/A	105.46	0.69
1	MH130	USF	106.25	104.98	1.27	105.22	1.03
1	MH131	USF	106.15	Free flow	N/A	105.26	0.89
1	MH140	USF	106.25	Free flow	N/A	105.33	0.92
1	MH134	USF	106.40	Free flow	N/A	Free flow	N/A
1	MH141	Proposed Ground	108.40	Free flow	N/A	Free flow	N/A
1	MH135	USF	106.76	Free flow	N/A	Free flow	N/A
1	MH150	USF	106.65	Free flow	N/A	Free flow	N/A
1	MH152	USF	107.40	Free flow	N/A	Free flow	N/A
1	MH153	USF	107.25	Free flow	N/A	Free flow	N/A
1	MH151	USF	107.00	Free flow	N/A	Free flow	N/A
1	MH149	USF	106.71	Free flow	N/A	Free flow	N/A

HGL SUMMARY PHASE 1
(TRIB. TO POND 5)
25% SEDIMENT ACCUMULATION

PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago	
			Elevation (m)	HGL (m)	Freeboard (m)
Trunk to Pond 5	MH207	Proposed Ground	107.17	105.00	2.17
	MH206	Proposed Ground	107.15	105.10	2.05
	MH205	Proposed Ground	107.28	105.20	2.08
1	MH110	Proposed Ground	107.52	105.35	2.17
1	MH109	Proposed Ground	107.45	105.38	2.07
1	MH107	Proposed Ground	107.41	105.43	1.98
1	MH105	USF	105.65	105.48	0.17
1	MH104	USF	105.85	105.54	0.31
1	MH103	USF	105.75	105.61	0.14
1	MH102	USF	105.95	105.67	0.28
1	MH110C	Proposed Ground	107.93	105.82	2.11
1	MH170	USF	105.50	105.56	-0.06
1	MH171	USF	105.35	105.67	-0.32
1	MH172	USF	105.50	105.75	-0.25
1	MH173	USF	105.65	105.80	-0.15
1	MH174	USF	105.80	105.87	-0.07
1	MH175	USF	106.00	105.91	0.09
1	MH176	USF	106.10	105.96	0.14
1	MH177	Proposed Ground	106.55	106.04	0.51
1	MH181	USF	105.65	105.90	-0.25
1	MH180	USF	105.85	106.14	-0.29
1	MH184	USF	105.68	105.92	-0.24
1	MH183	USF	105.95	106.05	-0.10
1	MH182	USF	106.19	106.55	-0.36
1	MH187	USF	105.75	106.10	-0.35
1	MH186	USF	106.05	106.26	-0.21
1	MH191	USF	106.02	106.35	-0.33
1	MH185	USF	106.45	106.44	0.01
1	MH127	USF	106.70	106.68	0.02
1	MH190	USF	106.35	105.98	0.37
1	MH189	USF	106.05	106.04	0.01
1	MH188	USF	106.55	106.35	0.20
1	MH120	USF	105.70	105.67	0.03
1	MH121	USF	105.70	105.71	-0.01
1	MH122	USF	105.90	105.74	0.16
1	MH123	USF	106.00	105.79	0.21
1	MH124	USF	106.10	105.92	0.18
1	MH125	USF	106.20	106.14	0.06
1	MH126	USF	106.35	106.31	0.04
1	MH128	USF	106.65	106.91	-0.26
1	MH129	Proposed Ground	109.23	106.91	2.32
1	MH114	USF	106.00	105.79	0.21
1	MH113	USF	106.05	105.90	0.15
1	MH112	USF	106.10	106.06	0.04
1	MH111	Proposed Ground	108.19	106.08	2.11
1	MH132	USF	106.15	106.06	0.09
1	MH130	USF	106.25	105.89	0.36
1	MH131	USF	106.15	106.09	0.06
1	MH140	USF	106.25	106.00	0.25

HGL SUMMARY PHASE 1
(TRIB. TO POND 5)
25% SEDIMENT ACCUMULATION

PHASE	MH	USF or Proposed Ground		100 year 3 hour Chicago	
			Elevation (m)	HGL (m)	Freeboard (m)
1	MH134	USF	106.40	106.39	0.01
1	MH141	Proposed Ground	108.40	106.56	1.84
1	MH135	USF	106.76	106.33	0.43
1	MH136	USF	106.71	106.39	0.32
1	MH150	USF	106.65	106.22	0.43
1	MH152	USF	107.40	106.39	1.01
1	MH153	USF	107.25	106.59	0.66
1	MH151	USF	107.00	106.60	0.40
1	MH149	USF	106.71	106.80	-0.09

APPENDIX G

- **Erosion and Sedimentation Control Plan - (Drawing 27970-900)**

REVIEWED BY
DEVELOPMENT REVIEW SERVICES BRANCH

Signed ______________________

Date ______________________ 2017

Plan Number ______________________

LEGEND:

LIGHT DUTY SILT FENCE PER OPSD 219.110

STRAW BALE BARRIER PER OPSD 219.100

No.	REVISIONS	By	Date
14			
13			
12			
11			
10			
9			
8			
7	RESUBMISSION FOR MOE APPROVAL	JIM	17:07:14
6	SUBMISSION FOR MOE APPROVAL	JIM	17:02:10
5	SUBMISSION #5 FOR CITY REVIEW	JIM	16:11:10
4	SUBMISSION #4 FOR CITY REVIEW	JIM	15:06:15
3	SUBMISSION #3 FOR CITY REVIEW	JIM	14:08:22
2	SUBMISSION #2 FOR CITY REVIEW	JIM	14:01:22
1	SUBMISSION #1 FOR CITY REVIEW	JIM	13:08:29

CRT DEVELOPMENT INC.

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Project Title

CRT LANDS
FERNBANK COMMUNITY
PHASE 1

LICENSED PROFESSIONAL ENGINEER
J. I. MOFFATT
2017/07/14
PROVINCE OF ONTARIO

Drawing Title

ERosion & SEDIMENTATION CONTROL PLAN

Scale 1:1500

Design	Date
J.I.M.	OCTOBER '12
Drawn	**Checked**
M.M.	P.K.
Project No.	**Drawing No.**
27970	900

D07-16-11-0003

#17366