MTE
More Than Engineering
25 YEARS 1985-2010

STRATFORD FAIRGROUNDS

Conceptual Servicing Report

Project Location:
Stratford, ON

Prepared for:

Stratford
ONTARIO CANADA
Dramatically Different!

December 5, 2014

Rev. January 20, 2015

Issued. February 20, 2015

MTE File: 37888-300

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APPENDICES

FIGURES

1.0 INTRODUCTION AND BACKGROUND

MTE Consultants Inc. has been retained by the City of Stratford to prepare a preliminary servicing report to address the servicing requirements to transfer the land use for the property located at Part of Lot 3, Concession 1 from a recreational 'fairground' use to a residential use complex, refer to Figure 1 for site location.

This report is prepared to demonstrate that the overall proposed development is serviceable with the existing and proposed infrastructure and roads adjacent to the development. This report identifies the servicing required to facilitate the proposed development.

In addition to providing a servicing strategy for the overall parcel of land, the report provides the framework and design parameters for the development of future community facilities (namely a storm water management block and sewage pump station).

Refer to Figure 2 for the conceptual land use plan of the development provided by the City of Stratford with minor modifications made to reflect the proposed design for the site.

2.0 EXISTING CONDITIONS

The subject lands comprise of approximately 11.50 hectares of vacant lands that are bounded by the Rotary Recreational Complex to the north, Britannia Street to the south, and residential subdivisions to the east and west. The site previously was the home of the Stratford fairgrounds. All buildings have been removed and a record of site condition is available for this Brownfield site.

The subject property is generally gently sloping in a northerly direction. The existing topographic mapping identifies a total elevation difference of approximately 2m over the entire length of property or an average slope of less than 1%. In accordance with the geotechnical information in this area, the soils consist of generally silt, sand and glacial till. A limited amount of topsoil is available on the site due to its past land use and the remediation works completed. Groundwater depth should be confirmed.

FIGURE 1

Date: JUL.8/14
Scale: N.T.S.

LOCATION OF SITE

25 YEARS 1985-2010 MTE

Project No.: 37136-300

December 5, 2014 — 9:58 a.m. — Plotted By: dbolger

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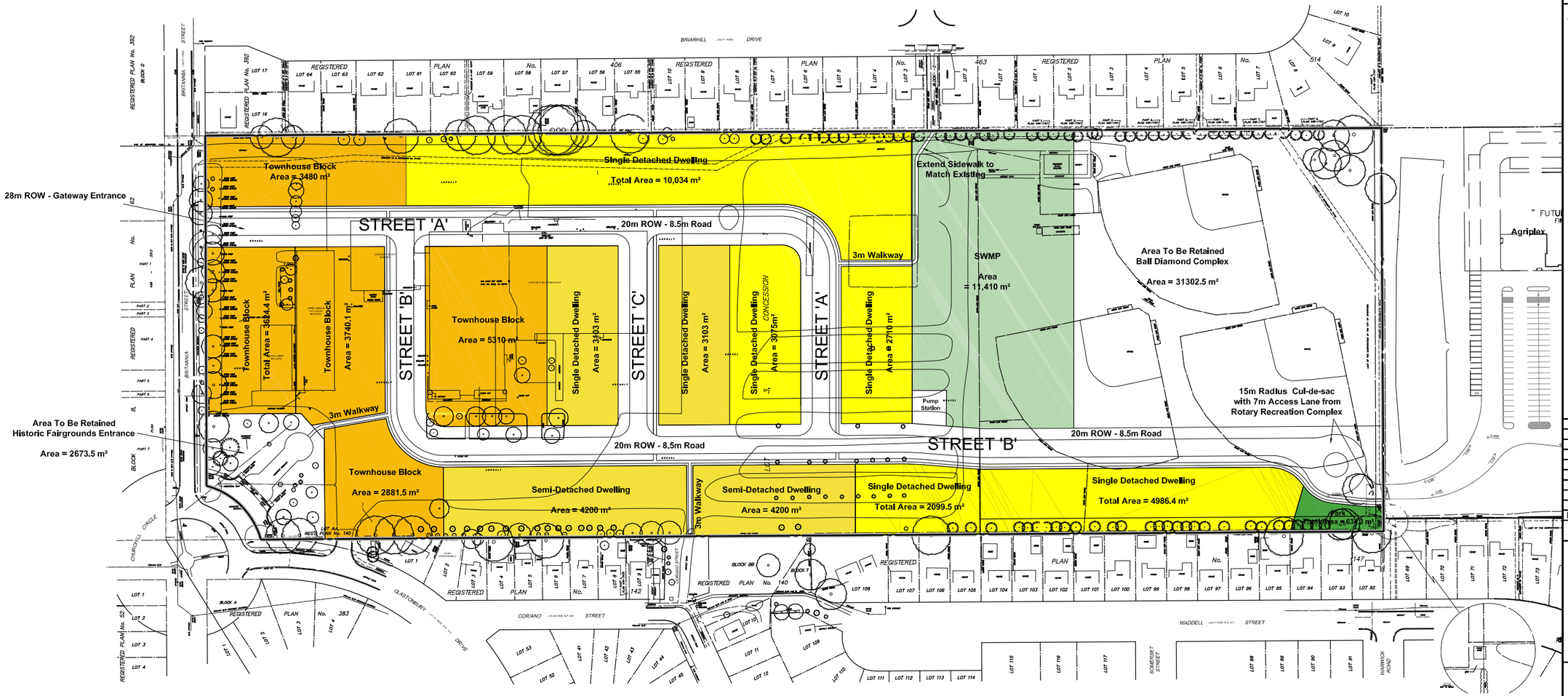
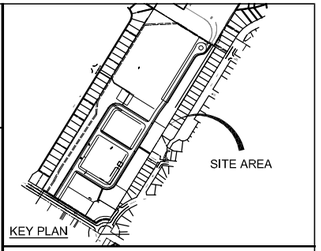




GENERAL NOTES

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND ABOVE GROUND UTILITIES AND STRUCTURES ARE NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR(S) WILL PROVE THE POSITION OF ALL SUCH UTILITIES AND STRUCTURES AND WILL ASSUME LIABILTY FOR DAMAGE TO THEM.

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.

ALL DIMENSIONS RELATED TO CURB ARE FROM BASE OF CURB AT GUTTER.

ALL ABANDONED M.H. OPENINGS AND ABANDONED PIPES TO BE FILLED WITH NON-SHRINK GROUT.

ALL ABANDONED PIPE TO BE REMOVED FROM WITHIN EXCAVATION LIMITS, & CAPPED AT EXCAVATION LIMITS.

HDD SERVICE TO BE INSTALLED BY HORIZONTAL DIRECTIONAL DRILLING

ALL STRUCTURES TO BE ABANDONED ARE MARKED "T.B.A."
ALL STRUCTURES TO BE REMOVED ARE MARKED "T.B.R."

R DENOTES REMOVAL OF TREE BY CITY OF STRATFORD
P DENOTES PROTECT & MAINTAIN TREE
T DENOTES TRANSPLANT TREE

LEGEND

SITE BOUNDARY

Area To Be Severed for Development = 80631.4 m²
(Total Units 140)

- **R1 - Residential First Density = 29241.4 m² (54 Units)**
- **R2 - Residential Second Density = 11026.4 m² (28 Units)**
- **R4 - Residential Fourth Density = 16439.5 m² @ 35 uph (58 Units)**
- **Park = 634.3 m²**
- **Storm Water Management Pond (SWMP) = 2690 m²**
- **Public Highway and Walkway = 20599.8 m²**

No.	DESCRIPTION	DATE	BY
1	ISSUED FOR REVIEW	SEPT. 3/14	S.Mc.

REVISIONS

THE CORPORATION OF THE CITY OF STRATFORD
ENGINEERING and PUBLIC WORKS DEPARTMENT

FIGURE 2

PROPOSED DEVELOPMENT CONCEPT PLAN

CONCEPT WITH CONNECTING ROAD TO RECREATION COMPLEX

SCALE: NTS		
DATE: SEPT. 3, 2014		
DRAWN BY: S. Mc.		
DESIGNED BY:		
REVIEWED BY: J. L.	SHEET: 2 OF 2	DWG: DWG 2
N. ROULSTON, P. Eng MANAGER	E. DUJLOVIC, P. Eng DIRECTOR	

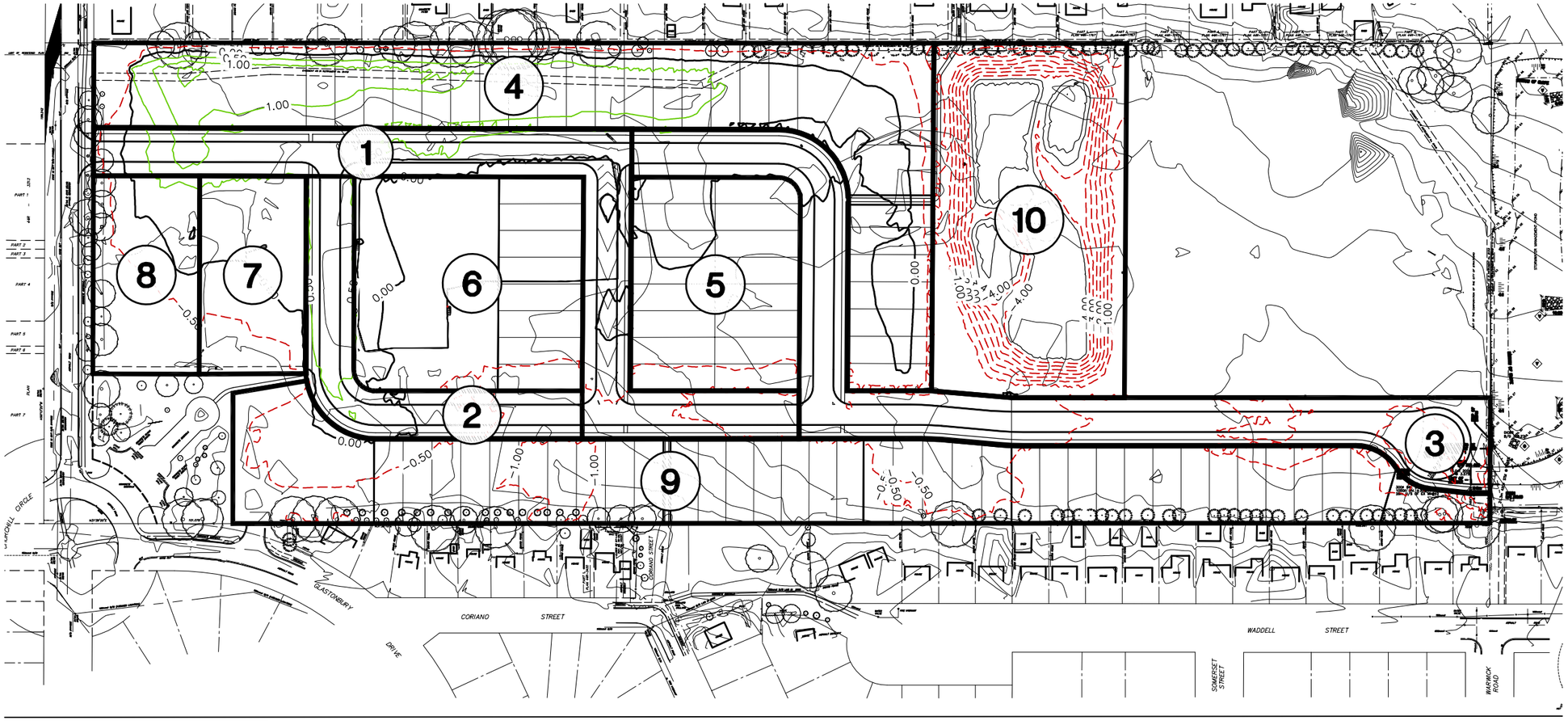
3.0 PRELIMINARY SITE GRADING

A preliminary grading design has been completed for the proposed development concept plan as follows:

- Preliminary grading complete to maintain the existing overland flow routes entering the site and drainage to SWM facility; and
- Preliminary grading design for the SMM Facility; and
- Preliminary cut/fill calculation for overall site.

Refer to Figure 3 for the conceptual cut/fill analysis based on the preliminary grading design. It should be noted that there is a surplus of fill generated from the 'Fairground' site works of approximately 47,000 cubic meters. This excess fill can be used to reinstate the dry SWM pond facility beside the Rotary Recreational facility and to level the existing ball fields.

Dec 04 2014 13.69PM; Grid size: 2.5; Base Surface: OG; Finish Surface: FG							
Area#	tot_Area	topsoil	cut	fill	net	stripping	pregrade
ID	m2	m3	m3	m3	m3	depth	depth
MTE_PARCEL : 1	8056.250	0.000	1293.780	2134.817	−841.0	0.0	0.7
MTE_PARCEL : 2	3906.250	0.000	743.071	1316.986	−573.9	0.0	0.7
MTE_PARCEL : 3	9868.750	0.000	4616.206	322.891	4293.3	0.0	0.7
MTE_PARCEL : 4	16331.250	0.000	2267.895	6147.298	−3879.4	0.0	0.9
MTE_PARCEL : 5	6175.000	0.000	1337.663	106.765	1230.9	0.0	0.9
MTE_PARCEL : 6	8412.500	0.000	2100.799	140.665	1960.1	0.0	0.9
MTE_PARCEL : 7	3606.250	0.000	716.433	524.453	192.0	0.0	0.9
MTE_PARCEL : 8	3618.750	0.000	1763.959	181.489	1582.5	0.0	0.9
MTE_PARCEL : 9	17712.500	0.000	12597.409	4.668	12592.7	0.0	0.9
MTE_PARCEL : 10	11712.500	0.000	30546.186	0.973	30545.2	0.0	0.3
totals:	89400	0.0	57983.4	10881.0	47102.4		



LEGEND

- PROPERTY BOUNDARY
- PARCEL LIMIT
- (1) PARCEL NUMBER
- -1.00 CUT CONTOURS
- 1.00 FILL CONTOURS
- 0.00 ZERO ELEVATION CONTOURS
- 372.0 EXISTING CONTOURS

FIGURE 3 Date: OCT.29/14 Scale: 1:2000

CUT/FILL ANALYSIS PLAN

MTE
Engineers | Scientists | Surveyors

Project No.: 37888-300

December 5, 2014 — 9:54 a.m. — Plotted By: dbolger

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4.0 SANITARY SERVICING

4.1 Existing Sanitary Servicing

The existing fairground site was serviced to Britannia Street by two sanitary services and to Glastonbury Drive by one 150mm service. Both services have been disconnected with the completion of the demolition of the site. These existing sanitary services are not suitable for the proposed subdivision development due to limited depth and size. There is an existing 200 sanitary main in front of the site on Britannia Street which conveys flows easterly to the Churchill Circle and John Street.

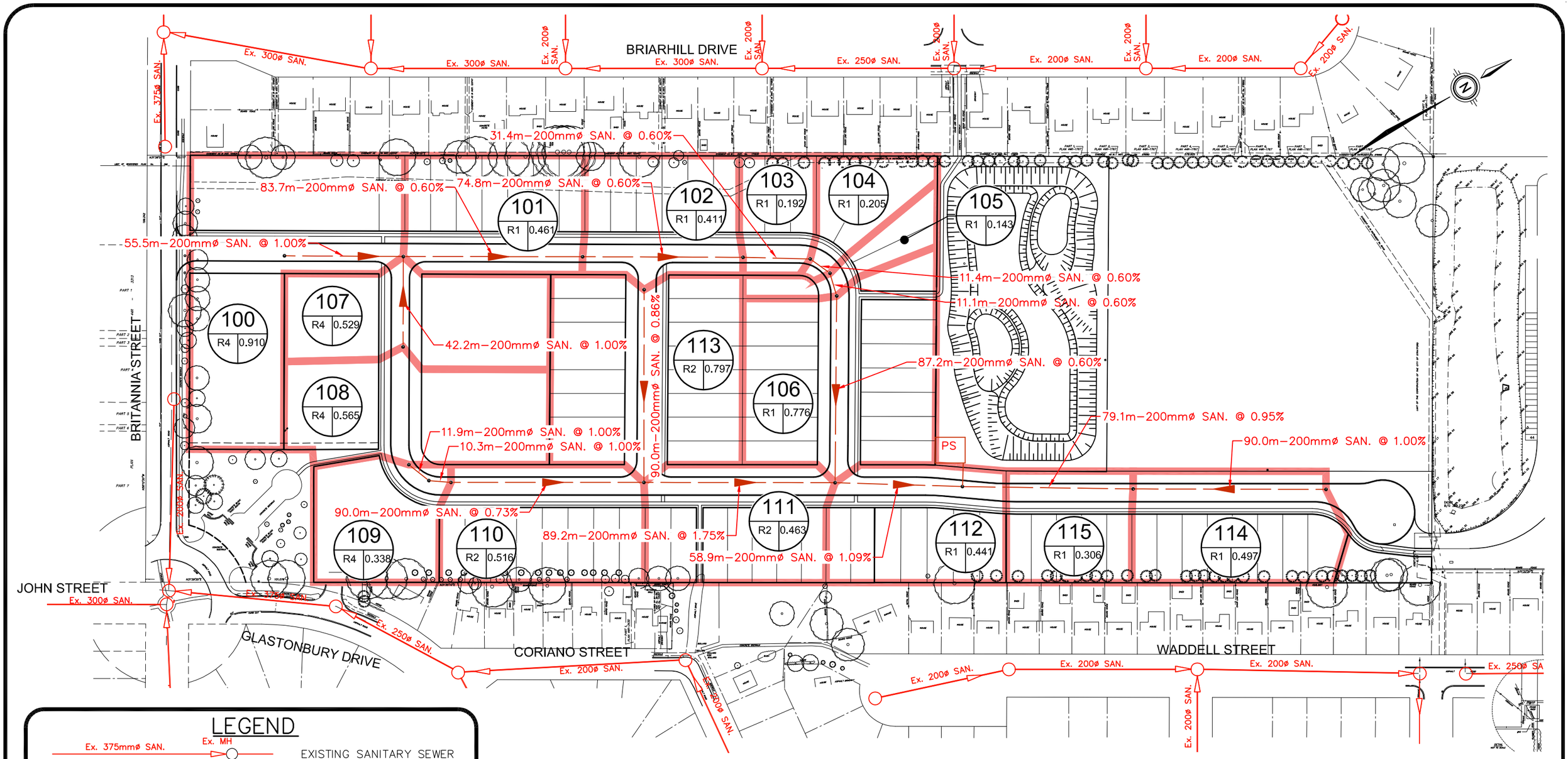
4.2 Proposed Sanitary Servicing Strategy

Various options have been examined to determine the most feasible and cost effective means to service the proposed plan of subdivision. Options for gravity sanitary drainage of the site are limited. Existing sewers on the adjacent streets (Briarhill, Glastonbury, Britannia, Coriano and Waddell) are at capacity, too shallow for connections or are not accessible from this site. An existing 375mm diameter sewer exists on Britannia Street near Briarhill Drive.

In order to connect the entire development site to this sewer, the site would be required to be graded from north to south. This would require significant fill at the north end of the site. Additionally due to very limited overland flow capacity within the major storm drainage sub-catchments, the City of Stratford will not permit significant changes to these sewer catchment areas.

In addition to reviewing a number of gravity servicing options, MTE has also reviewed several sanitary pumping options and configurations to service the development. The recommended sanitary solution includes the construction of a small pump station adjacent to the proposed SWM facility and Street ‘B’. This pump station is located centrally on the site and located to permit local sewers at a minimal depth to drain to it.

Refer to Figure 4 for the existing and proposed sanitary servicing strategy.



LEGEND

- Ex. 375mmø SAN. / Ex. MH — EXISTING SANITARY SEWER
- MH — 14.6m–200mmø SAN @ 1.5% — PROPOSED SANITARY SEWER
- DRAINAGE AREA
- 101 / R1 | 0.131 — ID NUMBER; AREA (ha.); RESIDENTIAL ZONING

FIGURE 4

EXISTING & CONCEPTUAL SANITARY SERVICING PLAN

Date: AUG.15/14
Scale: 1:1750

MTE

Project No.: 37888-300

December 5, 2014 — 10:00 a.m. — Plotted By: dbolger

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4.3 Proposed Sanitary Pump Station

The Fairgrounds Sanitary Pumping Station (FSPS) is designed to service new residential development lands at the former fairgrounds site in the City of Stratford. The preliminary sizing is specific to the concept that was provided by the City of Stratford, alternative concepts may result in different sizing requirements.

The pump station is being proposed to be located on the future Street 'B' adjacent to the proposed SWM facility for the development. A single sanitary forcemain will extend southerly from the pump station along the future Street 'B' and will outlet to an existing gravity sewer.

Two potential gravity outlets for the discharge of the sanitary forcemain were examined. The first location is the manhole located on Glastonbury immediately north of the Churchill roundabout. From this manhole sanitary flows are conveyed via an existing 375mm sanitary sewer to John Street. It has been determined that the downstream sanitary sewer at this location does not have sufficient capacity to accommodate the proposed subdivision.

The second discharge location examined was the existing manhole at the intersection of John Street and Charles Street. From this manhole wastewater is conveyed downstream southerly on John Street via an existing 450mm sanitary sewer. MTE has confirmed that this discharge location is preferred and has suitable capacity for the conveyance of the flows from the proposed pump station. Refer to Figure 5 for a concept plan of the preferred forcemain routing on John Street.

From this preferred location, wastewater will be conveyed by the gravity sewer system which ultimately outlets to the Stratford Wastewater Treatment Plant.

4.4 DESIGN PARAMETERS

4.4.1 Design Guidelines

The following is a summary of the design parameters for the Fairgrounds SPS:

Design Flow rates as per The Engineering Design Criteria Manual for the City of Stratford and the *MOE Design Guidelines for Sewage Works (2008)* an average daily per capita flow of 345.6 L/person/day with an infiltration allowance of 0.10L/s/ha is to be used for sewage calculations. Based upon the preferred development concept plan, the total population for the development is 145 units. As per the City of Stratford design guidelines, the population density is 2.4 pp/unit. Therefore the total design population for the proposed development in 348 persons. The Harmon Peaking Factor has been applied to calculate the peak design flow rate for the entire catchment area.

Pumping Station and Forcemain Design Standards as per the *MOE Design Guidelines for Sewage Works (2008),* and;

Standby Generator Set as per the Ministry of Environment Standard Specification for Diesel Engine Generator Sets (MOE Spec No. 2, June 1981). The standby generator specified for the Fairgrounds SPS will be required to be registered through the Environmental Activity and Sector Registry (EASR).

4.4.2 Design Flow Rate

The design flow rates for the Fairgrounds SPS have been determined based upon the preferred conceptual land use plan.

The Harmon Peaking Factor has been applied to calculate the peak flow rate of 6.41 L/s. Refer to Appendix A for the drainage area plan and the design flow rate calculation.

The design flow rates for the Fairgrounds SPS are summarized as follows:

Peak Flow	*6.41 L/s*
Average Flow	*2.17 L/s*

4.4.3 Wet Well Sizing

In accordance with the *MOE Design Guidelines for Sewage Works (2008)*, the new wet well has been sized based on a minimum 10 minute cycle time. The required wet well volume was determined based on a single pump system plus one redundant backup pump of equal size. Wet well sizing is discussed further in Section 4.5.4.

4.4.4 Firm Capacity and Forcemain Velocities

A total of two pumps, one duty and one standby, are proposed to be provided in the Fairgrounds SPS. In accordance with the *MOE Design Guidelines for Sewage Works (2008)*, the firm pumping capacity has been established based on the standby pump being out of operation. The station's design capacity is 7.5 L/s; which is slightly larger than the required design flow. The proposed 100 mm diameter forcemain will maintain velocities within the MOE recommended range of 0.6 m/s to 3.0 m/s. It should be noted that a minimum velocity of 1.1 m/s is generally preferred to ensure solids remain in suspension, and once the velocity exceeds 2.6 m/s, measures should be taken to provide additional forcemain capacity within the system. Pump and forcemain sizing is discussed further in Section 4.5.3.

4.5 PUMPING STATION DESIGN SUMMARY

4.5.2 Description

The Fairgrounds SPS is to be located on a block in the former fairground site, Stratford, ON. The Site is approximately 700 m north of the Churchill Roundabout. The block size will be required to approximately 20m x 20m and the building size should be approximately 6 x 8 m. The Site will be serviced with water and three phase electrical power. The preliminary construction cost for the SPS and forcemain is approximately $1.05 million.

The pumping station construction should consist of a pre-cast 1.8 m diameter wet well, separate metering chamber, control building, standby diesel generator set, submersible sewage pumps, magnetic flow meter, forcemain bypass, process piping air release valve and PLC based control system connected to the City SCADA system.

4.5.3 Pumps Capacity and Forcemain

ITT Flygt submersible pumps have been sized to accommodate the peak design sewage flow rate of 6.41L/s. Two identical pumps will be used (one duty and one stand by), each with an independent capacity of 7.5 L/s to provide the station's firm capacity 7.5 L/s. During normal operation, the sewage level will oscillate between predetermined level set points. The pumps should have rotational duty such that there is equal use of each pump.

The two pumps are arranged to discharge through two 75 mm diameter pipes. These pipes will enter a separate metering chamber located approximately 1.0 meter downstream of the wet well. A combination air/vacuum release valve is provided in the metering chamber for each pump discharge line.

Within the metering chamber, the two pump discharge pipes will join into a common 100 mm diameter header which passes through a magnetic flow meter. Once leaving the metering chamber, the single 100 mm diameter outlet piping will connect into the 100 mm diameter forcemain.

A single 100 mm diameter discharge forcemain is recommended to be installed from the valve chamber to the existing gravity discharge outlet manhole located at John Street and Charles Street.

The downstream sewer at this location has sufficient capacity to accommodate the additional peak flow (6.42 l/s) from the proposed development and the construction cost and complexity to install the forcemain at this location should be reasonable if it can be kept in the boulevard.

4.5.4 Wet Well Sizing

The proposed wet well will be a single 1.8 m diameter precast concrete manhole. *MOE Design Guidelines for Sewage Works (2008)* recommend that the sewage wet wells be sized to allow a minimum 10 minute cycles times, which is equivalent to six pump starts per hour. It is also recommended that the time required to fill the wet well volume not exceed 30 minutes based on the average design flow rate of 2.17 L/s

In order to accommodate the pumping capacity of 6.41 L/s, the required working wet well volume was calculated using the following equation:

$$Wet\ well\ volume\ (m^3) = Q_{pumping\ capacity\ \left(\frac{m3}{min}\right)} \times \frac{T_{cycle\ time\ (min)}}{4}$$

A cycle time of 10 minutes was utilized, with the single duty pump able to accommodate a pumping capacity of 0.45 m^3/min. This corresponds to a wet well volume of 3.68 m^3. The total area of the 1.8 m diameter wet well is 4.5 m^2. In order to provide a working wet well volume of 3.68 m^3 with a wet well area of 4.5 m^2 the wet well needs to have a minimum operating depth of 0.81 m. Since this is a single duty pump system (with one standby pump) the required operating depth is measured from the duty pump ON sewage level to the pump OFF sewage level within the wet well.

To allow for storage volume within the wet well and the potential for increasing the service area of the Fairgrounds pumping station in the future, the station design allows for an operating depth of approximately 1.0 m, which provides sufficient operating volume in the wet well to ensure the pumps operate with a minimum cycle time of greater than 10 minutes. An operating depth of 1.0 m provides a working wet well volume of 4.5 m^3, which corresponds to a fill time of approximately 10.2 minutes based on an average design flow rate of 2.17 L/s.

The precast wet well is to be approximately 6.0 m deep from finished grade to underside of structure. The wet well sizing calculations are contained in Appendix A.

4.5.5 Ventilation

A continuous power heated ventilator will be installed on the wet well lid to provide positive air displacement to the wet well at all times. A single gooseneck vent will allow for the air to dissipate to the atmosphere and minimize the accumulation of odour causing gases in the wet well. The heater ventilator will prolong the service life of the wet well by reducing corrosion of metals and concrete. The heat is necessary to prevent freezing during the winter while still allowing pressurized ventilation.

4.5.6 Emergency Generator

A diesel 40 kW standby generator will provide power in the event of an electricity outage at the site. The generator is sized to have both pumps (duty and standby) running as well as power to station auxiliary equipment (lights, ventilation and controls) and an outdoor 30A receptacle for temporary pumps. The generator will automatically start upon a sustained outage in the permanent power supply. The automatic transfer switch will operate to connect the generator to the station equipment while disconnecting the permanent power supply. The 715 L double-walled diesel storage tank complete with low fuel sensor has sufficient capacity to allow the station to operate for 24 hours on standby power.

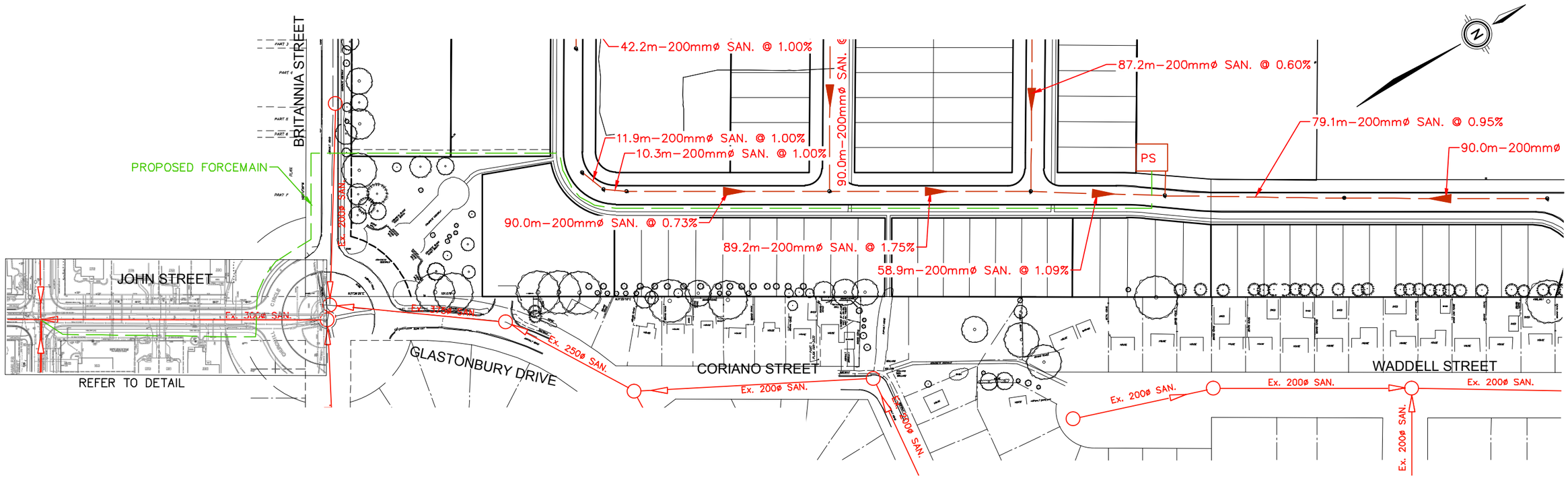
4.6 SUMMARY

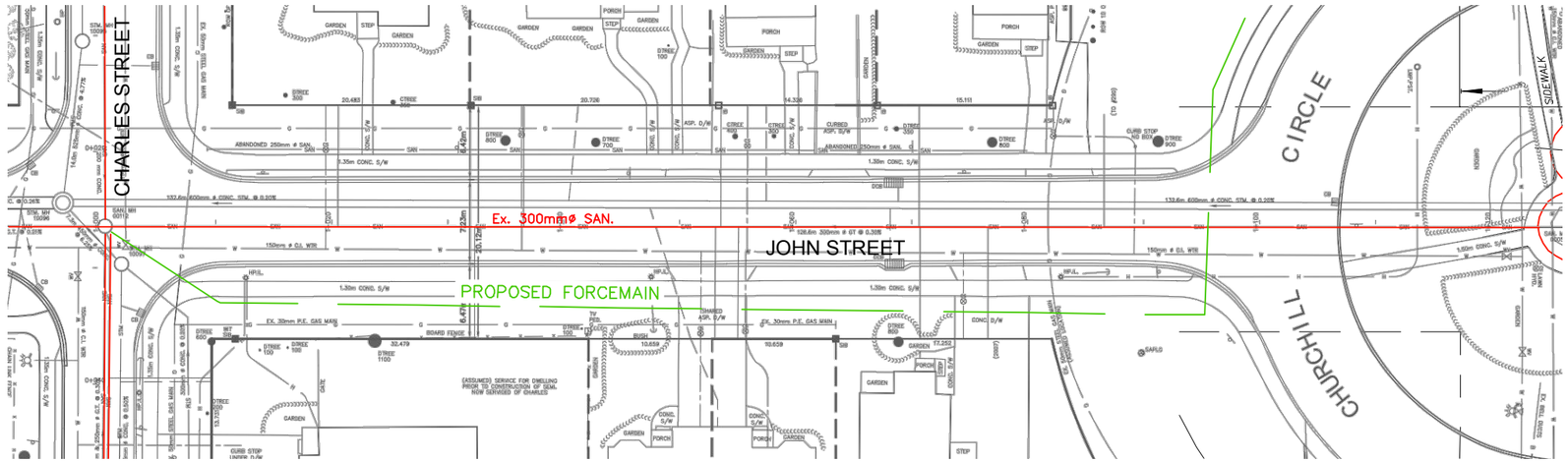
The Fairgrounds SPS has been designed to service proposed residential development lands in the City of Stratford which are located at the old fairgrounds site and include an area of approximately 8.0ha for a peak design flow rate of 6.4 L/s. Based on the pump selection, the station's rated capacity will be 7.5 L/s. The system has been designed in accordance with the City of Stratford and the *MOE Design Guidelines for Sewage Works (2008).* It should be noted that a Municipal Class EA, Schedule B will be required for a municipal pump station.

The Pump station will require an area of approximately 20mx20m and the preliminary cost estimate is $1.08 million. This budget price includes the following items:

- Site preparation, grading & sediment control;
- Dewatering;
- Wet well & pumps;
- Generator building including instrumentation, controls and standby power generator;
- Electrical work;
- Mechanical work;
- Water service, storm sewers and sanitary sewers & forcemain within the pump station site limits; and
- Asphalt driveway, topsoil, sod, landscaping & fence.

The forcemain required to convey the flows from the pump station is a 100mm diameter. The approximate cost to install the forcemain from the proposed pump station to John and Charles Street is $60,000. Refer to Figure 5 for the preliminary routing of the proposed forcemain.





PROPOSED FORCEMAIN OUTLET DETAIL

SCALE=1:500

LEGEND

- Ex. 375mmø SAN. — Ex. MH — EXISTING SANITARY SEWER
- MH — 14.6m–200mmø SAN @ 1.5% — PROPOSED SANITARY SEWER
- PROPOSED FORCEMAIN

FIGURE 5

Date: AUG.15/14
Scale: 1:1750

PROPOSED FORCEMAIN LOCATION PLAN

MTE

Project No.: 37888-300

January 20, 2015 – 9:05 a.m. – Plotted By: jdick

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5.0 STORMWATER MANAGEMENT

5.1 Existing Stormwater Servicing

The predevelopment land use of the subject site consists of large buildings with parking lots, baseball diamonds and grassed areas. The predevelopment land use of the recreational facility lands north of the site was considered to be row crops, while the developed land west of the subject site was modeled as a subdivision for the predevelopment condition.

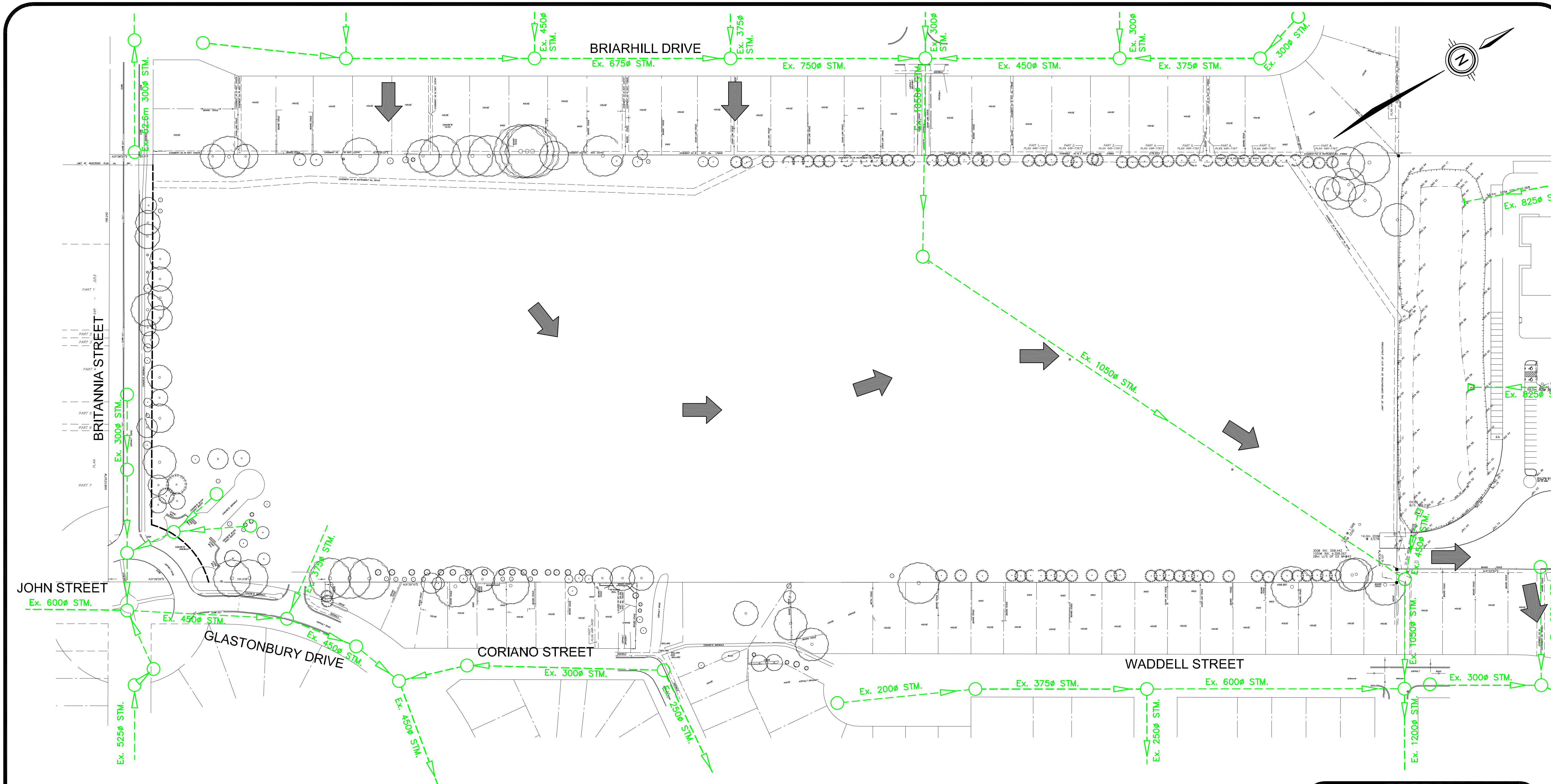
The stormwater flows from the south most area of the site outlet to the Britannia Street storm sewer while an area just north of this portion outlets to the storm sewer on Glastonbury Drive. The remaining north portion of the site outlets to the 1050mm diameter trunk storm sewer; which is located within the site. This sewer also services the 12.54 ha residential subdivision (Briarhill) to the west.

The 1050mm storm sewer enters the subject site approximately 360 meters north of Britannia Street within an existing pedestrian walkway and exits the site at the northeast corner of the property towards Warwick Road.

The current overland flow route enters the site from Briarhill Dr. near the south leg of both Windemere Cres. and Braemar Cres. The overland flow then travels towards the northeast corner of the site where it outlets towards Waddell St. The major drainage flow path for the site has been derived from Figure 5.3 'Existing System Screening (NW)' in the City of Stratford's *City-Wide Storm System Master Plan (October 2004)* prepared by Dillon Consulting.

Stormwater flows produced by the Rotary Recreational Facility north of the subject lands are directed to an existing dry pond which is located at the south end of the recreational site. The discharge from the dry pond is controlled by a 285mm diameter orifice which outlets to the existing 1050mm trunk storm sewer.

Refer to Figure 6 for illustration and clarification of the existing storm sewer servicing.



LEGEND

Ex. MH

EXISTING STORM SEWER

OVERLAND FLOW ROUTE (MAJOR STORM)

FIGURE 6

Date: AUG.15/14
Scale: 1:1750

EXISTING STORM SERVICING PLAN

MTE

Project No.: 37888-300

January 20, 2015 — 9:05 a.m. — Plotted By: jdick

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5.2 SWM Design Criteria

The proposed development site will be required to control storm flows in accordance to the MOECC and City of Stratford guidelines. This developed site will be required to be provided with both SWM quantity and quality controls. The stormwater management design targets to minimize the impact of development on the downstream watercourse are identified in sections 5.2.1 and 5.2.2.

The proposed SWM facility is required to be designed to consolidate storm drainage from the proposed development site and the existing Rotary Complex north of the subject site. The SWM criteria noted above will also apply to the storm drainage from the Rotary Complex site.

The existing storm drainage from the external lands west of the subject property is to be conveyed through the SWM facility and not subject to quality or quantity controls.

5.2.1 Quality Control

The City of Stratford requires that stormwater quality control be provided to achieve a *Normal* level of protection, which would require a 70% long term suspended solid removal.

As outlined in the *Ministry of the Environment's Storm Water Management Planning and Design Manual*, a Wet Pond receiving drainage from an area that is 55% impervious with Normal protection requires storage of 110 m^3/ha for water quality treatment. The required storage volume includes 70 m^3/ha in the permanent pool (Dead Storage) and 40 m^3/ha for extended detention (Active Storage for erosion control).

Additionally a Wet Pond receiving drainage from an area that is 95% impervious with Normal protection requires storage of 165 m^3/ha for water quality treatment. The required storage volume includes 125 m^3/ha in the permanent pool (Dead Storage) and 40 m^3/ha for extended detention (Active Storage for erosion control).

5.2.2 Quantity Control

Stormwater Quantity Control is to be provided such that the post development 250 year storm event peak flow rates are restricted to the 5 year storm predevelopment level.

5.3 Predevelopment Condition

The predevelopment land use of the 12.68 ha area containing the subject site consists of large buildings with parking lots, baseball diamonds and grassed areas. The predevelopment land use of the 7.81ha recreational facility lands north of the site was considered to be row crops, while the 12.54 ha of developed land west of the subject site was modeled as a subdivision for predevelopment condition.

Refer to Figure 7 for the predevelopment catchment areas plan.

5.4 Proposed Stormwater Servicing Strategy

To accommodate the quality and quantity SWM criteria required, a wet pond has been proposed to service the subject site and the Rotary Complex. The drainage (minor and major flows) from the westerly external lands (Briarhill) will be conveyed through the proposed SWM facility but will not be subject to additional treatment. The SWM Block required to be allocated for the proposed SWM facility has been determined to be 11,700 m^2 (1.17 ha).

The proposed SWM Facility will allow the existing dry SWM facility for the Rotary Complex site to be decommissioned. The minor and major storm flows are directed to the proposed SWM Facility through a swale along the west boundary of the subject site. The swale will include a ditch inlet catchbasin that outlets to the proposed SWM facility.

The existing 1050mm trunk storm sewer servicing the subdivision west of the site (Briarhill) is undersized and unable to convey the 5 year storm event. It is proposed to upsize approximately 50m of this sewer from the Briarhill subdivision and outlet this sewer to the proposed SWM facility. The SWM outlet and downstream storm sewers will convey the restricted flows from the proposed development lands and the conveyed flows from the Briarhill subdivision.

Both the inlet and outlet sewer construction will be required to be completed as part of the redevelopment of the fairground property. It should be noted that although the construction of these works will assist with some of the current deficiencies with the Briarhill storm sewer system, additional sewer replacement in the Briarhill subdivision will be required in the future to eliminate all capacity constraints.

Refer to Figures 8 for the conceptual storm sewer servicing.

All internal and external overland flows will be conveyed through the subject site and directed towards the proposed SWM pond. The existing overland flow routes entering the site from the existing development to the west must be maintained. The overland flows leaving the SWM facility will be directed along the current location of the existing overland flow route to Waddell Street.

Refer to Figures 9 for the post development catchment areas.

LEGEND

- Ex. MH — EXISTING STORM SEWER
- 101 / 0.68 — ID No. / AREA (Ha)
- CATCHMENT 101
- CATCHMENT 102
- CATCHMENT 103

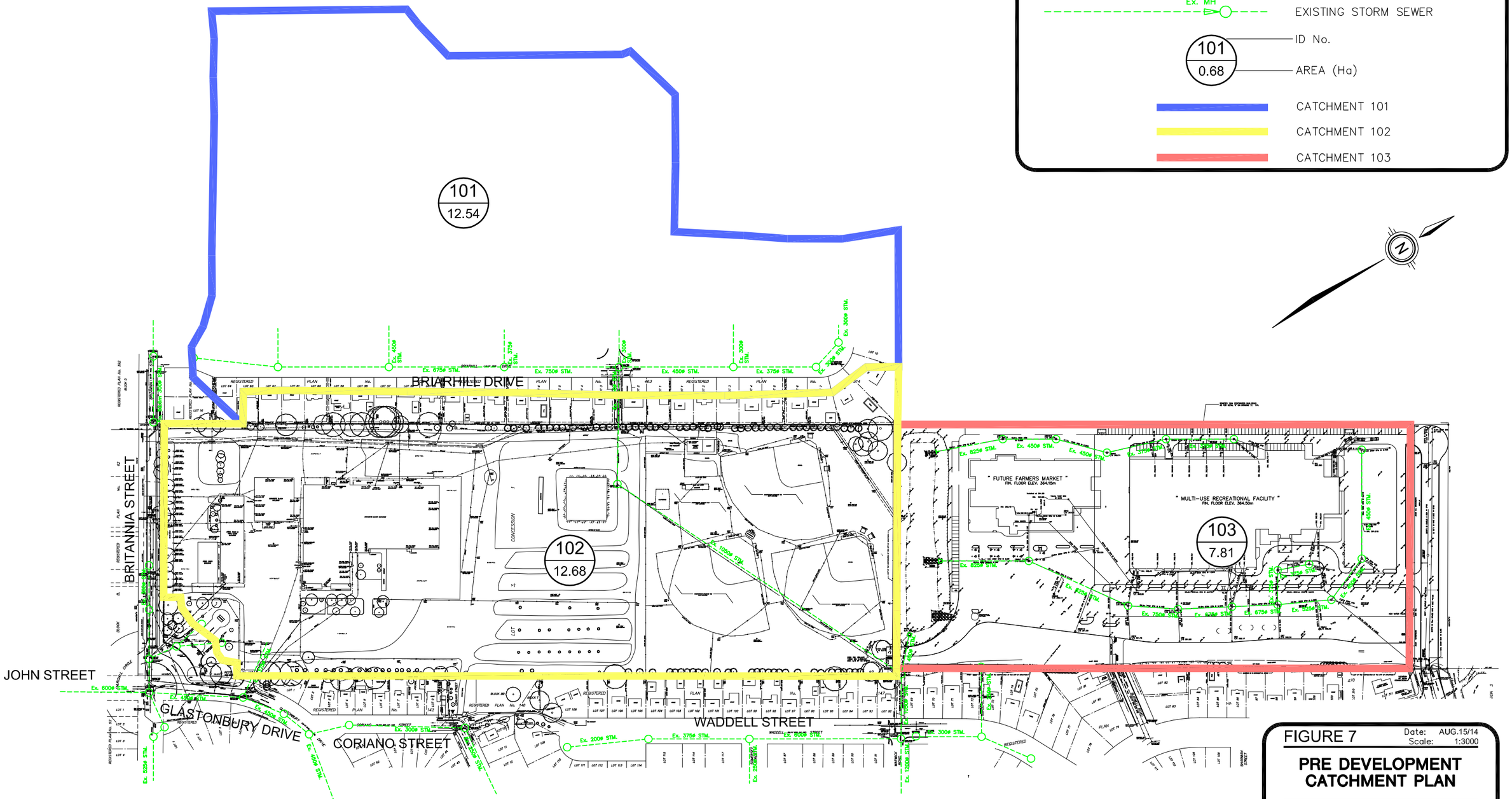

FIGURE 7

Date: AUG.15/14
Scale: 1:3000

PRE DEVELOPMENT CATCHMENT PLAN

MTE

Project No.: 37888-300

BRIARHILL DRIVE

Ex. 675ø STM.

Ex. 750ø STM.

Ex. 450ø STM.

Ex. 375ø STM.

Ex. 300ø STM.

Ex. 450ø STM.

Ex. 375ø STM.

Ex. 300ø STM.

Ex. 300ø STM.

47.5m–1200mmø STM. @ 0.32%

8.0m–1200mmø STM. @ 0.38%

90.0m–675mmø STM. @ 0.55%

90.0m–600mmø STM. @ 0.75%

75.8m–450mmø STM. @ 1.00%

15.4m–675mmø STM. @ 0.55%

12.5m–675mmø STM. @ 0.60%

13.1m–675mmø STM. @ 0.65%

10.0m–900mmø STM. @ 0.50%

46.2m–900mmø STM. @ 0.20%

16.6m–1200mmø STM. @ 1.99%

89.2m–825mmø STM. @ 0.20%

Ex. 825ø STM.

0.3%

0.3%

0.3%

BRITANNIA STREET

66.0m–450mmø STM. @ 1.00%

90.0m–375mmø STM. @ 1.00%

46.5m–900mmø STM. @ 0.35%

90.0m–675mmø STM. @ 0.35%

34.6m–900mmø STM. @ 1.01%

34.6m–375mmø STM. @ 0.87%

43.9m–300mmø STM. @ 1.00%

Ex. 825ø STM.

98.8m–1200mmø STM. @ 0.25%

49.7m–525mmø STM. @ 0.40%

10.1m–450mmø STM. @ 1.00%

Ex. 375ø STM.

51.1m–600mmø STM. @ 0.30%

47.1m–675mmø STM. @ 0.35%

42.6m–675mmø STM. @ 0.35%

54.1m–300mmø STM. @ 0.35%

58.3m–300mmø STM. @ 0.35%

60.0m–1200mmø STM. @ 0.25%

51.3m–1200mmø STM. @ 0.23%

Ex. 250ø STM.

JOHN STREET

Ex. 600ø STM.

Ex. 450ø STM.

GLASTONBURY DRIVE

Ex. 450ø STM.

CORIANO STREET

Ex. 300ø STM.

Ex. 250ø STM.

WADDELL STREET

Ex. 200ø STM.

Ex. 375ø STM.

Ex. 600ø STM.

Ex. 250ø STM.

Ex. 300ø STM.

Ex. 1200ø STM.

1	0.904	0.75	
2	0.554	0.75	
3	0.875	0.75	
4	0.466	0.55	
5	0.533	0.55	
6	0.070	0.55	
7	0.255	0.55	
8	0.147	0.55	
9	0.266	0.55	
10	0.260	0.55	
11	0.264	0.55	
12	0.198	0.55	
13	0.375	0.55	
14	0.309	0.55	
15	0.488	0.55	
16	0.302	0.55	
17	0.799	0.55	
18	0.726	0.55	

LEGEND

- Ex. MH — EXISTING STORM SEWER
- MH — 14.6m–200mmø SAN @ 1.5% — PROPOSED STORM SEWER
- DRAINAGE AREA
- 1 / 2.02 / 0.9 — ID No. / AREA (Ha) / RUNOFF COEFFICIENT
- OVERLAND FLOW ROUTE (MAJOR STORM)
- 1.0% — DIRECTION OF PROPOSED SWALE

FIGURE 8

Date: AUG.15/14

Scale: 1:1750

CONCEPTUAL STORM SERVICING PLAN

MTE

Project No.: 37888-300

January 20, 2015 – 9:05 a.m. – Plotted By: jdick

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LEGEND

- Ex. MH — EXISTING STORM SEWER
- MH — 14.6m–200mmø SAN @ 1.5% — PROPOSED STORM SEWER
- 205 / 0.68 — ID No. / AREA (Ha)
- CATCHMENT 201
- CATCHMENT 202
- CATCHMENT 203
- CATCHMENT 204
- CATCHMENT 204

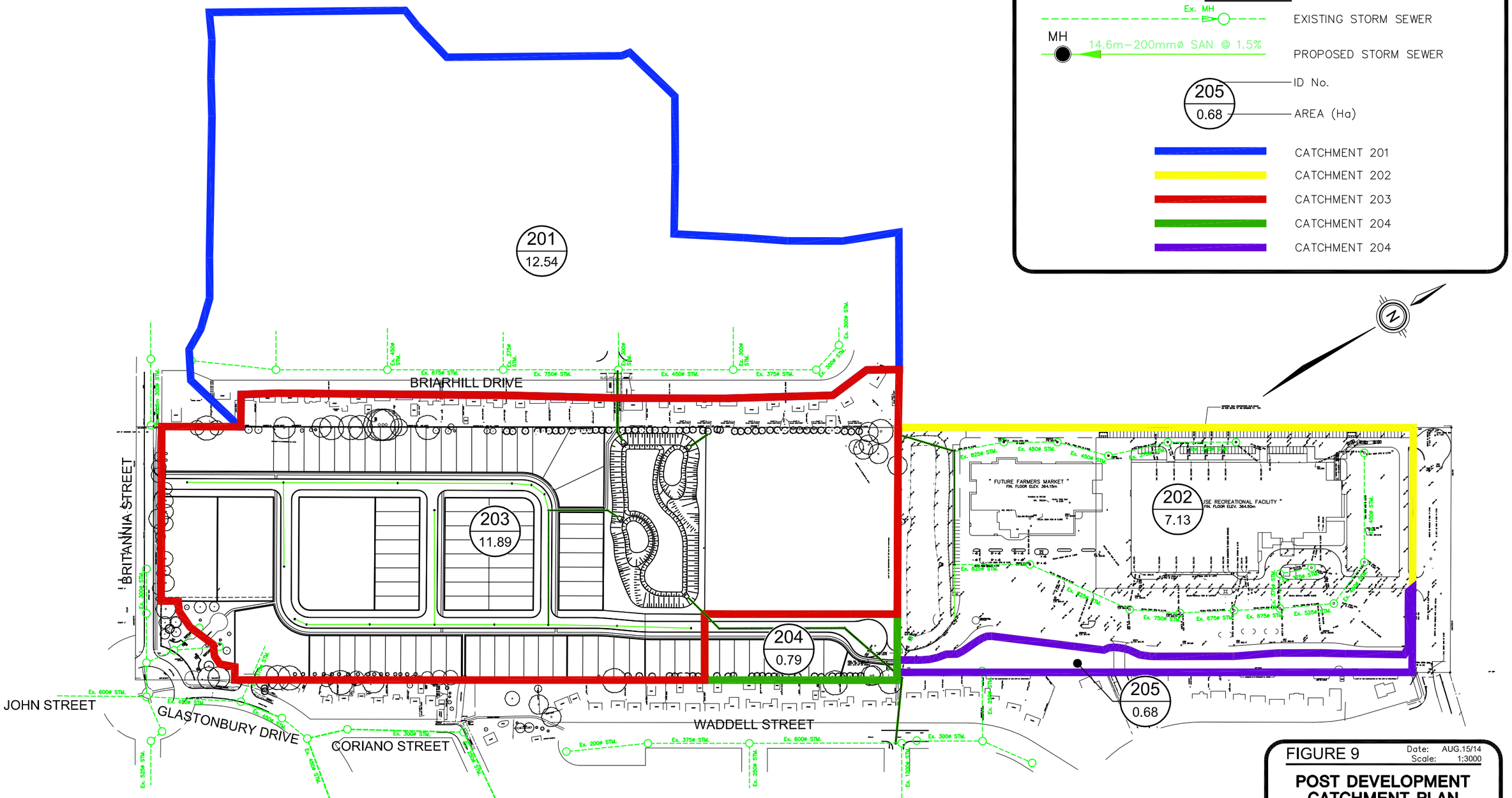

FIGURE 9 — Date: AUG.15/14 — Scale: 1:3000

POST DEVELOPMENT CATCHMENT PLAN

MTE

Project No.: 37888-300

January 20, 2015 — 9:05 a.m. — Plotted By: jdick

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5.4.1 Quality Control

To satisfy the Normal level of quality control for the subject site area of 11.89 ha at 55% impervious, a 110 m^3/ha storage volume was taken from Table 3.2 of the MOE Manual. The quality control storage volume requires an extended detention volume of 476 m^3 and a permanent pool volume of 832 m^3.

Stormwater flows will enter the SWM facility through a headwall into a sediment forebay. The forebay has been designed to be 15.0 m wide by 27.0 m long and be 1.1m deep. This will provide approximate quality volume of 506 m^3 which exceeds the required volume.

For the 7.13 ha of the recreational facility at 95% impervious, an interpolated storage volume of 165 m^3/ha was calculated. The quality control storage volume requires an extended detention volume of 285 m^3 and a permanent pool volume of 892 m^3.

Stormwater flows will enter the SWM facility through a headwall into a second sediment forebay. The forebay has been designed to be 13.0 m wide by 30.0 m long and be 1.1m deep. This will provide approximate quality volume of 530 m^3 which exceeds the required volume.

A permanent pool has been designed to have a maximum ponding depth of 1.1 meter, with 3:1 slopes and provides an approximate volume of 3,380, which exceeds the required volume of 1,724 m^3.

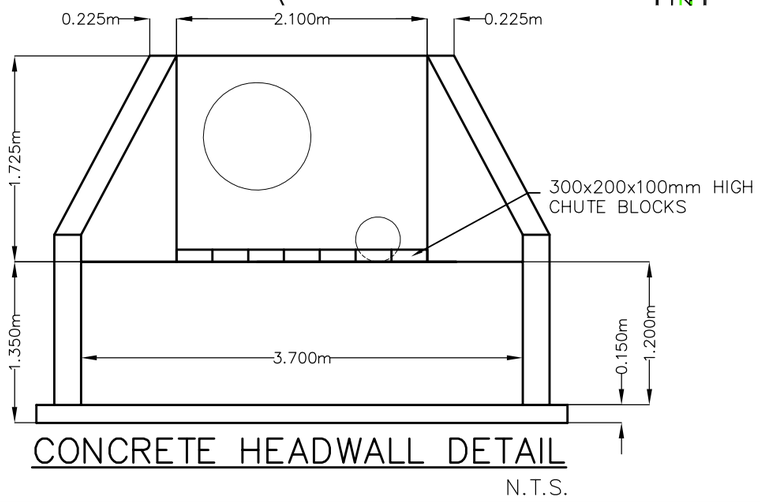
Refer to Figure 10 for illustration and clarification.

5.4.2 Quantity Control

The proposed SWM facility has been sized to accommodate and control the 250 year post development flow to the 5 year pre development flow. A total active storage volume of approximately 20,450 m^3 is available within the pond. Embankment grading to obtain the required storage volume has been designed to have a maximum allowable slope of 3:1.

Flows for extended detention and flood control are discharged to the storm sewer from a multi-stage outlet comprised of a 375mm outlet pipe and a 900mm outlet pipe (Figure 10). The 375mm pipe controls discharge for extended detention and the 900mm pipe is set above the storage elevation for extended detention.

(361.00)
(358.00)
(356.90)
MAX 3:1
4.0m ACCESS ROAD 10:1
MAX SLOPE
SEDIMENT FOREBAY
STORAGE=530m3
ACTIVE STORAGE=20,450m3
PERMANENT POOL
STORAGE=3380m3
SEDIMENT FOREBAY
STORAGE=506m3
REFER TO CONCRETE
HEADWALL DETAIL
PART 2, PLAN 44R-1787
PART 1, PLAN 44R-1787
EASEMENT AS IN INST. No. 174609
BOARD FEI
BOAA



CONCRETE HEADWALL DETAIL

N.T.S.

SWM BASIN PEAK FLOWS PONDING VOLUMES & DEPTHS

STORM EVENT	PEAK FLOW (m^3/s)	ELEVATION (m)	ACTIVE DEPTH (m)	VOLUME (m^3)
5-Year	0.537	359.23	1.23	7260
250-Year	1.988	360.72	2.72	18,165

FIGURE 10

Date: AUG.15/14
Scale: 1:500

CONCEPTUAL SWM POND PLAN

MTE

Project No.: 37888-300

January 20, 2015 — 9:05 a.m. — Plotted By: jdick

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The following table summarizes the stormwater flow at the SWM facility.

Design Storm	Pre-Development (m3/s)	Post Development				Total Flow (m3/s)
		Uncontrolled (m3/s)	Inflow (m3/s)	Discharge (m3/s)	Storage (m3)*	
5-year	2.174	-	-	-	-	2.174
5-year		0.188	2.567	0.537	7,260	0.558
250-year	-	0.614	6.991	1.988	18,165	2.073

* Not including permanent pool storage of 3,380 m^3

See Appendix B for stormwater management calculations and modeling information.

5.5 Summary

The proposed 1.14 ha Stormwater Management Block has been designed to service the proposed residential development, existing recreational facility and the existing trunk storm sewer. The SWM Block has been adequately sized to construct a SWM Facility that will restrict post development peak flows to the 5 year predevelopment peak flow for the 250 year storm post development event.

The SWM Pond will also provide the 'Normal' level of water quality treatment required for the proposed development and recreational facility. The SWM Block has been designed in accordance with the City of Stratford and the *MOE Storm Water Management Planning and Design Manual (2003).*

The preliminary cost to construct the SWM Pond is $315,000. This budget price includes the following items:

- Site preparation, grading & sediment control;
- Earth excavation, headwalls & landscaping.

The preliminary cost for works external to the SWM Block is $250,000. This budget price includes the following items:

- Decommissioning of the existing dry pond;
- Upsizing/installation of Storm sewers and appurtenances;
- LID Swale

The preliminary cost for works associated with the SWM Pond outlet pipe is $204,000.

The trunk storm sewer from Briarhill Drive has been designed to be upgraded and intercepted by the SWM Pond. The trunk sewer upgrades resume after the outlet from the SWM Pond and extend out to Warwick Road.

Overland flow routes that enter and leave the site are to remain in their current locations and be accommodated by the proposed development. Any potential changes to overland flow routes will need to be confirmed during detailed design.

6.0 CONCLUSIONS AND RECOMMENDATIONS

MTE hereby recommends the adoption of this report as a Preliminary Servicing Report demonstrating the intent and feasibility of providing services for the proposed development as summarized below:

Sanitary Servicing

Sanitary sewers for the proposed development will be directed to the proposed Fairgrounds Sanitary Pumping Station:

- The Fairgrounds SPS has been designed to service approximately 8.0ha proposed residential development.
- The Pump station will require an area of approximately 20mx20m and the proposed discharge location for the Fairgrounds SPS is an existing manhole at the intersection of John Street and Charles Street.
- The preliminary cost estimate to construct the Fairgrounds SPS and associated forcemain is $1,140,000.

Stormwater Management and Storm Servicing

The proposed 1.14 ha Stormwater Management Block is adequately sized to construct a SWM Facility that will restrict post development peak flows to the 5 year storm predevelopment peak flows for the 250 year storm post development event. The SWM Pond will also provide the 'Normal' level of water quality treatment required for the proposed development and recreational facility.

- By redirecting the stormwater drainage from the recreational facility to the proposed SWM pond the existing dry pond can be decommissioned and the land can be repurposed to suit the needs of the site.
- The proposed outlet for the SWM Pond is the existing trunk sewer at Warwick Road.
- The preliminary cost estimate to construct the SWM Pond and complete all other stormwater works is $769,000.

All of which is respectfully submitted,

MTE CONSULTANTS INC.

Jamie Dick, P. Eng.
Design Engineer

Bill Veitch, P. Eng.
Director

MTE
More Than Engineering
25 YEARS 1985-2010

APPENDIX A

Sewage Treatment Plant Preliminary Calculations

Conceptual Wastewater Pumping Station Design

Project Name: Stratford Fairgrounds

Project Number: 37888-300

Location: Stratford, ON

Date: October 24, 2014

No.	Calculation Title
1	Wet well sizing to ensure cycle time >or = 10 minutes

Formula

$$V_1 = \frac{T_1 Q_1}{4}$$

Where,

V_1= Minimum wet well volume ensuring a cycle time of of T_1.

Q_1= Pump discharge

T_1= Cycle time (10 minutes minimum per MOE Guidlines)

Cacluation

1.0 EA document flowrate

Parameter	Value	Units	Notes:
Q_1 =	6.4	L/s	
T_1 =	10.0	min	
V_1 =	**961.5**	L	Volume required between Pump ON & Pump OFF
Wet Well Diameter =	1.8	m	
Required Depth =	**0.4**	m	Depth based on required volume and wet well geometry
Ground Elev. =	360.5	mAMSL	
Lowest Inlet Invert =	356.0	mAMSL	
	0.3	m	
Control Spacing =	0.3	m	
	0.3	m	
Sump =	0.2	m	
Total Wet Well Depth =	**6.0**	m	
Wet Well Base Elev. =	354.5	mAMSL	

Calculation by: NJD

Checked by:

2 Forcemain Rating Curve - Flowmaster

Parameter	Value	Units
Outlet Pressure	0	m H20
Pump Inlet Elevation	354.7	mAMSL
Forcemain High Point	359	mAMSL
Forcemain Length	450	m
Ftg Losses (Equiv. Length)	14.783	m
Total (F/M + Equiv. Length)	464.783	m
Roughness Coeff.	130	N/A
Forcemain Diameter	100	mm
Discharge	6.4	L/s
F/M Velocity	0.82	m/s
Total Dynamic Head (TDH)	8.36	m H20
Static Head	4.3	m H20

Stratford Fairground Sewage Pumping Station
Design Flowrate Calculation

Calculation Parameters

		Per concept plan	Per max density
Total Residential Servicing Area (ha)		7.731	
Densitys (units/ ha)	R1	20	
	R2	30	
	R4	50	
	R5	100	
Total number of Units			check
R1 (28350.3 m^2)		52	56.7
R2 (11026.4 m^2)		28	33.1
R4 (11932.1 m^2)		41	59.7
R5 (3624 m^2)		24	36.2
		145	185.7
Persons/ Unit		2.4	2.4
Total Population		348	446

Peak Factor (Harmon) (ave)		4.050		3.999
infiltration (l/s/ha)		0.1		0.1
Per Capita Flow Rate (l/s/pp)	0.004	345.6	(l/pp/day)	345.6

Peak Flow Calculation

Q(peak) = (PqM/86.4)+IA

Q (peak) = ((.348)(345.6)(4.05)/86.4)+(.1)(7.73)

Q(peak) = 6.41083 l/s 7.902103

Average Flow Calculation

Q(avg) = (PqM/86.4)+IA

Q (avg) = ((.348)(345.6)(1.0)/86.4)+(.1)(7.73)

Q(avg) = 2.165 l/s 2.557

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25 YEARS 1985-2010

APPENDIX B

Storm Water Management Preliminary Calculations

STRATFORD FAIRGROUNDS
STORMWATER MANAGEMENT
Stratford, Ontario

Project Number:	37888-300
Date:	December 5, 2014
Design By:	JMD
File:	Q:\37888\300\SWM Design\37888-300 Forebay Design_Rev4.0.0.xls

HYDROLOGIC PARAMETERS

Pre-Development Conditions

Sub-Catchment Number	Area	Percent Impervious	Impervious Area	Overland Slope	Overland Length	SCS Curve Number		Land Use	Comment
						Pervious	Impervious		
	(ha)	*(%)*	*(ha)*	*(%)*	*(m)*				
101	12.54	55	6.90	2.00	36	84	98	Residential	External Subdivision
102	12.68	45	5.71	0.12	610	84	98	Fair Grounds	Future Development
103	7.81	0	0.00	1.50	187	84	98	Farm Land	Future Recreational Facility
Total	**33.03**	**38**	**12.60**						

Post-Development Conditions

Sub-Catchment Number	Area	Percent Impervious	Impervious Area	Overland Slope	Overland Length	SCS Curve Number		Land Use	Comment
						Pervious	Impervious		
	(ha)	*(%)*	*(ha)*	*(%)*	*(m)*				
201	12.54	55	6.90	2.00	36	84	98	Residential	External Subdivision
202	7.13	95	6.77	0.50	60	84	98	Commercial	Recreational Facility
203	11.89	55	6.54	0.50	610	84	98	Residential	Future Development
204	0.79	55	0.43	2.00	36	84	98	Residential	Future Develop. - Uncontrolled
205	0.68	0	0.00	0.50	10	84	98	Commercial	Rec. Facility - Uncontrolled
Total	**33.03**	**63**	**20.64**						

STRATFORD FAIRGROUNDS
STORMWATER MANAGEMENT
Stratford, Ontario

Project Number:	37888-300
Date:	December 5, 2014
Design By:	JMD
File:	Q:\37888\300\SWM Design\37888-300 Forebay Design_Rev4.0.0.xls

FOREBAY DESIGN CALCULATIONS - Proposed Subdivision Outlet
MOE SWM Planning and Design Manual, 2003

Forebay Design Flows

Flow into forebay during the 1:5-year return period event	1.00	m^3/s
Flow into forebay during the 25 mm - 4 hour design storm event	0.37	m^3/s
Peak flow from main pond outlet for the 25mm design storm (from MIDUSS)	0.148	m^3/s

Forebay Characteristics

b =	15.0	*m*	bottom width
y =	1.1	*m*	depth
z =	3	:1	side slope
w =	18.3	*m*	average width
R =	0.92	*m*	hydraulic radius
A =	20.1	m^2	cross-sectional area

1. Length Calculation Based on Settling Velocity

L = forebay flow length *(m)*
r = length-to-width ratio
Q_p = peak flow rate through forebay *(m^3/s)*
v_s = settling velocity *(m/s)*

$$L = \sqrt{\frac{rQ_p}{v_s}}$$ Equation 4.5: Forebay Settling Length

a) Required Settling Length (assuming Q_p = forebay through-flow & v_s = 0.0055 m/s)

Q_p =	0.37	m^3/s	peak flow rate through forebay
v_s =	0.0055	*m/s*	settling velocity
r =	0.20		length-to-width ratio
L =	3.6	*m*	required settling length
L =	*3.6*	*m*	*trial length*

b) Required Settling Length (assuming Q_p = pond discharge & v_s = 0.0003 m/s)

Q_p =	0.148	m^3/s	peak flow rate through forebay
v_s =	0.0003	*m/s*	settling velocity
r =	1.48		length-to-width ratio
L =	27.0	*m*	required settling length
L =	*27*	*m*	*trial length*

Table 1: Average settling velocities

	Mass Removed	Particle Size Range	Average Settling Velocity
	%	*µm*	*m/s*
	80 - 100	x ≤ 20	0.00000254
Enhanced:	70 - 80	20 < x ≤ 40	0.00001300
Normal:	60 - 70	40 < x ≤ 60	0.00002540
Basic:	40 - 60	60 < x ≤ 130	0.00012700
Medium Sand:	20 - 40	130 < x ≤ 400	0.00059267
Gross Grit:	0 - 20	400 < x ≤ 4000	0.00550333

2. Length Calculation Based on Flow Dispersion Length

Q =	1.00	m^3/s	inlet flow rate
d =	1.1	*m*	depth of permanent pool in forebay
V_f =	0.50	*m/s*	desired velocity in forebay (typical value ≤ 0.50 *m/s*)
L =	14.5	m	required length of dispersion

$$L_D = \frac{8Q}{dV_f}$$ Equation 4.6: Dispersion Length

3. Required Forebay Length

L =	**27.0**	***m***	**design length**

STRATFORD FAIRGROUNDS
STORMWATER MANAGEMENT
Stratford, Ontario

Project Number:	37888-300
Date:	December 5, 2014
Design By:	JMD
File:	Q:\37888\300\SWM Design\37888-300 Forebay Design_Rev4.0.0.xls

FOREBAY DESIGN CALCULATIONS - Recreational Complex Outlet
MOE SWM Planning and Design Manual, 2003

Forebay Design Flows

Flow into forebay during the 1:5-year return period event	0.87	m^3/s
Flow into forebay during the 25 mm - 4 hour design storm event	0.32	m^3/s
Peak flow from main pond outlet for the 25mm design storm (from MIDUSS)	0.148	m^3/s

Forebay Characteristics

b =	13.0	*m*	bottom width
y =	1.1	*m*	depth
z =	3	:1	side slope
w =	16.3	*m*	average width
R =	0.90	*m*	hydraulic radius
A =	17.9	m^2	cross-sectional area

1. Length Calculation Based on Settling Velocity

L = forebay flow length *(m)*
r = length-to-width ratio
Q_p = peak flow rate through forebay *(m^3/s)*
v_s = settling velocity *(m/s)*

$$L = \sqrt{\frac{rQ_p}{v_s}}$$ Equation 4.5: Forebay Settling Length

a) Required Settling Length (assuming Q_p = forebay through-flow & v_s = 0.0055 m/s)

Q_p =	0.32	m^3/s	peak flow rate through forebay
v_s =	0.0055	*m/s*	settling velocity
r =	0.21		length-to-width ratio
L =	3.5	*m*	required settling length
L =	*3.5*	*m*	*trial length*

b) Required Settling Length (assuming Q_p = pond discharge & v_s = 0.0003 m/s)

Q_p =	0.148	m^3/s	peak flow rate through forebay
v_s =	0.0003	*m/s*	settling velocity
r =	1.84		length-to-width ratio
L =	30.1	*m*	required settling length
L =	*30*	*m*	*trial length*

Table 1: Average settling velocities

	Mass Removed	Particle Size Range	Average Settling Velocity
	%	*µm*	*m/s*
	80 - 100	x ≤ 20	0.00000254
Enhanced:	70 - 80	20 < x ≤ 40	0.00001300
Normal:	60 - 70	40 < x ≤ 60	0.00002540
Basic:	40 - 60	60 < x ≤ 130	0.00012700
Medium Sand:	20 - 40	130 < x ≤ 400	0.00059267
Gross Grit:	0 - 20	400 < x ≤ 4000	0.00550333

2. Length Calculation Based on Flow Dispersion Length

Q =	0.87	m^3/s	inlet flow rate
d =	1.1	*m*	depth of permanent pool in forebay
V_f =	0.50	*m/s*	desired velocity in forebay (typical value ≤ 0.50 *m/s*)
L =	12.6	m	required length of dispersion

$$L_D = \frac{8Q}{dV_f}$$ Equation 4.6: Dispersion Length

3. Required Forebay Length

L =	**30.1**	***m***	**design length**

Predevelopment Hydrologic Modelling

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                    Q:\37888\300\SWM Design\MIDUSS"
"                Output filename:                      37888-300 Pre005Yr3.out"
"                Licensee name:                                          Admin"
"                Company                                              Microsoft"
"                Date & Time last used:               11/27/2014 at 3:22:38 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      875.105   Coefficient A"
"        7.641   Constant B"
"        0.762   Exponent C"
"        0.400   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          122.128    mm/hr"
"             Total depth                 52.484    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 101"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          101   Briarhill Subdivision"
"       55.000   % Impervious"
"       12.540   Total Area"
"       36.000   Flow length"
"        2.000   Overland Slope"
"        5.643   Pervious Area"
"       36.000   Pervious length"
"        2.000   Pervious slope"
"        6.897   Impervious Area"
"       44.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.450   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.884   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.985     0.000     0.000     0.000 c.m/sec"
"             Catchment 101          Pervious   Impervious Total Area "
"             Surface Area           5.643      6.897      12.540     hectare"
"             Time of concentration  16.608     2.614      6.727      minutes"
"             Time to Centroid       153.035    119.923    129.655    minutes"
"             Rainfall depth         52.484     52.484     52.484     mm"
"             Rainfall volume        2961.67    3619.82    6581.50    c.m"
"             Rainfall losses        28.884     6.092      16.348     mm"
"             Runoff depth           23.601     46.392     36.136     mm"
"             Runoff volume          1331.78    3199.65    4531.43    c.m"
"             Runoff coefficient     0.450      0.884      0.689      "
"             Maximum flow           0.440      1.883      1.985      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.985     1.985     0.000     0.000"
" 51          PIPE DESIGN"
"        1.985   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        1.050   Diameter    metre"
"        0.070   Gradient   %"
```

```
"             Surcharged HGL                0.528    %"
"             Velocity                      2.292    m/sec"
"             Pipe capacity                 0.722    c.m/sec"
"             Critical depth                0.000    metre"
" 53          ROUTE    Pipe Route 94"
"        94.00      Pipe Route 94 Reach length   ( metre)"
"        0.000   X-factor <= 0.5"
"        0.000   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.000   Beta weighting factor"
"        0.000   Routing time step   ( seconds)"
"            0   No. of sub-reaches"
"             Peak outflow                  1.985    c.m/sec"
"                     1.985     1.985     1.985     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                     1.985     1.985     1.985     0.000"
" 33          CATCHMENT 102"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          102   Future Development"
"       45.000   % Impervious"
"       12.680   Total Area"
"      610.000   Flow length"
"        0.120   Overland Slope"
"        6.974   Pervious Area"
"      610.000   Pervious length"
"        0.120   Pervious slope"
"        5.706   Impervious Area"
"      499.091   Impervious length"
"        0.120   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.450   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.900   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.763     1.985     1.985     0.000 c.m/sec"
"             Catchment 102          Pervious   Impervious Total Area "
"             Surface Area           6.974      5.706      12.680     hectare"
"             Time of concentration  211.001    26.101     96.247     minutes"
"             Time to Centroid       430.157    155.989    260.002    minutes"
"             Rainfall depth         52.484     52.484     52.484     mm"
"             Rainfall volume        3660.24    2994.74    6654.98    c.m"
"             Rainfall losses        28.865     5.260      18.243     mm"
"             Runoff depth           23.619     47.224     34.241     mm"
"             Runoff volume          1647.18    2694.60    4341.79    c.m"
"             Runoff coefficient     0.450      0.900      0.652      "
"             Maximum flow           0.070      0.753      0.763      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.763     2.173     1.985     0.000"
" 51          PIPE DESIGN"
"        2.173   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        1.050   Diameter    metre"
"        0.110   Gradient   %"
"             Surcharged HGL                0.633    %"
"             Velocity                      2.510    m/sec"
"             Pipe capacity                 0.906    c.m/sec"
"             Critical depth                0.000    metre"
" 53          ROUTE    Pipe Route 92"
```

```
"        92.00      Pipe Route 92 Reach length   ( metre)"
"        0.000   X-factor <= 0.5"
"        0.000   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.000   Beta weighting factor"
"        0.000   Routing time step   ( seconds)"
"            0   No. of sub-reaches"
"             Peak outflow                  2.173    c.m/sec"
"                     0.763     2.173     2.173     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                  2.173    c.m/sec"
"             Hydrograph volume          8873.207    c.m"
"                     0.763     2.173     2.173     2.173"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.763     0.000     2.173     2.173"
" 33          CATCHMENT 103"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          103   Fair Grounds"
"        0.000   % Impervious"
"        7.810   Total Area"
"      187.000   Flow length"
"        1.500   Overland Slope"
"        7.810   Pervious Area"
"      187.000   Pervious length"
"        1.500   Pervious slope"
"        0.000   Impervious Area"
"        0.000   Impervious length"
"        1.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.450   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.276     0.000     2.173     2.173 c.m/sec"
"             Catchment 103          Pervious   Impervious Total Area "
"             Surface Area           7.810      0.000      7.810      hectare"
"             Time of concentration  48.654     0.002      48.654     minutes"
"             Time to Centroid       198.909    115.322    198.909    minutes"
"             Rainfall depth         52.484     52.484     52.484     mm"
"             Rainfall volume        4099.00    0.00       4099.00    c.m"
"             Rainfall losses        28.846     9.981      28.846     mm"
"             Runoff depth           23.638     42.503     23.638     mm"
"             Runoff volume          1846.12    0.00       1846.12    c.m"
"             Runoff coefficient     0.450      0.000      0.450      "
"             Maximum flow           0.276      0.000      0.276      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.276     0.276     2.173     2.173"
" 52          CHANNEL DESIGN"
"        0.276   Current peak flow    c.m/sec"
"        0.025   Manning 'n'"
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        1.000   Basewidth    metre"
"       50.000   Left bank slope"
"       50.000   Right bank slope"
"        0.300   Channel depth    metre"
```

```
"        0.500   Gradient   %"
"             Depth of flow                0.105    metre"
"             Velocity                     0.420    m/sec"
"             Channel capacity             3.914    c.m/sec"
"             Critical depth               0.082    metre"
" 53          ROUTE    Channel Route 340"
"       340.00      Channel Route 340 Reach length   ( metre)"
"        0.475   X-factor <= 0.5"
"      303.909   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"            2   No. of sub-reaches"
"             Peak outflow                 0.276    c.m/sec"
"                     0.276     0.276     0.276     2.173 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                "
"             Maximum flow                 2.174    c.m/sec"
"             Hydrograph volume        10719.336    c.m"
"                     0.276     0.276     0.276     2.174"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                "
"             Maximum flow                 2.174    c.m/sec"
"             Hydrograph volume        10719.335    c.m"
"                     0.276     2.174     0.276     0.000"
" 51          PIPE DESIGN"
"        2.174   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        1.050   Diameter    metre"
"        0.250   Gradient   %"
"             Surcharged HGL               0.634    %"
"             Velocity                     2.511    m/sec"
"             Pipe capacity                1.365    c.m/sec"
"             Critical depth               0.000    metre"
" 53          ROUTE    Pipe Route 47"
"        47.00      Pipe Route 47 Reach length   ( metre)"
"        0.475   X-factor <= 0.5"
"      303.909   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"            2   No. of sub-reaches"
"             Peak outflow                 2.174    c.m/sec"
"                     0.276     2.174     2.174     0.000 c.m/sec"
" 38          START/RE-START TOTALS 1"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    33.030    hectare"
"             Total Impervious area                   12.603    hectare"
"             Total % impervious                      38.156"
" 19          EXIT"
```

Post Development Hydrologic Modelling

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                    Q:\37888\300\SWM Design\MIDUSS"
"                Output filename:                      37888-300 Pst005Yr2.out"
"                Licensee name:                                          Admin"
"                Company                                              Microsoft"
"                Date & Time last used:                12/2/2014 at 3:55:48 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"      240.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"      875.105   Coefficient A"
"        7.641   Constant B"
"        0.762   Exponent C"
"        0.400   Fraction R"
"      240.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity          122.128    mm/hr"
"             Total depth                 52.484    mm"
"            6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          201   BRIARHILL SUBDIVISION"
"       55.000   % Impervious"
"       12.540   Total Area"
"       36.000   Flow length"
"        2.000   Overland Slope"
"        5.643   Pervious Area"
"       36.000   Pervious length"
"        2.000   Pervious slope"
"        6.897   Impervious Area"
"       44.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.450   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.884   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    1.985     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           5.643      6.897      12.540     hectare"
"             Time of concentration  16.608     2.614      6.727      minutes"
"             Time to Centroid       153.035    119.923    129.655    minutes"
"             Rainfall depth         52.484     52.484     52.484     mm"
"             Rainfall volume        2961.67    3619.82    6581.50    c.m"
"             Rainfall losses        28.884     6.092      16.348     mm"
"             Runoff depth           23.601     46.392     36.136     mm"
"             Runoff volume          1331.78    3199.65    4531.43    c.m"
"             Runoff coefficient     0.450      0.884      0.689      "
"             Maximum flow           0.440      1.883      1.985      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    1.985     1.985     0.000     0.000"
" 51          PIPE DESIGN"
"        1.985   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        1.200   Diameter    metre"
"        0.300   Gradient   %"
```

```
"             Depth of flow                 0.915    metre"
"             Velocity                      2.145    m/sec"
"             Pipe capacity                 2.135    c.m/sec"
"             Critical depth                0.775    metre"
" 53          ROUTE    Pipe Route 60"
"        60.00      Pipe Route 60 Reach length   ( metre)"
"        0.000   X-factor <= 0.5"
"       20.984   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.856   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  1.910    c.m/sec"
"                    1.985     1.985     1.910     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                SWM POND"
"             Maximum flow                  1.910    c.m/sec"
"             Hydrograph volume          4531.426    c.m"
"                    1.985     1.985     1.910     1.910"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    1.985     0.000     1.910     1.910"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          202   Fair Grounds"
"       95.000   % Impervious"
"        7.130   Total Area"
"       60.000   Flow length"
"        0.500   Overland Slope"
"        0.357   Pervious Area"
"       60.000   Pervious length"
"        0.500   Pervious slope"
"        6.773   Impervious Area"
"     1140.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.450   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.900   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.875     0.000     1.910     1.910 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.357      6.773      7.130      hectare"
"             Time of concentration  34.201     27.922     28.083     minutes"
"             Time to Centroid       178.206    158.786    159.284    minutes"
"             Rainfall depth         52.484     52.484     52.484     mm"
"             Rainfall volume        187.11     3555.01    3742.11    c.m"
"             Rainfall losses        28.853     5.258      6.438      mm"
"             Runoff depth           23.631     47.226     46.046     mm"
"             Runoff volume          84.24      3198.85    3283.09    c.m"
"             Runoff coefficient     0.450      0.900      0.877      "
"             Maximum flow           0.017      0.859      0.875      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.875     0.875     1.910     1.910"
" 52          CHANNEL DESIGN"
"        0.875   Current peak flow    c.m/sec"
"        0.040   Manning 'n'"
```

```
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        3.000   Basewidth    metre"
"        3.000   Left bank slope"
"        3.000   Right bank slope"
"        0.750   Channel depth    metre"
"        0.500   Gradient   %"
"             Depth of flow                0.316    metre"
"             Velocity                     0.701    m/sec"
"             Channel capacity             4.434    c.m/sec"
"             Critical depth               0.192    metre"
" 53          ROUTE    Channel Route 250"
"       250.00      Channel Route 250 Reach length   ( metre)"
"        0.430   X-factor <= 0.5"
"      267.494   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"             1   No. of sub-reaches"
"             Peak outflow                 0.869    c.m/sec"
"                     0.875     0.875     0.869     1.910 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 SWM POND"
"             Maximum flow                 2.005    c.m/sec"
"             Hydrograph volume         7814.511    c.m"
"                     0.875     0.875     0.869     2.005"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                     0.875     0.000     0.869     2.005"
" 33          CATCHMENT 203"
"             1   Triangular SCS"
"             2   Proportional to %"
"             1   SCS method"
"           203   Future Development"
"        55.000   % Impervious"
"        11.890   Total Area"
"       610.000   Flow length"
"        0.500   Overland Slope"
"        5.351   Pervious Area"
"       610.000   Pervious length"
"        0.500   Pervious slope"
"        6.540   Impervious Area"
"       745.556   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.450   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.900   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     1.022     0.000     0.869     2.005 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           5.351      6.540      11.890     hectare"
"             Time of concentration  137.514    21.642     55.307     minutes"
"             Time to Centroid       326.005    149.140    200.526    minutes"
"             Rainfall depth         52.484     52.484     52.484     mm"
"             Rainfall volume        2808.16    3432.19    6240.35    c.m"
"             Rainfall losses        28.848     5.261      15.875     mm"
"             Runoff depth           23.636     47.223     36.609     mm"
"             Runoff volume          1264.66    3088.12    4352.78    c.m"
"             Runoff coefficient     0.450      0.900      0.698      "
"             Maximum flow           0.079      1.009      1.022      c.m/sec"
```

```
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     1.022     1.022     0.869     2.005"
" 52          CHANNEL DESIGN"
"         1.022   Current peak flow    c.m/sec"
"         0.015   Manning 'n'"
"            0.   Cross-section type: 0=trapezoidal; 1=general"
"         2.000   Basewidth    metre"
"        50.000   Left bank slope"
"        50.000   Right bank slope"
"         0.300   Channel depth    metre"
"         0.500   Gradient   %"
"              Depth of flow                 0.136    metre"
"              Velocity                      0.852    m/sec"
"              Channel capacity              7.066    c.m/sec"
"              Critical depth                0.135    metre"
" 53          ROUTE    Channel Route 50"
"         50.00      Channel Route 50 Reach length   ( metre)"
"         0.385   X-factor <= 0.5"
"        44.026   K-lag   ( seconds)"
"         0.000   Default(0) or user spec.(1) values used"
"         0.500   X-factor <= 0.5"
"        30.000   K-lag   ( seconds)"
"         0.500   Beta weighting factor"
"        50.000   Routing time step   ( seconds)"
"             1   No. of sub-reaches"
"              Peak outflow                  1.002    c.m/sec"
"                     1.022     1.022     1.002     2.005 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                SWM POND"
"              Maximum flow                  2.567    c.m/sec"
"              Hydrograph volume         12167.296    c.m"
"                     1.022     1.022     1.002     2.567"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                SWM POND"
"              Maximum flow                  2.567    c.m/sec"
"              Hydrograph volume         12167.297    c.m"
"                     1.022     2.567     1.002     0.000"
" 54          POND DESIGN"
"         2.567   Current peak flow    c.m/sec"
"         2.000   Target outflow    c.m/sec"
"       12167.3   Hydrograph volume    c.m"
"           16.   Number of stages"
"       100.000   Minimum water level    metre"
"       103.000   Maximum water level    metre"
"       100.000   Starting water level    metre"
"             0   Keep Design Data: 1 = True; 0 = False"
"                   Level Discharge    Volume"
"                 100.000     0.000     0.000"
"                 100.200   0.02045  1074.207"
"                 100.400   0.06830  2187.288"
"                 100.600    0.1209  3339.734"
"                 100.800    0.1986  4532.208"
"                 101.000    0.3288  5765.196"
"                 101.200    0.5024  7039.318"
"                 101.400    0.7069  8355.202"
"                 101.600    0.9282  9713.323"
"                 101.800     1.151  11114.36"
"                 102.000     1.363  12558.78"
"                 102.200     1.558  14047.22"
"                 102.400     1.735  15580.31"
"                 102.600     1.896  17158.50"
"                 102.800     2.045  18782.50"
"                 103.000     2.183  20452.76"
"           1.   LAYERS"
```

```
"                Bottom    Aspect    Bottom       Top   Average"
"                  area     ratio elevation elevation sideslope"
"             5275.000     2.400   100.000   103.000     3.000"
"          2.   OUTFLOW PIPE"
"             Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"               invert    invert    Length  Diameter       'n'   loss Ke"
"              100.000    99.700    30.000     0.375     0.013     0.500"
"              100.600   100.300    30.000     0.900     0.013     0.500"
"            Peak outflow                  0.537    c.m/sec"
"            Maximum level               101.234    metre"
"            Maximum storage            7260.573    c.m"
"            Centroidal lag                8.991   hours"
"                 1.022     2.567     0.537     0.000 c.m/sec"
" 40         HYDROGRAPH Next link "
"           5   Next link "
"                    1.022     0.537     0.537     0.000"
" 33         CATCHMENT 204"
"           1   Triangular SCS"
"           2   Proportional to %"
"           1   SCS method"
"         204   Future Development"
"      55.000   % Impervious"
"       0.790   Total Area"
"      36.000   Flow length"
"       2.000   Overland Slope"
"       0.356   Pervious Area"
"      36.000   Pervious length"
"       2.000   Pervious slope"
"       0.435   Impervious Area"
"      44.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      84.000   Pervious SCS Curve No."
"       0.450   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       4.838   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.884   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                    0.125     0.537     0.537     0.000 c.m/sec"
"            Catchment 204          Pervious   Impervious Total Area "
"            Surface Area           0.356      0.435      0.790      hectare"
"            Time of concentration  16.608     2.614      6.727      minutes"
"            Time to Centroid       153.036    119.923    129.655    minutes"
"            Rainfall depth         52.484     52.484     52.484     mm"
"            Rainfall volume        186.58     228.04     414.62     c.m"
"            Rainfall losses        28.884     6.092      16.348     mm"
"            Runoff depth           23.601     46.392     36.136     mm"
"            Runoff volume          83.90      201.57     285.47     c.m"
"            Runoff coefficient     0.450      0.884      0.689      "
"            Maximum flow           0.028      0.119      0.125      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                    0.125     0.547     0.537     0.000"
" 52         CHANNEL DESIGN"
"       0.547   Current peak flow    c.m/sec"
"       0.015   Manning 'n'"
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       8.000   Basewidth    metre"
"      50.000   Left bank slope"
"      50.000   Right bank slope"
"       0.300   Channel depth    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.070    metre"
"            Velocity                      0.673    m/sec"
"            Channel capacity             10.429    c.m/sec"
"            Critical depth                0.067    metre"
```

```
" 53          ROUTE    Channel Route 170"
"       170.00      Channel Route 170 Reach length   ( metre)"
"        0.478   X-factor <= 0.5"
"      189.367   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  0.547    c.m/sec"
"                     0.125     0.547     0.547     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  0.547    c.m/sec"
"             Hydrograph volume         11625.695    c.m"
"                     0.125     0.547     0.547     0.547"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.125     0.000     0.547     0.547"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          205   Fair Grounds - Uncontrolled"
"        0.000   % Impervious"
"        0.680   Total Area"
"       10.000   Flow length"
"        0.500   Overland Slope"
"        0.680   Pervious Area"
"       10.000   Pervious length"
"        0.500   Pervious slope"
"        0.000   Impervious Area"
"        0.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.450   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.063     0.000     0.547     0.547 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.680      0.000      0.680      hectare"
"             Time of concentration  11.672     0.000      11.672     minutes"
"             Time to Centroid       145.915    115.326    145.915    minutes"
"             Rainfall depth         52.484     52.484     52.484     mm"
"             Rainfall volume        356.89     0.00       356.89     c.m"
"             Rainfall losses        28.863     9.963      28.863     mm"
"             Runoff depth           23.621     42.521     23.621     mm"
"             Runoff volume          160.62     0.00       160.62     c.m"
"             Runoff coefficient     0.450      0.000      0.450      "
"             Maximum flow           0.063      0.000      0.063      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.063     0.063     0.547     0.547"
" 52          CHANNEL DESIGN"
"        0.063   Current peak flow    c.m/sec"
"        0.040   Manning 'n'"
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        0.000   Basewidth    metre"
"       50.000   Left bank slope"
"       50.000   Right bank slope"
```

```
"        0.300   Channel depth    metre"
"        0.500   Gradient   %"
"             Depth of flow                0.079    metre"
"             Velocity                     0.204    m/sec"
"             Channel capacity             2.245    c.m/sec"
"             Critical depth               0.050    metre"
" 53          ROUTE    Channel Route 360"
"       360.00      Channel Route 360 Reach length   ( metre)"
"        0.459   X-factor <= 0.5"
"      264.418   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"            5   No. of sub-reaches"
"             Peak outflow                 0.059    c.m/sec"
"                    0.063     0.063     0.059     0.547 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                 0.558    c.m/sec"
"             Hydrograph volume        11786.317    c.m"
"                    0.063     0.063     0.059     0.558"
" 38          START/RE-START TOTALS 205"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    33.030    hectare"
"             Total Impervious area                   20.644    hectare"
"             Total % impervious                      62.502"
" 19          EXIT"
```

```
"               MIDUSS Output ----------------------------------------------->"
"               MIDUSS version                          Version 2.25  rev. 473"
"               MIDUSS created                       Sunday, February 07, 2010"
"          10   Units used:                                          ie METRIC"
"               Job folder:                    Q:\37888\300\SWM Design\MIDUSS"
"               Output filename:                       37888-300 Pst25mm2.out"
"               Licensee name:                                           Admin"
"               Company                                              Microsoft"
"               Date & Time last used:               12/2/2014 at 3:50:43 PM"
" 31          TIME PARAMETERS"
"       5.000   Time Step"
"     240.000   Max. Storm length"
"    1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"     510.410   Coefficient A"
"       5.500   Constant B"
"       0.800   Exponent C"
"       0.400   Fraction R"
"     240.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity            74.660    mm/hr"
"            Total depth                  25.000    mm"
"           5   25hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"           1   Triangular SCS"
"           2   Proportional to %"
"           1   SCS method"
"         201   BRIARHILL SUBDIVISION"
"      55.000   % Impervious"
"      12.540   Total Area"
"      36.000   Flow length"
"       2.000   Overland Slope"
"       5.643   Pervious Area"
"      36.000   Pervious length"
"       2.000   Pervious slope"
"       6.897   Impervious Area"
"      44.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      84.000   Pervious SCS Curve No."
"       0.237   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       4.838   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.795   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                   0.949     0.000     0.000     0.000 c.m/sec"
"            Catchment 201          Pervious   Impervious Total Area "
"            Surface Area           5.643      6.897      12.540     hectare"
"            Time of concentration  27.328     3.283      8.000      minutes"
"            Time to Centroid       171.367    122.279    131.909    minutes"
"            Rainfall depth         25.000     25.000     25.000     mm"
"            Rainfall volume        1410.74    1724.24    3134.99    c.m"
"            Rainfall losses        19.072     5.127      11.402     mm"
"            Runoff depth           5.928      19.872     13.598     mm"
"            Runoff volume          334.53     1370.60    1705.13    c.m"
"            Runoff coefficient     0.237      0.795      0.544      "
"            Maximum flow           0.075      0.941      0.949      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                   0.949     0.949     0.000     0.000"
" 51          PIPE DESIGN"
"       0.949   Current peak flow    c.m/sec"
"       0.013   Manning 'n'"
"       1.200   Diameter    metre"
"       0.300   Gradient   %"
```

```
"             Depth of flow                 0.560    metre"
"             Velocity                      1.832    m/sec"
"             Pipe capacity                 2.135    c.m/sec"
"             Critical depth                0.527    metre"
" 53          ROUTE    Pipe Route 60"
"        60.00      Pipe Route 60 Reach length   ( metre)"
"        0.000   X-factor <= 0.5"
"       24.559   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.662   Beta weighting factor"
"       60.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  0.898    c.m/sec"
"                    0.949     0.949     0.898     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                SWM POND"
"             Maximum flow                  0.898    c.m/sec"
"             Hydrograph volume          1705.127    c.m"
"                    0.949     0.949     0.898     0.898"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.949     0.000     0.898     0.898"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          202   Fair Grounds"
"       95.000   % Impervious"
"        7.130   Total Area"
"       60.000   Flow length"
"        0.500   Overland Slope"
"        0.357   Pervious Area"
"       60.000   Pervious length"
"        0.500   Pervious slope"
"        6.773   Impervious Area"
"     1140.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.237   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.808   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    0.316     0.000     0.898     0.898 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
"             Surface Area           0.357      6.773      7.130      hectare"
"             Time of concentration  56.278     35.068     35.390     minutes"
"             Time to Centroid       212.956    173.038    173.645    minutes"
"             Rainfall depth         25.000     25.000     25.000     mm"
"             Rainfall volume        89.12      1693.37    1782.49    c.m"
"             Rainfall losses        19.071     4.809      5.522      mm"
"             Runoff depth           5.929      20.191     19.478     mm"
"             Runoff volume          21.14      1367.61    1388.75    c.m"
"             Runoff coefficient     0.237      0.808      0.779      "
"             Maximum flow           0.003      0.314      0.316      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.316     0.316     0.898     0.898"
" 52          CHANNEL DESIGN"
"        0.316   Current peak flow    c.m/sec"
"        0.040   Manning 'n'"
```

```
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        3.000   Basewidth    metre"
"        3.000   Left bank slope"
"        3.000   Right bank slope"
"        0.750   Channel depth    metre"
"        0.500   Gradient   %"
"             Depth of flow                0.178    metre"
"             Velocity                     0.504    m/sec"
"             Channel capacity             4.434    c.m/sec"
"             Critical depth               0.101    metre"
" 53          ROUTE    Channel Route 250"
"       250.00      Channel Route 250 Reach length   ( metre)"
"        0.418   X-factor <= 0.5"
"      186.091   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"             2   No. of sub-reaches"
"             Peak outflow                 0.315    c.m/sec"
"                     0.316     0.316     0.315     0.898 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"             6   Combine "
"             1   Node #"
"                 SWM POND"
"             Maximum flow                 0.926    c.m/sec"
"             Hydrograph volume         3093.878    c.m"
"                     0.316     0.316     0.315     0.926"
" 40          HYDROGRAPH Start - New Tributary"
"             2   Start - New Tributary"
"                     0.316     0.000     0.315     0.926"
" 33          CATCHMENT 203"
"             1   Triangular SCS"
"             2   Proportional to %"
"             1   SCS method"
"           203   Future Development"
"        55.000   % Impervious"
"        11.890   Total Area"
"       610.000   Flow length"
"        0.500   Overland Slope"
"        5.351   Pervious Area"
"       610.000   Pervious length"
"        0.500   Pervious slope"
"        6.540   Impervious Area"
"       745.556   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"        84.000   Pervious SCS Curve No."
"        0.237   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"        0.808   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.375     0.000     0.315     0.926 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           5.351      6.540      11.890     hectare"
"             Time of concentration  226.281    27.180     65.729     minutes"
"             Time to Centroid       456.264    160.404    217.687    minutes"
"             Rainfall depth         25.000     25.000     25.000     mm"
"             Rainfall volume        1337.62    1634.87    2972.49    c.m"
"             Rainfall losses        19.073     4.802      11.224     mm"
"             Runoff depth           5.927      20.198     13.776     mm"
"             Runoff volume          317.13     1320.83    1637.96    c.m"
"             Runoff coefficient     0.237      0.808      0.551      "
"             Maximum flow           0.012      0.373      0.375      c.m/sec"
```

```
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.375     0.375     0.315     0.926"
" 52          CHANNEL DESIGN"
"         0.375   Current peak flow    c.m/sec"
"         0.015   Manning 'n'"
"            0.   Cross-section type: 0=trapezoidal; 1=general"
"         2.000   Basewidth    metre"
"        50.000   Left bank slope"
"        50.000   Right bank slope"
"         0.300   Channel depth    metre"
"         0.500   Gradient   %"
"              Depth of flow                 0.088    metre"
"              Velocity                      0.660    m/sec"
"              Channel capacity              7.066    c.m/sec"
"              Critical depth                0.085    metre"
" 53          ROUTE    Channel Route 50"
"         50.00      Channel Route 50 Reach length   ( metre)"
"         0.422   X-factor <= 0.5"
"        56.823   K-lag   ( seconds)"
"         0.000   Default(0) or user spec.(1) values used"
"         0.500   X-factor <= 0.5"
"        30.000   K-lag   ( seconds)"
"         0.500   Beta weighting factor"
"        60.000   Routing time step   ( seconds)"
"              1   No. of sub-reaches"
"              Peak outflow                  0.371    c.m/sec"
"                     0.375     0.375     0.371     0.926 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                SWM POND"
"              Maximum flow                  1.067    c.m/sec"
"              Hydrograph volume          4731.842    c.m"
"                     0.375     0.375     0.371     1.067"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                SWM POND"
"              Maximum flow                  1.067    c.m/sec"
"              Hydrograph volume          4731.842    c.m"
"                     0.375     1.067     0.371     0.000"
" 54          POND DESIGN"
"         1.067   Current peak flow    c.m/sec"
"         2.000   Target outflow    c.m/sec"
"        4731.8   Hydrograph volume    c.m"
"           16.   Number of stages"
"       100.000   Minimum water level    metre"
"       103.000   Maximum water level    metre"
"       100.000   Starting water level    metre"
"              0   Keep Design Data: 1 = True; 0 = False"
"                    Level Discharge    Volume"
"                  100.000     0.000     0.000"
"                  100.200   0.02045  1074.207"
"                  100.400   0.06830  2187.288"
"                  100.600    0.1209  3339.734"
"                  100.800    0.1986  4532.208"
"                  101.000    0.3288  5765.196"
"                  101.200    0.5024  7039.318"
"                  101.400    0.7069  8355.202"
"                  101.600    0.9282  9713.323"
"                  101.800     1.151  11114.36"
"                  102.000     1.363  12558.78"
"                  102.200     1.558  14047.22"
"                  102.400     1.735  15580.31"
"                  102.600     1.896  17158.50"
"                  102.800     2.045  18782.50"
"                  103.000     2.183  20452.76"
"            1.   LAYERS"
```

```
"                Bottom    Aspect    Bottom       Top   Average"
"                  area     ratio elevation elevation sideslope"
"             5275.000     2.400   100.000   103.000     3.000"
"          2.   OUTFLOW PIPE"
"             Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"               invert    invert    Length  Diameter       'n'   loss Ke"
"              100.000    99.700    30.000     0.375     0.013     0.500"
"              100.600   100.300    30.000     0.900     0.013     0.500"
"            Peak outflow                  0.118    c.m/sec"
"            Maximum level               100.590    metre"
"            Maximum storage            3279.455    c.m"
"            Centroidal lag               12.509   hours"
"                 0.375     1.067     0.118     0.000 c.m/sec"
" 40         HYDROGRAPH Next link "
"           5   Next link "
"                 0.375     0.118     0.118     0.000"
" 33         CATCHMENT 204"
"           1   Triangular SCS"
"           2   Proportional to %"
"           1   SCS method"
"         204   Future Development"
"      55.000   % Impervious"
"       0.790   Total Area"
"      36.000   Flow length"
"       2.000   Overland Slope"
"       0.356   Pervious Area"
"      36.000   Pervious length"
"       2.000   Pervious slope"
"       0.435   Impervious Area"
"      44.000   Impervious length"
"       2.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      84.000   Pervious SCS Curve No."
"       0.237   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"       4.838   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      98.000   Impervious SCS Curve No."
"       0.795   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.518   Impervious Initial abstraction"
"                 0.060     0.118     0.118     0.000 c.m/sec"
"            Catchment 204          Pervious   Impervious Total Area "
"            Surface Area           0.356      0.435      0.790      hectare"
"            Time of concentration  27.328     3.283      8.000      minutes"
"            Time to Centroid       171.367    122.279    131.909    minutes"
"            Rainfall depth         25.000     25.000     25.000     mm"
"            Rainfall volume        88.87      108.62     197.50     c.m"
"            Rainfall losses        19.072     5.127      11.402     mm"
"            Runoff depth           5.928      19.872     13.598     mm"
"            Runoff volume          21.07      86.35      107.42     c.m"
"            Runoff coefficient     0.237      0.795      0.544      "
"            Maximum flow           0.005      0.059      0.060      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                 0.060     0.121     0.118     0.000"
" 52         CHANNEL DESIGN"
"       0.121   Current peak flow    c.m/sec"
"       0.015   Manning 'n'"
"          0.   Cross-section type: 0=trapezoidal; 1=general"
"       8.000   Basewidth    metre"
"      50.000   Left bank slope"
"      50.000   Right bank slope"
"       0.300   Channel depth    metre"
"       0.500   Gradient   %"
"            Depth of flow                 0.030    metre"
"            Velocity                      0.417    m/sec"
"            Channel capacity             10.429    c.m/sec"
"            Critical depth                0.027    metre"
```

```
" 53          ROUTE    Channel Route 170"
"       170.00      Channel Route 170 Reach length   ( metre)"
"        0.490   X-factor <= 0.5"
"      305.982   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  0.121    c.m/sec"
"                     0.060     0.121     0.121     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                  0.121    c.m/sec"
"             Hydrograph volume          4197.022    c.m"
"                     0.060     0.121     0.121     0.121"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                     0.060     0.000     0.121     0.121"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          205   Fair Grounds - Uncontrolled"
"        0.000   % Impervious"
"        0.680   Total Area"
"       10.000   Flow length"
"        0.500   Overland Slope"
"        0.680   Pervious Area"
"       10.000   Pervious length"
"        0.500   Pervious slope"
"        0.000   Impervious Area"
"        0.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.237   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.000   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     0.011     0.000     0.121     0.121 c.m/sec"
"             Catchment 205          Pervious   Impervious Total Area "
"             Surface Area           0.680      0.000      0.680      hectare"
"             Time of concentration  19.207     0.001      19.207     minutes"
"             Time to Centroid       159.747    116.341    159.747    minutes"
"             Rainfall depth         25.000     25.000     25.000     mm"
"             Rainfall volume        170.00     0.00       170.00     c.m"
"             Rainfall losses        19.081     6.820      19.081     mm"
"             Runoff depth           5.919      18.180     5.919      mm"
"             Runoff volume          40.25      0.00       40.25      c.m"
"             Runoff coefficient     0.237      0.000      0.237      "
"             Maximum flow           0.011      0.000      0.011      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     0.011     0.011     0.121     0.121"
" 52          CHANNEL DESIGN"
"        0.011   Current peak flow    c.m/sec"
"        0.040   Manning 'n'"
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        0.000   Basewidth    metre"
"       50.000   Left bank slope"
"       50.000   Right bank slope"
```

```
"        0.300   Channel depth    metre"
"        0.500   Gradient   %"
"             Depth of flow                0.041    metre"
"             Velocity                     0.132    m/sec"
"             Channel capacity             2.245    c.m/sec"
"             Critical depth               0.025    metre"
" 53          ROUTE    Channel Route 360"
"       360.00      Channel Route 360 Reach length   ( metre)"
"        0.470   X-factor <= 0.5"
"      292.179   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"             7   No. of sub-reaches"
"             Peak outflow                 0.011    c.m/sec"
"                     0.011     0.011     0.011     0.121 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                 0.122    c.m/sec"
"             Hydrograph volume         4237.274    c.m"
"                     0.011     0.011     0.011     0.122"
" 38          START/RE-START TOTALS 205"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    33.030    hectare"
"             Total Impervious area                   20.644    hectare"
"             Total % impervious                      62.502"
" 19          EXIT"
```

```
"                MIDUSS Output ------------------------------------------------>"
"                MIDUSS version                          Version 2.25  rev. 473"
"                MIDUSS created                       Sunday, February 07, 2010"
"           10   Units used:                                          ie METRIC"
"                Job folder:                    Q:\37888\300\SWM Design\MIDUSS"
"                Output filename:                      37888-300 Pst250Yr7.out"
"                Licensee name:                                          Admin"
"                Company                                              Microsoft"
"                Date & Time last used:                12/2/2014 at 3:44:56 PM"
" 31          TIME PARAMETERS"
"        5.000   Time Step"
"     1440.000   Max. Storm length"
"     1500.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"            1   Chicago storm"
"     2095.179   Coefficient A"
"       13.509   Constant B"
"        0.773   Exponent C"
"        0.400   Fraction R"
"     1440.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           213.438    mm/hr"
"             Total depth                 180.669    mm"
"            6   250hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 201"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          201   BRIARHILL SUBDIVISION"
"       55.000   % Impervious"
"       12.540   Total Area"
"       36.000   Flow length"
"        2.000   Overland Slope"
"        5.643   Pervious Area"
"       36.000   Pervious length"
"        2.000   Pervious slope"
"        6.897   Impervious Area"
"       44.000   Impervious length"
"        2.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.760   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.957   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                     4.973     0.000     0.000     0.000 c.m/sec"
"             Catchment 201          Pervious   Impervious Total Area "
"             Surface Area           5.643      6.897      12.540     hectare"
"             Time of concentration  10.607     2.065      5.429      minutes"
"             Time to Centroid       716.219    655.123    679.183    minutes"
"             Rainfall depth         180.669    180.669    180.669    mm"
"             Rainfall volume        1.0195     1.2461     2.2656     ha-m"
"             Rainfall losses        43.332     7.715      23.742     mm"
"             Runoff depth           137.337    172.954    156.927    mm"
"             Runoff volume          0.7750     1.1929     1.9679     ha-m"
"             Runoff coefficient     0.760      0.957      0.869      "
"             Maximum flow           2.095      3.624      4.973      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                     4.973     4.973     0.000     0.000"
" 56          DIVERSION"
"          201   Node number"
"        2.114   Overflow threshold"
"        1.000   Required diverted fraction"
"            1   Conduit type; 1=Pipe;2=Channel"
```

```
"        2.135   Conduit capacity"
"        1.200   Conduit height/diameter"
"        0.300   Conduit Grade (%)"
"             Peak of diverted flow         2.859    c.m/sec"
"             Volume of diverted flow    2628.377    c.m"
"             DIV00201.250hyd"
"             Major flow at 201"
"                    4.973     4.973     2.114     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"            5   Next link "
"                    4.973     2.114     2.114     0.000"
" 51          PIPE DESIGN"
"        2.114   Current peak flow    c.m/sec"
"        0.013   Manning 'n'"
"        1.200   Diameter    metre"
"        0.300   Gradient   %"
"             Depth of flow                 0.973    metre"
"             Velocity                      2.153    m/sec"
"             Pipe capacity                 2.135    c.m/sec"
"             Critical depth                0.801    metre"
" 53          ROUTE    Pipe Route 60"
"        60.00      Pipe Route 60 Reach length   ( metre)"
"        0.000   X-factor <= 0.5"
"       20.906   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.919   Beta weighting factor"
"      100.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                  2.114    c.m/sec"
"                    4.973     2.114     2.114     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                SWM POND"
"             Maximum flow                  2.114    c.m/sec"
"             Hydrograph volume         17050.020    c.m"
"                    4.973     2.114     2.114     2.114"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    4.973     0.000     2.114     2.114"
" 33          CATCHMENT 202"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          202   Fair Grounds"
"       95.000   % Impervious"
"        7.130   Total Area"
"       60.000   Flow length"
"        0.500   Overland Slope"
"        0.357   Pervious Area"
"       60.000   Pervious length"
"        0.500   Pervious slope"
"        6.773   Impervious Area"
"     1140.000   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.755   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       98.000   Impervious SCS Curve No."
"        0.960   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    2.454     0.000     2.114     2.114 c.m/sec"
"             Catchment 202          Pervious   Impervious Total Area "
```

```
"             Surface Area           0.357      6.773      7.130      hectare"
"             Time of concentration  21.844     22.056     22.047     minutes"
"             Time to Centroid       733.888    692.757    694.392    minutes"
"             Rainfall depth         180.669    180.669    180.669    mm"
"             Rainfall volume        0.0644     1.2238     1.2882     ha-m"
"             Rainfall losses        44.192     7.254      9.101      mm"
"             Runoff depth           136.477    173.415    171.568    mm"
"             Runoff volume          0.0487     1.1746     1.2233     ha-m"
"             Runoff coefficient     0.755      0.960      0.950      "
"             Maximum flow           0.101      2.353      2.454      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.454     2.454     2.114     2.114"
" 52          CHANNEL DESIGN"
"        2.454   Current peak flow    c.m/sec"
"        0.040   Manning 'n'"
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        3.000   Basewidth    metre"
"        3.000   Left bank slope"
"        3.000   Right bank slope"
"        0.750   Channel depth    metre"
"        0.500   Gradient   %"
"             Depth of flow                0.552    metre"
"             Velocity                     0.954    m/sec"
"             Channel capacity             4.434    c.m/sec"
"             Critical depth               0.360    metre"
" 53          ROUTE    Channel Route 250"
"       250.00      Channel Route 250 Reach length   ( metre)"
"        0.384   X-factor <= 0.5"
"      196.612   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      150.000   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                 2.389    c.m/sec"
"                    2.454     2.454     2.389     2.114 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                SWM POND"
"             Maximum flow                 4.408    c.m/sec"
"             Hydrograph volume        29276.963    c.m"
"                    2.454     2.454     2.389     4.408"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    2.454     0.000     2.389     4.408"
" 33          CATCHMENT 203"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          203   Future Development"
"       55.000   % Impervious"
"       11.890   Total Area"
"      610.000   Flow length"
"        0.500   Overland Slope"
"        5.351   Pervious Area"
"      610.000   Pervious length"
"        0.500   Pervious slope"
"        6.540   Impervious Area"
"      745.556   Impervious length"
"        0.500   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       84.000   Pervious SCS Curve No."
"        0.707   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"        4.838   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
```

```
"       98.000   Impervious SCS Curve No."
"        0.963   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.518   Impervious Initial abstraction"
"                    2.670     0.000     2.389     4.408 c.m/sec"
"             Catchment 203          Pervious   Impervious Total Area "
"             Surface Area           5.351      6.540      11.890     hectare"
"             Time of concentration  87.829     17.095     43.634     minutes"
"             Time to Centroid       820.991    684.664    735.814    minutes"
"             Rainfall depth         180.669    180.669    180.669    mm"
"             Rainfall volume        0.9667     1.1815     2.1482     ha-m"
"             Rainfall losses        52.924     6.623      27.459     mm"
"             Runoff depth           127.745    174.046    153.210    mm"
"             Runoff volume          0.6835     1.1382     1.8217     ha-m"
"             Runoff coefficient     0.707      0.963      0.848      "
"             Maximum flow           0.506      2.555      2.670      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    2.670     2.670     2.389     4.408"
" 52          CHANNEL DESIGN"
"        2.670   Current peak flow    c.m/sec"
"        0.015   Manning 'n'"
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        2.000   Basewidth    metre"
"       50.000   Left bank slope"
"       50.000   Right bank slope"
"        0.300   Channel depth    metre"
"        0.500   Gradient   %"
"             Depth of flow                0.203    metre"
"             Velocity                     1.085    m/sec"
"             Channel capacity             7.066    c.m/sec"
"             Critical depth               0.206    metre"
" 53          ROUTE    Channel Route 50"
"        50.00      Channel Route 50 Reach length   ( metre)"
"        0.335   X-factor <= 0.5"
"       34.557   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"       42.857   Routing time step   ( seconds)"
"            1   No. of sub-reaches"
"             Peak outflow                 2.607    c.m/sec"
"                    2.670     2.670     2.607     4.408 c.m/sec"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                SWM POND"
"             Maximum flow                 6.991    c.m/sec"
"             Hydrograph volume         47491.840    c.m"
"                    2.670     2.670     2.607     6.991"
" 40          HYDROGRAPH   Confluence    1"
"            7   Confluence "
"            1   Node #"
"                SWM POND"
"             Maximum flow                 6.991    c.m/sec"
"             Hydrograph volume         47491.836    c.m"
"                    2.670     6.991     2.607     0.000"
" 54          POND DESIGN"
"        6.991   Current peak flow    c.m/sec"
"        2.000   Target outflow    c.m/sec"
"      47491.8   Hydrograph volume    c.m"
"          16.   Number of stages"
"      100.000   Minimum water level    metre"
"      103.000   Maximum water level    metre"
"      100.000   Starting water level    metre"
"            0   Keep Design Data: 1 = True; 0 = False"
"                  Level Discharge    Volume"
"                100.000     0.000     0.000"
```

```
"                100.200   0.02045  1074.207"
"                100.400   0.06830  2187.288"
"                100.600    0.1209  3339.734"
"                100.800    0.1986  4532.208"
"                101.000    0.3288  5765.196"
"                101.200    0.5024  7039.318"
"                101.400    0.7069  8355.202"
"                101.600    0.9282  9713.323"
"                101.800     1.151  11114.36"
"                102.000     1.363  12558.78"
"                102.200     1.558  14047.22"
"                102.400     1.735  15580.31"
"                102.600     1.896  17158.50"
"                102.800     2.045  18782.50"
"                103.000     2.183  20452.76"
"           1.   LAYERS"
"                 Bottom    Aspect    Bottom       Top   Average"
"                   area     ratio elevation elevation sideslope"
"               5275.000     2.400   100.000   103.000     3.000"
"           2.   OUTFLOW PIPE"
"               Upstream Downstr'm      Pipe      Pipe   Manning     Entry"
"                 invert    invert    Length  Diameter       'n'   loss Ke"
"                100.000    99.700    30.000     0.375     0.013     0.500"
"                100.600   100.300    30.000     0.900     0.013     0.500"
"             Peak outflow                  1.988    c.m/sec"
"             Maximum level                102.724    metre"
"             Maximum storage            18164.645    c.m"
"             Centroidal lag                15.316   hours"
"                  2.670     6.991     1.988     0.000 c.m/sec"
" 40          HYDROGRAPH Next link "
"              5   Next link "
"                      2.670     1.988     1.988     0.000"
" 33          CATCHMENT 204"
"             1   Triangular SCS"
"             2   Proportional to %"
"             1   SCS method"
"           204   Future Development"
"        55.000   % Impervious"
"         0.790   Total Area"
"        36.000   Flow length"
"         2.000   Overland Slope"
"         0.356   Pervious Area"
"        36.000   Pervious length"
"         2.000   Pervious slope"
"         0.435   Impervious Area"
"        44.000   Impervious length"
"         2.000   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        84.000   Pervious SCS Curve No."
"         0.760   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"         4.838   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.957   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                      0.313     1.988     1.988     0.000 c.m/sec"
"             Catchment 204          Pervious   Impervious Total Area "
"             Surface Area           0.356      0.435      0.790      hectare"
"             Time of concentration  10.607     2.065      5.429      minutes"
"             Time to Centroid       716.219    655.123    679.184    minutes"
"             Rainfall depth         180.669    180.669    180.669    mm"
"             Rainfall volume        642.28     785.01     1427.28    c.m"
"             Rainfall losses        43.332     7.715      23.742     mm"
"             Runoff depth           137.337    172.954    156.927    mm"
"             Runoff volume          488.23     751.49     1239.72    c.m"
"             Runoff coefficient     0.760      0.957      0.869      "
"             Maximum flow           0.132      0.228      0.313      c.m/sec"
```

```
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.313     2.028     1.988     0.000"
" 52          CHANNEL DESIGN"
"         2.028   Current peak flow    c.m/sec"
"         0.015   Manning 'n'"
"            0.   Cross-section type: 0=trapezoidal; 1=general"
"         8.000   Basewidth    metre"
"        50.000   Left bank slope"
"        50.000   Right bank slope"
"         0.300   Channel depth    metre"
"         0.500   Gradient   %"
"              Depth of flow                 0.139    metre"
"              Velocity                      0.979    m/sec"
"              Channel capacity             10.429    c.m/sec"
"              Critical depth                0.140    metre"
" 53          ROUTE    Channel Route 170"
"       170.00      Channel Route 170 Reach length   ( metre)"
"         0.460   X-factor <= 0.5"
"       130.192   K-lag   ( seconds)"
"         0.000   Default(0) or user spec.(1) values used"
"         0.500   X-factor <= 0.5"
"        30.000   K-lag   ( seconds)"
"         0.500   Beta weighting factor"
"       100.000   Routing time step   ( seconds)"
"             1   No. of sub-reaches"
"              Peak outflow                  2.027    c.m/sec"
"                    0.313     2.028     2.027     0.000 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"              Maximum flow                  2.027    c.m/sec"
"              Hydrograph volume         44367.504    c.m"
"                    0.313     2.028     2.027     2.027"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.313     0.000     2.027     2.027"
" 33          CATCHMENT 205"
"            1   Triangular SCS"
"            2   Proportional to %"
"            1   SCS method"
"          205   Fair Grounds - Uncontrolled"
"         0.000   % Impervious"
"         0.680   Total Area"
"        10.000   Flow length"
"         0.500   Overland Slope"
"         0.680   Pervious Area"
"        10.000   Pervious length"
"         0.500   Pervious slope"
"         0.000   Impervious Area"
"         0.000   Impervious length"
"         0.500   Impervious slope"
"         0.250   Pervious Manning 'n'"
"        84.000   Pervious SCS Curve No."
"         0.761   Pervious Runoff coefficient"
"         0.100   Pervious Ia/S coefficient"
"         4.838   Pervious Initial abstraction"
"         0.015   Impervious Manning 'n'"
"        98.000   Impervious SCS Curve No."
"         0.000   Impervious Runoff coefficient"
"         0.100   Impervious Ia/S coefficient"
"         0.518   Impervious Initial abstraction"
"                    0.301     0.000     2.027     2.027 c.m/sec"
"              Catchment 205          Pervious   Impervious Total Area "
"              Surface Area           0.680      0.000      0.680      hectare"
"              Time of concentration  7.455      0.000      7.455      minutes"
"              Time to Centroid       710.170    649.556    710.170    minutes"
"              Rainfall depth         180.669    180.669    180.669    mm"
```

```
"             Rainfall volume        1228.55    0.00       1228.55    c.m"
"             Rainfall losses        43.234     23.093     43.234     mm"
"             Runoff depth           137.435    157.575    137.435    mm"
"             Runoff volume          934.56     0.00       934.56     c.m"
"             Runoff coefficient     0.761      0.000      0.761      "
"             Maximum flow           0.301      0.000      0.301      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.301     0.301     2.027     2.027"
" 52          CHANNEL DESIGN"
"        0.301   Current peak flow    c.m/sec"
"        0.040   Manning 'n'"
"           0.   Cross-section type: 0=trapezoidal; 1=general"
"        0.000   Basewidth    metre"
"       50.000   Left bank slope"
"       50.000   Right bank slope"
"        0.300   Channel depth    metre"
"        0.500   Gradient   %"
"             Depth of flow                0.141    metre"
"             Velocity                     0.302    m/sec"
"             Channel capacity             2.245    c.m/sec"
"             Critical depth               0.094    metre"
" 53          ROUTE    Channel Route 360"
"       360.00      Channel Route 360 Reach length   ( metre)"
"        0.456   X-factor <= 0.5"
"      298.080   K-lag   ( seconds)"
"        0.000   Default(0) or user spec.(1) values used"
"        0.500   X-factor <= 0.5"
"       30.000   K-lag   ( seconds)"
"        0.500   Beta weighting factor"
"      300.000   Routing time step   ( seconds)"
"            3   No. of sub-reaches"
"             Peak outflow                 0.280    c.m/sec"
"                     0.301     0.301     0.280     2.027 c.m/sec"
" 40          HYDROGRAPH   Combine    2"
"            6   Combine "
"            2   Node #"
"                "
"             Maximum flow                 2.073    c.m/sec"
"             Hydrograph volume         45301.496   c.m"
"                     0.301     0.301     0.280     2.073"
" 38          START/RE-START TOTALS 205"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    33.030    hectare"
"             Total Impervious area                   20.644    hectare"
"             Total % impervious                      62.502"
" 19          EXIT"
```